IARU Emergency Telecommunications Guide

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Use of this Training Guide

This emergency telecommunications guide was developed to provide the IARU member-societies with materials suitable for training their members to participate in emergency events. It is also designed to provide guidance to the individual amateur radio operator who has little or no experience in handling emergency communications but desires to enhance their ability to participate in such events or to simply have a better understanding of the process.

IARU member-societies are encouraged to distribute this guide among its membership and, if necessary, to provide a translation into a language used within their own country.

This guide can also be used in conjunction with other training materials by leaders within the emergency communication community to train radio operators in the basic theory and practice of handling emergency telecommunications traffic.

Chapter 1
Introduction to Emergency Telecommunications

What is a Communication Emergency?

A communication emergency exists when a critical communication system failure puts the public at risk. As used in this guide, emergency telecommunications may also be referred to emergency communications or "emcomm."

A variety of circumstances can overload or damage critical day-to-day communication systems. It could be a storm that knocks down telephone lines or radio towers, a massive increase in the use of a communication system that causes it to become overloaded, or the failure of a key component in a system that has widespread consequences. Examples are easily found. Violent storms and earthquakes can knock out communication facilities. Critical facilities can also be damaged in "normal" circumstances: underground cables are dug up, fires occur in telephone equipment buildings, or a car crash knocks down a key telephone pole. Hospital telephone systems can fail. Even when no equipment fails, a large-scale emergency such as a chemical or nuclear accident can result in more message traffic than the system was designed to handle. Some emergency operations occur in areas without any existing communication systems, such as with forest fires.

Most cellular phone systems are designed to handle only about 6-10% of their subscribers at any one time. This works well in normal situations and is economical for the company. But when a crisis happens, they quickly become overloaded as everyone (the other 90%) tries to talk at once.

What Makes A Good Volunteer?

Emergency telecommunication volunteers come from a wide variety of backgrounds and with a range of skills and experience. The common attributes that all effective volunteers share are a desire to help others without personal gain of any kind, the ability to work as a member of a team, and to take direction from others. Emergency telecommunication volunteers need to be able to think and act quickly, under the stress and pressure of an emergency.

You cannot help others when you are worried about those you love. Your own family should always be your first priority. Adequate personal and family preparation will enable you to get your own situation under control more quickly so that you are in a position to be of service to others.

Where Do You Fit In?

Amateur Radio operators have been a communication resource in emergency situations ever since there has been radio. To the agencies they serve, amateurs are their immediately available communication experts. Amateurs have the equipment, the skills, and the frequencies necessary to create expedient and efficient emergency communication networks under poor conditions. They are licensed and pre-authorized for national and international communication. And all of this comes at no cost to the served agency, whether that is an arm of government or a disaster relief and mitigation organization such as the International Red

Cross.

Hams have the ability to rapidly enlarge their communication capacity to meet growing needs in an emergency, something commercial and public safety systems cannot normally do. Many of the skills are the same ones that are used in everyday ham activities. However, just having radios, frequencies, and basic radio skills is not enough. Certain emergency communication skills are very different from those you use in your daily ham radio life. Outlines like this one help fill that need, as do local training programs and regular emergency exercises. Without specific emergency communication skills, you can easily become part of the problem rather than part of the solution.

As you might expect, technical and operating skills are critical. Just as important, though, is your ability to function as a team player within your own organization, and the organization you are serving. Those critical skills will also be covered in this course.

What You Are Not

As important as what you are, is what you are not. There are limits to your responsibilities as an emergency communicator, and it is important to know where to draw the line.

You are not a "first responder." Except in rare cases of chance, you will seldom be first on the scene. You do not need flashing lights and sirens, gold badges, or fancy uniforms.

You have no authority. In most cases, you cannot make decisions for others, or make demands on the agency you serve or any other agency. The only decisions you can make are whether to participate or not, and those affecting your own health and safety.

You cannot do it all. When the agency you are helping runs short of doctors, cooks, or traffic cops, it is not your job to fill the void. In most cases, you are not trained for it. That does not mean you cannot lend a hand to fill an urgent need when you are qualified to do so, or perform other jobs for the served agency of which communication is an integral part, and for which you are trained and capable.

You are not in charge. You are there to temporarily fulfill the needs of an agency whose communication system is unable to completely do its job. They tell you what they need, and you do your best to comply.

"Day-to-Day" Versus "Emergency" Communication

In your daily ham radio life, there is no pressure to get any particular message through. You do things at your leisure, and no one's life depends upon you. In an emergency all that changes. The list of differences is lengthy but here are some examples:

1. Instead of one leisurely net a day, emergency communicators are often dealing with several continuous nets simultaneously to pass critical messages within a limited time frame.

2. Unlike public service events where the communicators serve primarily under the direction of one lead organization, emergency communicators may need to interact with several key organizations within a limited period of time.

3. Unlike typical home installations, emergency stations must be portable and able to be set up and operate anywhere in a very short time.

4. Unlike contesting, which involves contacting many random station for points; emergency communicators need to contact specific stations quickly to pass important messages. Teamwork is important, not competition between stations.

The Missions

The job you are asked to do will vary with the specific agency you serve. If that agency is a branch of the International Red Cross, you will likely be providing the communications needed to maintain a system of shelters and other relief efforts. If it is a national or local government emergency management agency, you could be handling interagency communications or serving as the eyes and ears of the emergency managers. When a hospital's telephone system fails, you might be handling the "mechanics" of communicating so that doctors and nurses can concentrate on patients. In a large forest fire or a search and rescue operation, you might be handling personal for firefighters or rescuers to their families or assisting with logistical communications to insure that food, supplies, personnel and materials arrive when and where needed. In any widespread disaster, hams could be assisting all the agencies listed above, and more, at the same time.

Communicating – Job #1

While you are proud of your skill as a radio operator, and the impressive equipment and systems you have in place, it is important to remember that your job is "communicating." If a served agency asks you to deliver a long shelter supply list to headquarters, you should be prepared to use any means required – including the fax machine if it is still working. Our job is to get the message through, even if it means using smoke signals. Do not think about how to use ham radio to send the message – just think about the best and fastest way to send it. If that means using ham radio, so much the better. If an agency asks you to use their radio system, do it. Your operating and technical skills are just as important as your ham radio resources.

Anatomy of a Communication Emergency

In the earliest stages of many disasters, there may be a limited need for emergency communication services. (An obvious exception would be a coming storm or tornado or earthquake.) This phase might occur during a severe storm "watch" or "warning" period. You should use this time to monitor developments and prepare to deploy when and if a request for assistance comes. Some amateur radio nets may be activated early in the storm watch or warning phases to provide the served agencies with up- to- the-minute information.

Once a potential or actual need for more communication resources is identified, a served agency puts out the call for its volunteer communicators. Depending on the situation, operators and equipment might be needed at an emergency operations center or to set up in field locations, or both. In some areas, a "Rapid Response Team" or similar small sub-group might deploy a minimal response in a very short time, to be backed up by a second, more robust response in an hour or two.

A "resource" or "logistics" net might be set up to handle incoming communication volunteers and direct resources where they are needed most. Any volunteer not presently assigned to a specific net or task should check into and monitor this net.

Once operations begin, all kinds of things can happen. The volume of messages can grow

quickly, and confusion is common. In addition to handling messages, your team of communicators will need to think about relief or replacement operators, food and water, sleeping accommodations, batteries, fuel, and other logistical needs. Radios and antennas will fail and need to be replaced. Some operators will need to leave early for personal reasons.

Communication assignments might include staffing a shelter to handle calls for information, supplies, and personnel, "shadowing" or staying close to an official to be their communication link, gathering weather information, or collecting and transmitting damage reports. Some nets might pass health and welfare inquiries to refugee/evacuee centers, or pass messages from refugees to family members outside the disaster area. Other nets might handle logistical needs for the served agency, such as those regarding supplies, equipment, and personnel.

Nets will be set up, rearranged, and dismantled as needs change. Volunteers will need to remain flexible in order to meet the changing needs of the served agency or the government agency. Over time, the need for emergency communication networks will diminish as the message load decreases, and some nets will be closed or reduced in size. Operators will be demobilized (released to go home) one by one, in small groups, or all at once as the needs dictate.

Not long after the operation has ended, the emergency communication group should review the effectiveness of its response, either alone or with the served agency. This might be done on the air in a formal net, by email, or in a face-to-face meeting. However it is done, it should occur as soon as possible after operations have ended to be sure that events are fresh in everyone's mind. Critiques, when done properly, can greatly improve your emergency telecommunication organization's – and your own – effectiveness.

Chapter 2
Relationship With Served Agencies

"What does my attitude have to do with emergency communications?"

In a word, everything! In situations where a professional and helpful attitude is maintained, served agencies point with pride to ham's efforts and accomplishments. The opposite situation is clearly illustrated in the words of one emergency management official who said, "Working with ham radio operators is like herding cats—get them the heck out of here!" This man was clearly frustrated with the attitude of his volunteers.

Although our name says that we are "Amateurs," its real reference is to the fact that we are not paid for our efforts. It need not imply that our efforts or demeanor will be anything less than professional. "Professionalism" means getting the job done efficiently—with a minimum of fuss.

No matter which agency you serve — a governmental emergency management agency, an arm of the Red Cross or others, it is helpful to remember that emergency telecommunication volunteers are like unpaid employees. If you maintain the attitude that you are an employee of the agency you are serving, with all that employee status implies, there is little chance for you to go astray. You are there to help solve their communication problems. Do whatever you can, within reason, to accomplish that goal, and avoid becoming part of the problem.

Who Works For Whom?

The relationship between the volunteer communicator and served agency will vary from situation to situation, but the fact is that you work for them. It doesn't matter whether you are part of a separate radio group of amateur radio emergency telecommunication operators, or part of the agency's regular volunteer force. You still work for them.

Your job is to meet the communication needs of the served agency. It is often said that volunteers don't have to take orders. This is true. However, when you volunteer your services to an organization, you implicitly agree to accept and comply with reasonable orders and requests from your "employer." If you do not feel comfortable doing this, do not volunteer.

There may be times that you find yourself unwilling or unable to comply with a served agency's demands. The reasons may be personal or related to safety or health, or it may be that you do not consider yourself qualified or capable of meeting a particular demand. On rare occasions, it may be that you are asked to do something not permitted by the amateur radio rules applicable to your country. Regardless of the reason, respectfully explain the situation, and work with the served agency or your fellow emergency telecommunication volunteers in your communication group to come up with an alternative solution. If the discussion with the served agency becomes difficult or uncomfortable, you can always

politely pass the discussion up to your immediate emergency telecommunication superiors so that they can handle it instead.

How Professional Emergency Responders Often View Volunteers

Unless a positive and long established relationship exists between professionals and volunteers, professionals who do not work regularly with competent volunteers are likely to look at them as "less than useful." There are several reasons for this. Fire departments have a long history of competitive relationships between professional and volunteer firefighters, and this attitude may carry over to volunteers in general. Police agencies are often distrustful of outsiders—often for legitimate information security concerns. Professionals in any field put a great deal of time and effort into their skills and training, and take considerable pride in their professional standing. As a result, they may view themselves as able to handle all possible situations without outside assistance.

Volunteers, on the other hand, may be viewed as "part timers" whose skill level and dedication to the job vary widely. Many agencies and organizations have learned that some volunteers cannot be depended on when they are needed most. Do not be offended if this attitude is obvious, and remember that you cannot change it overnight. It takes time for you to prove yourselves as volunteers, and for a positive working relationship to develop and mature.

Emergency Communication Organizations and Systems

This guide is written without any particular national orientation, it is suggested that the reader investigate the various emergency communication organizations active in the reader's country and local area. These organizations can provide great training opportunities for ham radio operators with little or no experience in handling emergency telecommunications. They also provide a forum for discussing common communication problems and situations that arise during an emergency telecommunication incident.

Chapter 3
Served Agency Communication Systems and Procedures

Introduction

Many served agencies will have their own communication systems and equipment, ranging from modest to complex. In our ever-broadening role as emergency communicators, we may be asked to operate some of this equipment. If this occurs, you must become familiar with its operation. Your emergency telecommunication group should work with the served agency well in advance to determine whether the agency will need you to use its equipment, and under what conditions. Many of these radio systems are different from ham radio, and special training may be required. In addition to different equipment, on-air procedures will likely be different. Training and drills may be necessary to make Amateur Radio emergency telecommunications operators proficient.

National, State and Local Government Radio Systems

These systems might include police, fire, or other local or municipal departments. If you are asked to use any of these systems, be sure to learn their standard operating procedures and "phonetic alphabet" system if one is used and adapt accordingly.

Casual conversations are prohibited by the served agency. All transmissions must be directly related to the agency's mission.

You would do well to learn if your area hospitals use radios and determine what their operating procedures are before any emergency.

The International Red Cross and its various component national Red Cross organizations have its own radio systems. Learn about those radio systems and operating systems before any communication emergency exists. It is not advisable to try to learn about these radio systems and operating procedures during any communications emergency.

Many agencies have more than one channel, each assigned to a different purpose. For instance, a fire department might have a "dispatch" channel, and one or more "fireground" channels. This allows local operations at a fire scene to be kept separate from on-going dispatch operations.

"Local Governments may be assigned to frequencies that may be used for any legitimate local government function. In addition to "simple" systems where each user group has its own frequency, there are three different types of systems that allow multiple user groups to share resources. These are known as "community repeaters," "trunked repeater systems," and "shared simplex systems."

Community Repeater Systems

A "community" or "shared" repeater uses a different CTCSS tone for each of several user groups. For instance, a city might have one repeater shared by the water, public works and

sanitation departments, licensed as a single "local government" radio system. Since each department uses a different CTCSS tone, they will not normally hear one another's conversations, but only one department can use the system at any given moment. Some very small towns may even combine fire and police department operations on the same system, on either a repeater or simplex frequency.

When using any shared frequency—repeater or simplex—it is important to press the "monitor" button for a moment before transmitting. This disables the CTCSS decoder, temporarily allowing you to hear any transmissions being made on the frequency. Some mobile radios automatically switch to "monitor" mode when the microphone is removed from its hang-up clip. In this way, you can be certain that no one else is using the channel before making your call.

In an emergency situation, these shared channel systems can quickly become overloaded. A common practice is to end all non-essential communications or perhaps move them to an Amateur system instead.

Trunked Systems

Trunked systems provide an efficient means for several "low volume" users to share a single radio system. They use several co-located repeaters tied together, using computer control to automatically switch a call to an available repeater. When one radio in a group is switched to a new frequency, all the others in the group automatically follow. This is accomplished by having a computer controller move the conversation from frequency to frequency in accordance with a pre-established algorithm. The number of available frequencies in the system depends on its design and the number of different user groups. Channel switching and assignment data is transmitted on a dedicated channel. Unlike a shared single-frequency repeater system using multiple CTCSS tones, a trunked system will provide almost instant on-demand clear channels in normal usage. Amateur Radio does not currently use this type of system.

In emergency situations, however, most trunked systems suffer from a lack of reserve capacity. To keep designs cost effective, there are always many more user groups than available channels. The number of available channels is designed to handle the normal day-to-day communications load. When an emergency occurs, these systems can be quickly overloaded with calls, and finding a clear channel can be difficult or impossible.
One "solution" to this problem is to assign certain users or user groups "priority" over others. If all the available channels are occupied, a higher priority user will bump the lowest priority user off the system and take over the channel. Priority status can either be full time or turned on in an emergency, depending on the system's design.

Telephone Systems

Telephone systems in use by public service agencies vary greatly. The served agency should be able to provide training in its use. Most telephone systems come with user manuals, and if possible, a copy of one should be included in your amateur radio group's training materials.

Most business telephone systems allow the following basic functions, with which you should be familiar:

- Answering incoming calls
- Placing outside calls
- Placing and answering intercom calls
- Making “speed dial” calls
- Overhead paging
- Placing calls on hold, and then retrieving them
- Transferring calls to another extension
- Transferring calls to voice mail, if available
- Retrieving calls from a voice mailbox

There may be other more advanced functions available, but in most cases, you will not need to learn them for temporary operations. However, it is always a good idea to keep the user’s manual nearby. You should also try to determine the extent to which the agency’s telephone system is dependent on or susceptible to fluctuations in commercial power.

Satellite Telephones

Satellite phones and data terminals are becoming more common among served agencies as the cost of ownership and airtime decreases. Satellite telephone/data service is offered by a number of companies, including Inmarsat, Iridium, Thuraya and Globalstar. Some of the services cover much of the earth’s surface, others only certain regions. Some phones or terminals require that an antenna be pointed directly at the satellite, others do not, but all require line-of-sight to the satellite. Some are handheld; others are contained in briefcases and must be set up before operating. In addition to voice communication, some companies offer paging, fax and data transmission, although at slower speeds than a typical land-based dial-up connection. A few phones also integrate a terrestrial cellular phone in the same unit. Calls are typically expensive when compared to cellular telephone calls. All calls made through these systems are considered to be “international” calls, and each company has one or more “country codes.” If you need to use one of these phones, keep conversations short and to the point. While most of the phones are fairly simple to use, due to the wide variety of phones and services it is essential that users be fully trained in their use. In addition, there is some concern that the number of satellite telephones sold far outstrips the number of satellite channels available, so system overload remains a real possibility in a widespread incident.

Satellite Data Systems

Satellite systems in use by served agencies also vary greatly. Some are used for two- way data and voice communication, others for one-way reception of voice, data or video. The agency will need to provide prior training in their use if they want you to be able to operate this equipment in a crisis.

Other Agency-Owned Equipment

In addition to radio and telephone systems, you may need to use fax machines, copiers, computers, and similar devices. Since many of us use these items every day at work, learning their operation should not be a problem in most cases. However, some copiers and computer programs are quite complicated and may require instruction in their use. Computer software used in public safety applications is usually specially written for the purpose and may require some training in the rare situation where you will be required to use the system.

Chapter 4
Working Directly with the Public

Introduction

Many radio amateurs want to be of help when the need arises but are unable to commit the time or meet the schedule required for formal participation with any particular served agency or emergency telecommunication organization. Some may have mobility issues which limits the scope of volunteering outside their own homes. These hams can still make valuable contributions to their local communities by getting involved at the local neighborhood level and making their skills available to their neighbors. Becoming a resource in your neighborhood can also enhance the public's understanding of and appreciation for Amateur Radio.

How Do I Get Started?

Neighbors may band together in a variety of ways to help one another, especially during any emergency.

Find out what preparedness activities are going on in your area and join in the effort. Learn what plans are already in place and note the communication plan or absence thereof. Let the other participants know that you are a licensed Amateur Radio operator and want to help develop or improve the group's communication resources. Community groups are usually eager to learn from people with knowledge and experience in the areas of concern to them. It's also a good idea to take whatever local training is already offered in disaster preparedness so that your understanding will be at least equal to that of your neighbors and so that you can present your suggestions regarding communications in context with that understanding. Participation in local preparedness courses will also let you meet like-minded individuals with whom you can share ideas. If there is no preparedness group or program in your area, consider starting one.

Using Personal Service Radios

The most popular and ubiquitous communication tools not dependent on the telephone system or the Internet are sometimes referred to as Family Radio Service ("FRS") or PMR446 Radios. Many national telecommunications administrations allows unlicensed radio usage at very low powers, mostly within the UHF bands. Check with your national administration to determine if such usage is allowed within your country. CB or citizens band radio services may also be available.

If you are advising a neighborhood group on the use of Personal Radio Service radios, you can suggest one of the following:

When equipping a group for the first time, have everyone buy one make and model of radio (or buy the same model in bulk for additional cost savings). This will assure consistent channel numbering.

If different makes and models are already employed by group members, prepare a chart to go with each radio showing the channel number that goes with each frequency.

Every radio owner should be able to power his or her transceiver from standard alkaline batteries. Rechargeable NiCad, NiMH or Li-Ion batteries are great for everyday use when AC power is available to recharge them, but recharging batteries when the power is out or when heavy use drains the batteries quickly can be a problem. Alkaline cells are inexpensive, can be replaced quickly, have a relatively long shelf life and are usually kept on hand already for use in flashlights and other devices. If a radio needs a separate shell to use these disposable batteries, get one for each radio. If the alkaline batteries fit directly into the radio, keep some packed near (not in) the radio, and refresh the supply when necessary.

Radio Coverage

You can suggest or organize a coverage-mapping exercise in which your neighbors test their radios from different locations, indoors and out, to identify any hot spots and dead spots. Find the places you can transmit with the most complete coverage and prepare to use relays for hard-to-reach areas if necessary. Knowing this before a disaster strikes will be most helpful, and it will get people used to using their radios.

Radio Protocol

During a disaster, time and radio resources may both be in short supply. People will be occupied with caring for their own families or performing their assigned team tasks. It benefits everyone to keep transmissions short and to minimize confusion over who is calling whom. Radio Amateurs are familiar with good radio protocol and can teach it to their neighbors to promote efficient use of whatever radios are in use.

Linking To the Outside

In addition to helping with neighborhood communications plans, Radio Amateurs may be called upon or expected to provide a link to adjacent areas or to first responders. You should be aware of the other Amateurs in your area who are active in the local emergency telecommunication organizations and know the frequencies on which you can reach them. They will probably be your best access to first responders and aid organizations if there is any access to be had.

You should set realistic expectations as to what you can accomplish. Surrounding areas may be experiencing the same problems you have locally. Fire department and law-enforcement agency communications will be very busy and will give priority to those groups with which they are familiar. You can learn more by getting to know the formal emergency telecommunication organizations in your area. Even if you don't have time to participate with the local emergency telecommunication group regularly, you need to find out where they are likely to be stationed and how you can contact them. For example, if you know which hospitals will have ham radio coverage and the best way to reach them, you may be able to determine whether a given facility is functioning in a disaster so that a seriously injured person can be transported there.

An Emerging Definition of "Served Community"

There is an emerging philosophy within the ranks of the amateur radio community involved in emergency preparedness that individual hams can be most helpful to the public by being a “community” or “neighborhood” resource to the neighborhood where the amateur resides.

Here is an article written by Rick Palm K1CE, a longstanding proponent of amateur radio involvement in disaster relief and response.

“Communications in Neighborhood Preparedness

Let's take a moment to look at how the radio amateur down the street can help support his or her neighborhood to meet its preparedness goals. A radio amateur is ideal to call a meeting of his neighbors because of his expertise and experience with communications, the first prerequisite for any successful resident endeavor. Flyers announcing a planning meeting and agenda can be dropped in mailboxes, followed up with telephone calls. A community center or even a neighbor's home can serve as the venue for the meeting. The initial meeting is an ice breaker for neighbors to get to know one another in the context of possibly relying on each other in a disaster response scenario. To start off the meeting, a review of the types of hazards that face the neighborhood and history of events in the past can set the tone and instill the gravity of the mission with attendees.

A roundtable discussion can be held with introductions of individual neighbors, noting their personal and professional experience, and interest in fulfilling preparedness functions. Initial assignments can be made, and then changed or modified in future meetings as necessary.

The radio amateur is the obvious choice to lead the communications function, and accordingly able to overcome the effects of isolation of the neighborhood in a post-disaster environment. Amateur Radio is the most versatile radio communication service available to the average citizen and neighborhood. The radio amateur is the most experienced in radio communications principles and practical applications.

The ARRL's Mike Corey, KI1U, says "there has been a lot of research on the issue of a lack of trust between the issuers of warnings and the public that receives them. Amateurs are a good way to bridge the trust issue as we can put warnings in terms that our neighbors can understand."

Communications functions also involve the immediate safety of life and property in the aftermath of a disaster, getting the neighbors to communicate with one another to activate the neighborhood plan and establish reliable communications with the outside world to convey situation reports, critical needs and delivery of critical supplies.

Health and welfare messages on behalf of neighborhood members can be transmitted to the outside world (which might be only a few blocks away) to concerned friends and family members. There is no underestimating the need for radio communications, not only for critical needs, but indeed for the morale of the potentially psychologically stressed, devastated neighborhood families.

The radio amateur could also maintain portable electrical generators and docking stations for rechargeable batteries, perhaps in his garage, for neighborhood use as required when normal power is out. Hams are experts in the use of alternative power sources.

Many radio amateurs are trained in search and rescue (SAR) techniques and protocols, and Amateur Radio has a longstanding history of serving searchers/rescuers with radio communications. SAR has been linked with Amateur Radio for decades. There are numerous

environments for SAR, and one size does not fit all. The person in charge of this neighborhood function should be aware of, and trained specifically for, the kind of SAR environment he/she will face: urban SAR, for example. Communications for this function is critical, when neighbors are missing and potentially injured.

The neighborhood team concept can potentially save the lives and properties of some of the most important people you hold dear besides your family and friends - your neighbors. Amateur Radio is a critical component of the team's assets.-- *K1CE"*

Chapter 5
Emergency Telecommunication Skills

Introduction

An emergency communicator must do his or her part to get every message to its intended recipient, quickly, accurately, and with a minimum of fuss. A number of factors can affect your ability to do this, including your own operating skills, the communication method used, a variety of noise problems, the skills of the receiving party, the cooperation of others, and adequate resources.

Life–and-death communications are not part of our daily experience. Most of what we say and do each day does not have the potential to severely impact the lives and property of hundreds or thousands of people. In an emergency, any given message can have huge and often unintended consequences. An unclear message, or one that is modified, delayed, mis-delivered or never delivered at all can have disastrous results.

Listening

Listening is at least 50% of communication. Discipline yourself to focus on your job and "tune out" distractions. If your attention drifts at the wrong time, you could miss a critical message. Listening also means avoiding unnecessary transmissions. A wise person once said, "A man has two ears and one mouth. Therefore he should listen twice as much as he talks." While you are asking, "When will the beds arrive?" for the fourth time that hour, someone else with a life and death emergency might be prevented from calling for help.
Sometimes the job of listening is complicated by noise. You might be operating from a noisy location, the signal might be weak or other stations may be causing interference. In each of these cases, it helps to have headphones to minimize local noise and help you concentrate on the radio signal. Any veteran of a major emergency situation will tell you, headphones are one of the "must have" items in emergency telecommunication operations. Digital Signal Processing (DSP), filters and other technologies may also help to reduce radio noise and interference.

Microphone Techniques

Even something as simple as using your microphone correctly can make a big difference in intelligibility. For optimum performance, hold the microphone close to your cheek, and just off to the side of your mouth. Talk across, rather than into, the microphone. This will reduce breath noises and "popping" sounds that can mask your speech.

Speak in a normal, clear, calm voice. Raising your voice or shouting can result in over-modulation and distortion, and will not increase volume at the receiving end. Speak at a normal pace—rushing your words can result in slurred and unintelligible speech.

Pronounce words carefully, making sure to enunciate each syllable and sound. Radios should be adjusted so that a normal voice within 2 inches of the microphone element will produce full modulation. If your microphone gain is set so high that you can achieve full modulation

with the microphone in your lap, it will also pick up extraneous background noise that can mask or garble your voice.

A noise-canceling microphone is a good choice since it blocks out nearly all unwanted background noise, and is available in handheld and headset boom configurations.

Headset boom microphones are becoming less expensive and more popular, but care should be taken to choose one with a cardioid or other noise-canceling type element. Many low-cost headset boom microphones have omni-directional elements, and will pick up extraneous noise.

"Voice operated transmission" (VOX) is not recommended for emergency communication. It is too easy for background noise and off-air operator comments to be accidentally transmitted, resulting in embarrassment or a disrupted net. Use a hand or foot switch instead.

When using a repeater, be sure to leave a little extra time between pressing the push-to- talk switch and speaking. A variety of delays can occur within a system, including CTCSS decode time, and transmitter rise time. Some repeaters also have a short "kerchunk" timer to prevent brief key-ups and noise from keying the transmitter. It also gives time for some handhelds to come out of the "power-saver" mode. Leaving extra time is also necessary on any system of linked repeaters, to allow time for all the links to begin transmitting. Momentary delay in speaking after keying up will ensure that your entire message is transmitted, avoiding time-wasting repeats for lost first words.

Lastly, pause a little longer than usual between transmissions any time there is a possibility that other stations may have emergency traffic to pass. A count of "one, one thousand" is usually sufficient.

Brevity & Clarity

Each communication should consist of only the information necessary to get the message across clearly and accurately. Extraneous information can distract the recipient and lead to misinterpretation and confusion. If you are the message's author and can leave a word out without changing the meaning of a message, leave it out. If the description of an item will not add to the understanding of the subject of the message, leave it out. Avoid using contractions within your messages. Words like "don't" and "isn't" are easily confused. If someone else has drafted the message, work with the author to make it more concise.
Make your transmissions sound crisp and professional, like the police and fire radio dispatchers and the air traffic controllers. Do not editorialize, or engage in chitchat. An emergency net is no place for "Hi Pablo, long time no hear", "Hey, you know that rig you were telling me about last month...." or any other non-essential conversation.
Be sure to say exactly what you mean. Use specific words to ensure that your precise meaning is conveyed. Do not say, "That place we were talking about," when "Richards School" is what you mean. Using non-specific language can lead to misunderstandings and confusion.

Communicate one complete subject at a time. Mixing different subjects into one message can cause misunderstandings and confusion. If you are sending a list of additional food supplies needed, keep it separate from a message asking for more sand bags. Chances are that the two

requests will have to be forwarded to different locations. If combined, one request will be lost.

Plain Language

As hams, we use a great deal of "jargon" (technical slang) and specialized terminology in our daily conversations. Most of us understand each other when we do, and if we do not on occasion it usually makes little difference. In an emergency, however, the results can be much different. A misunderstood message could cost someone's life.

Not everyone involved in an emergency communication situation will understand our slang and technical jargon. Even terms used by hams vary from one region to another, and non-hams or new hams will have no knowledge of most of our terminology. Hams assisting from another region might understand certain jargon very differently from local hams.

For these reasons, all messages and communications during an emergency should be in plain language. "Q" signals (except in CW communication or where required for international communications where there is a language barrier), 10 codes and similar jargon should be avoided. The one exception to this is the list of standard "pro-words" (often called "pro-signs") used in Amateur traffic nets, such as "clear", "say again all after" and so on.

Avoid words or phrases that carry strong emotions. Most emergency situations are emotionally charged already, and you do not need to add to the problem. For instance, instead of saying, "horrific damage and people torn to bits," you might say "significant physical damage and serious personal injuries."

And please watch your speed of speech. It should be at a normal rate. Many times emergency operators get too excited and talk very fast, making it hard for receiving stations to understand.

Phonetics

Certain words in a message may not be immediately understood. This might be the case with an unusual place name, such as "Franconia" or an unusual last name, like "Smythe." The best way to be sure it is understood correctly is to spell it. The trouble is, if you just spell the word using letters, it might still be misunderstood, since many letters sound alike at the other end of a radio circuit. "Z" and "C" in American English are two good examples. For that reason, radio communicators often use "phonetics." You should determine which phonetics are commonly used in your area and use them.

To reduce requests to repeat words, use phonetics anytime a word has an unusual or difficult spelling, or may be easily misunderstood. Do not spell common words unless the receiving station asks you to. In some cases, they may ask for the phonetic spelling of a common word to clear up confusion over what has been received. Standard practice is to first say the word, say "I spell," and then spell the word phonetically. This lets the receiving station know you are about to spell the word he just heard.

Several different phonetic alphabets are in common use, but most hams and public safety agencies use the ITU Phonetic Alphabet, and others use military alphabets. Many hams like to make up their own phonetics, especially as a memory aid for call signs, and often with

humorous results. This practice has no place in emergency communication. In poor conditions, unusual phonetic words might also be misunderstood. We need to be sure that what we say is always interpreted exactly as intended— this is why most professional communicators use standardized phonetics.

Alfa, Bravo, Charlie, Delta, Echo, Foxtrot, Golf, Hotel, India, Juliet, Kilo, Lima, Mike, November, Oscar, Papa, Quebec, Romeo, Sierra, Tango, Uniform, Victor, Whiskey, X-ray, Yankee and Zulu.

Pro-words

Pro-words, called "pro-signs" when sent in Morse code or digital modes, are procedural terms with specific meanings. ("Pro" is short for "procedural.") They are used to save time and ensure that everyone understands precisely what is being said.

Some pro-words are used in general communication, others while sending and receiving formal messages. The usage and meaning of some pro-words in other services, such as police, fire or military, may differ from amateur radio usage.

Amateurs should check with experienced amateur radio emergency communicators in their own area to determine if pro-words are used and what they mean in the local usage.

Tactical Call Signs

If legally allowed in your country, tactical call signs can identify the station's location or its purpose during an event, regardless of who is operating the station. This is an important concept. The tactical call sign allows you to contact a station without knowing the call sign of the operator. It virtually eliminates confusion at shift changes or at stations with multiple operators.

Tactical call signs should be used for all emergency nets and public service events if there are more than just a few participants. If one does not already exist, the Net Control Station (NCS) may assign the tactical call sign as each location is "opened." Tactical call signs will usually provide some information about the location or its purpose. It is often helpful if the tactical call signs have a meaning that matches the way in which the served agency identifies the location or function.

To be effective, a tactical call sign, once assigned, should be used consistently (i.e., don't use EOC" one time and "Command" the next). A list of tactical callsigns and the locations or functions to which they are assigned should be made known to all who might make calls to or receive calls from each such location or function.

Calling with Tactical Call Signs

If you are at "Aid 3" during a directed net and want to contact the net control station, you would say "Net, Aid 3" or, in crisper nets (and where the NCS is paying close attention), simply "Aid 3". If you had emergency traffic, you would say "Aid 3, emergency traffic," or for priority traffic "Aid 3, priority traffic." Notice how you have quickly conveyed all the information necessary, and have not used any extra words.

If you have traffic for a specific location, such as Firebase 5, you would say "Aid 3, priority traffic for Firebase 5." This tells the NCS everything needed to correctly direct the message. If there is no other traffic holding, the NCS will then call Firebase 5 with, "Firebase 5, call Aid 3 for priority traffic." Note that no call signs have been used - so far...

Station Identification

In addition to satisfying your national administration's amateur rules, proper station identification is essential to promoting the efficient operation of a net. In the United States the amateur rules require that you identify at ten-minute intervals during a conversation and at the end of your last transmission. During periods of heavy activity in tactical nets it is easy to forget when you last identified, but if you identify at the end of each transmission, you will waste valuable time. Be sure to follow your national administrations rules on identifying and follow the local amateur protocol to identify while using the tactical call signs.

A Review of Habits to Avoid

- Thinking aloud on the air: "Ahhh, let me see. Hmm. Well, you know, if..."
- On-air arguments, criticism, or rambling commentaries
- Shouting into your microphone
- "Cute" phonetics
- Identifying every time you key or un-key the mic
- Using "10" codes, Q-signals on phone, or anything other than "plain language"
- Speaking without planning your message in advance
- Talking just to pass the time.

Chapter 6
Network Theory and Emergency Communication Systems

Network Theory

The study of information transfer between multiple points is known as "network theory." During an emergency, messages vary greatly in terms of length, content, complexity and other characteristics. Similarly, the available communication pathways vary in how well they handle messages having different characteristics. Network theory can be thought of as the process of matching a particular message to the "best" communication pathway. The best pathway is that which can transfer the information with the most efficiency, tying up the communication resources the least amount of time, and getting the information transferred most accurately and dependably.

Hams are often invited to participate in emergency services planning, providing communications expertise. By incorporating some fundamental concepts about network theory into the planning of emergency communication systems, we can take advance steps to be sure that efficient and appropriate communication modes are available when the emergency strikes, thus providing a more valuable service to the public.

Let's start our discussion with the characteristics of messages.

Single Versus Multiple Destinations

There are major differences between broadcasting and one-to-one (exclusive) communication channels. Some messages are for one single addressee while others need to be received by multiple locations simultaneously. And some messages addressed to one destination can be useful and informative to "incidental" listeners.

A specific instruction to a particular shelter manager is a completely different kind of communication than an announcement to all shelters. Yet, it is common to hear these messages on the same communications channel.

High Precision versus Low Precision

Precision is not the same as accuracy. All messages must be received accurately. But sending a list of names or numbers requires precision at the "character" level, while a report that "the lost hiker has been found" does not. Both may be important messages and must be transferred accurately. But one involves a need for more precision.

Over low-precision communications channels (such as voice modes) even letters of the alphabet can be misinterpreted unless a phonetic system, feedback or error-correcting mechanism is used.

Conversely, typing out a low precision message that "the delivery van containing the coffee has arrived at this location" on a high-precision packet link can be more time consuming (and inefficient) than a simple voice report.

Complexity

A doctor at a hospital may use a radio to instruct an untrained field volunteer how to splint a fractured leg. A shelter manager may report that he is out of water. The level of complexity varies greatly between these two messages.

Some messages are so long and complicated that the recipient cannot remember or comprehend the entire message upon its arrival. Detailed maps, long lists, complicated directions and diagrams are best put in hard copy or electronic storage for later reference. This avoids the need to repeat and ask for "fills," activities that tie up the communication channel. Some modes, such as fax and packet radio, by their very nature generate such reference copy. Others (such as voice modes) do not, and require a time-consuming conversion step.

Timeliness

Some messages are extremely time-critical, while others can tolerate delays between origination and delivery without adverse effect. Relief workers and their communicators can be very busy people. Requiring a relief worker to handle a non-time-critical message may prevent him or her from handling a more pressing emergency. Also, a message might need to be passed at a time when the receiving station is tied up with other business, and by the time the receiving station is free the sending station is then occupied. In these cases, provision can be made for "time shifting"—the message can be left at a drop point for pickup when the receiving station becomes free. Conversely, highly time-critical messages must get through without delay.

Timeliness also relates to the establishment of a communications link. Some modes, such as telephones, require dialing and ringing to establish a connection. An operator of a base station radio may need to track down a key official at the site to deliver a message. What matters is the total elapsed time from the time the message originates to the time it is delivered to its final party.

Priority

The concept of priority as used by Network Theory is better known to hams as QSK, the ability to "break in" on a communication in progress. For example, a communication pathway is in use with a lengthy, but low-priority, message. A need suddenly arises for a high-priority message. Can the high-priority message take precedence and interrupt the low priority one to gain access to the channel? Some communications modes allow for this; others do not.

Characteristics of Communication Channels

Now that we have looked at the different message characteristics, let's consider the communication channels that might be used in an emergency. In addition to the concepts of destination, precision, complexity, timeliness, and priority, communication channels also can be evaluated in terms of their reliability and ease of use.

Telephones

The pathway most familiar to non-hams is the telephone. This voice-based mode is surprisingly reliable and can be operated without the need for specialized communication volunteers. It is often fully operational with plenty of unused capacity during localized and small-scale emergencies, but can quickly become overloaded during large-scale disasters.

The telephone system is very good for transferring simple information requiring low precision. Since this mode utilizes the human voice, transferring a large amount of high-precision data (such as spelling a long list of names or numbers) can become tedious and time consuming.

The telephone system is a one-to-one communication pathway, meaning it cannot be used for broadcasting. But, the one-to-one relationship between sender and receiver makes it ideal for messages containing sensitive or confidential information, such as casualty lists.
The exclusive nature of most telephone circuits makes it difficult or impossible to break-in on a conversation to deliver a higher-priority message. The need for break-in usually precludes leaving the channel open continuously between two points, resulting in the need to dial and answer each time a message needs to be sent.

The major drawback to telephones during emergencies is that the sending and receiving stations are not self-contained. The system requires wires and cables that can be damaged or destroyed during severe weather or other events. When the central switching center goes down or becomes overloaded, all communications on this mode come to a halt, regardless of priority or criticality.

Cellular Phones

Cellular phones offer advantages that make them attractive: they are simple to operate and do not require a separate, licensed communication volunteer. They are lightweight and can be carried in a pocket, eliminating the need for tracking individuals as they move around.

Like landlines (and unlike devices used in Amateur Radio), cellular phones are ideally suited to one-to-one communications, avoiding distraction to stations not involved in the message exchange. They are unsuitable for multiple-recipient messages that are better handled on a broadcast-capable communications mode.

Like the landline telephone system, cellular phones are not self-contained communications units. They are reliant on a complex central switching and control system that is subject to failure or overloading. If the central base station goes down, or if its links with the other components of the phone system fail, cellular phone communication comes to a halt. There is generally no “go to simplex” contingency option with cellular phones.

Fax

Fax machines overcome the limitations of voice communications when it comes to dealing with high-precision, lengthy and complex information. A four-page list of first-aid supplies, for example, can be faxed much faster than it can be read over a voice channel and transcribed. Fax machines can transfer drawings, pictures, diagrams and maps—information that is practically impossible to transfer over voice channels.

Today, fax machines are widely available. Most organizations use them as a routine part of their business communications. It is becoming increasingly likely that a fax machine will be found at the school, church, hospital, government center, or other institution involved in emergency or disaster-relief efforts. Most of today's computers (even laptops!) are equipped with modems that can send and receive fax information.

Another advantage of fax machines is their production of a permanent record of the message as part of the transfer process. They also facilitate "time-shifting."

But they rely on the phone system, and add one more piece of technology and opportunity for failure. Except for laptop modems, they generally require 120 V ac current, which is not always available during emergencies unless plans have been made for it.

Two-Way Voice Radios

Whether on the public service bands or ham frequencies, whether SSB or FM, via repeater or simplex, voice radio is simple and easy to operate. Most units can operate on multiple frequencies, making it a simple matter to increase the number of available communication circuits as the need arises. Most important, the units are generally self-contained, enhancing portability and increasing reliability of the system in adverse environmental conditions. Radios are ideal for broadcasting.

On the flip side, though, while a message is being transferred between two stations, the entire channel is occupied, preventing other stations from communicating. Using radio for one-to-one communication can be very distracting to stations not involved in the exchange. (The most common example of inefficient use of communication resources is a lengthy exchange between two stations on a channel being shared by a large number of users.) Also, radios suffer from the low precision inherent in voice modes of communication.

Trunked Radio Systems

These systems are becoming highly popular with public service agencies, such as fire services and police services. They are similar to the standard voice radio systems described above with two exceptions. Unfortunately, both exceptions have a direct (and adverse) impact on the use of trunked systems in emergency and disaster situations.

The first has to do with the fundamental purpose behind trunking. Trunked systems came into being to allow increased message density on fewer circuits. In other words, more stations could share fewer frequencies, with each frequency being utilized at a higher rate. Under everyday circumstances, this results in more efficient spectrum use. But when an emergency strikes and communication needs skyrocket, the channels quickly become saturated. A priority queue results and messages are delayed. Medium- and low-priority messages, and even some high- priority messages, might not get through unless important stations are assigned a higher priority in the system's programming. Many times the trunked radio systems are shared between several different public service departments within the local governments (i.e. Police, Fire, Highway, Courts, Justice Center, EMA, etc.).

The second difference deals with the way that frequencies are shared. Trunked systems rely on a complex central signaling system to dynamically handle the mobile frequency assignments. When the central control unit goes down for any reason, the entire system —

base and mobile units — must revert to a pre-determined simplex or repeater-based arrangement. This fallback strategy is risky in emergencies because of the small number of frequencies available to the system.

Packet Radio

As already mentioned, voice modes are ideal for low-precision messages. Digital data modes, on the other hand, facilitate high-precision message transfer. Modes such as packet radio ensure near-perfect accuracy in transmission and reception. And like fax machines, packet has the ability to provide a relatively permanent record of the message for later reference.

The packet mode has another advantage when dealing with information that is in electronic form, there is no need for a conversion step before transmission. This is especially valuable when the information being sent is generated by machine (such as automated weather sensors, GPS receivers, or shelter management computers).

Packet stations are generally self-contained and if located within line-of-sight, do not need a central switching system. Unlike fax machines, packet radio systems are perfect for the distribution of high-precision information to a large number of destinations simultaneously. And the automated retry feature means that several connections can share a single frequency simultaneously, effectively increasing the capacity of the channel.

Among the disadvantages, real-time packet messages require the operator to use a keyboard. This makes the mode unacceptable for low- precision but lengthy messages, such as describing an injury or giving a status report, especially where the operator is not a fast typist. Due to its need for perfect transmission accuracy, packet may not be reliable along marginal RF paths.

And unlike fax machines, most of today's common packet protocols are inefficient when transferring precision graphics, drawings and all but the most rudimentary maps.

Store-and-Forward Systems

Sometimes considered a subset of packet radio, store-and-forward systems (bulletin boards, messaging gateways, electronic mailboxes, etc) can handle non-time-critical messages and reference material, enabling communication in situations where sender and receiver cannot be available simultaneously. These systems also increase the effective capacity of a communication channel by serving as a buffer. When a destination is overloaded with incoming messages, the store- and-forward unit can hold the messages until the receiver is free.

It is important to remember that store-and- forward systems are not limited to digital modes. Voice-answering machines and even an arrangement of liaison stations can function as voice-based store-and-forward systems.

Winlink 2000 and D-Star

These two newer modes are gaining in popularity and are now "battle proven in use." Winlink is a system that allows for email type messaging using both radio and the Internet. It can provide a digital bridge into and out of areas where the Internet is not available.

D-Star provides for both digital voice and data. Winlink and D-Star will be discussed in more depth later.

Other Modes

Slow-scan television, fast-scan television, satellite communications, human couriers, the Internet, email and other modes of communication all have their own characteristics. Space limitations prohibit more discussion, but by now you get the idea of how communications channels relate to different types of messages.

Planning and Preparation—The Keys to Success

Serious communication planners should give advance thought to the kinds of information that might need to be passed during each kind of emergency they wish to consider. Will maps need to be transferred? What about long lists of names, addresses, supplies or other detailed identification? Will the communications consist mostly of short status reports? Will the situation likely require transfer of detailed instructions, directions or descriptions? Will they originally be in oral, written or electronic form?

You may be able to assist a served agency to prepare for the handling of detailed or complex messages by recommending that preformatted (e.g., fill-in-the-blank) messages and named kit lists be developed and circulated in advance among all parties to a given type of communication, effectively creating a "shorthand" message that can be sent more quickly and is prone to fewer errors.

Planners should next consider the origins and destinations of the messages. Will one station be disseminating information to multiple remote sites? Will there be many one-to-one messages? Will one station be overloaded while others sit idle? Will a store-and-forward system, even via voice, be useful or necessary?

The content of the messages should also be considered. Will a lot of confidential or sensitive information be passed? Will there be a need for break-in or interruption for pressing traffic or can one station utilize (tie up) the communications link for a while with no adverse consequences?

Along with the message analysis described above, the frequency of occurrence (count of messages) of each type should also be estimated. Then, in the most important step, the characteristics of the high-volume messages should be matched to one or more appropriate communication pathways.

Once you have identified the ideal pathways for the most common messages, the next step is to take action to increase the likelihood that the needed modes will be available during the emergency. Hams take pride in their "jump kit" emergency packs containing their 2-meter radios, extra batteries and roll-up antennas. How about doing the same thing for some additional communication modes, too? Put a list of critical phone numbers (including fax numbers, pager numbers, and cellular numbers) in your kit. Make sure your local packet digipeater has battery backup. If you are likely to be assigned to a school, church, or office building, see if you can get a copy of the instructions for using the fax machine to keep in your kit.

Advance scouting may be needed. It is a good idea to see if fax machines are in place and whether they will be accessible in an emergency. Is there a supply of paper available? Are the packet digipeaters within range of every likely communication post? Can computers be made available or will hams have to provide their own? How will backup power be provided to the computers? Can a frequency list be developed, along with guidelines of when and how to use each frequency?

Contingency planning is also of critical importance. How many times has a repeater gone down, and only then did the communicators wish they had agreed in advance on an alternate simplex frequency? What will you do if you need to send a map and the fax machine power fails? Suppose you are relying on cellular phones and the cellular network fails?

Training

The final step is training. Your staffing roster, assignment lists, and contingency plans need to be tied in to the training and proficiency of your volunteers.

Questions you might want to ask are: Who knows how to best use all the capabilities of today's cellular phones? Who knows how to use fax software? Who knows how to upload or download a file from a packet BBS? Who knows how to touch-type? By matching your needs with your personnel, you can identify areas where training is needed.

Ham radio club meeting programs and field trips provide excellent opportunities for training as well as building enthusiasm and sharing knowledge of the plans. You will be surprised at how a little advance planning and effort can go a long way to turning a volunteer mobilization into a versatile, effective, professional-quality communication system.

Chapter 7
Basic Net Operations

Why We Have Nets

Any list of the major strengths of Amateur Radio includes our abilities to share information in a "group setting" in real time across multiple locations and multiple message destinations. Unlike many other types of communications, our radio messages can be heard by everyone in the group at once - and they can respond. But, it can cause a problem if not organized.

A high volume of disorganized messages can quickly turn an overloaded communication system into a disaster. To prevent this from happening, Amateur Radio operators use regular protocols called a “network” or “net” to organize the flow of messages. The mission of the net is to effectively move as much traffic accurately and quickly as possible. Nets can be either formal or informal as needs dictate. Nets can be in voice, Morse code, or digital modes depending on the situation.

Anatomy of Net Operations

The Net Manager is the person in charge of a net, but is most often not the person who actually conducts the net on the air. Managers ensure that there is a Net Control Station (NCS) with enough operators for each shift, and monitors net and band conditions to see if changes in frequency are needed. If more than one net is operating, a Net Manager may be responsible for a group of nets. The Net Manager coordinates the various nets and their NCSs to ensure a smooth flow of traffic within and between nets. Managers may assign various human and equipment resources to meet the needs of each net.

Net Managers may be responsible for a regularly scheduled net, or may be temporarily appointed to manage one or more ad hoc nets created for a particular emergency incident. A NCS directs the minute-by-minute operation of the net on the air. The NCS controls the flow of messages according to priority, and keeps track of where messages come from and where they go, and any that have yet to be sent. They also keep a current list of which stations are where, their assignments, and their capabilities. In a busy situation, the NCS may have one or more assistants to help with record keeping.

Liaison Stations handle messages that need to be passed from one net to another. The NCS or Net Manager may assign one or more stations to act as liaisons between two specific nets. These stations can monitor one or both nets, depending on resources. It is easier to monitor only one net at a time. This can be accomplished by having one station in each net assigned as the liaison to the other, or by having a single liaison station check into both nets on a regular schedule. In the event that an “emergency” precedence message needs to be passed to another net when the liaison is not monitoring that net, any net member can be assigned to jump to the other net and pass the message.

Learning proper NCS technique and handling such duties is one of the most important functions in Emergency Communications. During an emergency or disaster, the first operator to arrive on frequency is the NCS operator– at least until a Net Manager or a leadership

official arrives on frequency to take control and perhaps to assign someone else to be the NCS.

Net Types - Open (Informal) Nets

During an open emergency net, there is minimal central control by a Net Control Station, if indeed there is an NCS at all. Stations call one another directly to pass messages. Unnecessary chatter is usually kept to a minimum. Open nets are often used during the period leading up to a potential emergency situation and as an operation winds down, or in smaller nets with only a few stations participating.

Net Types - Directed (Formal) Nets

A directed emergency net is created whenever large numbers of stations are participating, or where the volume of traffic cannot be dealt with on a first-come first-served basis. In a communication emergency of any size, it is usually best to operate a directed net. In such situations the NCS can prioritize traffic by nature and content.

In a directed net, the NCS controls all net operations. Check-ins may not "break into" (interrupt) the net or transmit unless specifically instructed to do so by the NCS, or unless they have an emergency message. The NCS will determine who uses the frequency and which traffic will be passed first. Casual conversation is strongly discouraged and tactical call signs will probably be used. Tactical call signs can be assigned to stations at various sites, locations and different purposes. For example mobile operators can often be assigned the sign "rover 1", "rover 2" and so on.

At his/her discretion, the NCS operator may often elect to create a "sub net" depending on the volume of traffic and its content and nature. In this case a "sub net" NCS may be appointed to take over the newly created net.

Net Missions

Each net has a specific mission, or set of missions. In a smaller emergency, all the communication needs may be met by one net. In a larger emergency, multiple nets may be created to handle different needs. Here are some examples:

Traffic Net -- Handles formal written messages.

Resource Net -- When incoming operators arrive on scene this is the net that they would check into to receive assignments, or to be reassigned as needs change. A resource net may also be used to locate needed equipment, or operators with specific skills.

Tactical Net -- In general, the tactical net(s) handle the primary on-site emergency communication..

Information Net -- An information net might be used to make regular announcements, disseminate official bulletins or answer general questions..

Health and Welfare (H&W) Nets: These nets usually handle messages between concerned friends, families and persons within and outside of the disaster area where legally permitted.

These various types of nets in the context of a communications emergency will be covered in more detail in the next section entitled “Emergency Net Operations.”

Chapter 8
Emergency Net Operations

What is an Emergency Net?

The purpose of any net is to provide a means for orderly communication within a group of stations. An "emergency" net is a group of stations who provide communication to one or more served agencies, or to the general public, in a communications emergency. An emergency net may be formal or informal, depending on the number of participants and volume of messages.

Net Formats -- Directed (formal) Nets

In a directed net, a "net control station" (NCS) organizes and controls all activity. One station wishing to call or send a message to another in the net must first receive permission from the NCS. This is done so that messages with a higher priority will be handled first, and that all messages will be handled in an orderly fashion. Directed nets are the best format when there are a large number of member stations. (Be careful not to confuse "formal nets" with "formal messages." There is no definite link between the two. A formal net may handle informal messages, and vice versa.)

Net Formats -- Open (informal) Nets

In an open net, the NCS is optional. Stations may call each other directly. When a NCS is used at all, he usually exerts minimal control over the net. The NCS may step in when the message volume increases for short periods, or to solve problems and keep the net operating smoothly. Open nets are most often used when there are only a few stations and little traffic.

Types of Emergency Nets

Emergency nets may have different purposes, and a given emergency may require one or more of each type of net. During a small operation, all functions may be combined into one net.

Traffic Nets. A traffic net handles formatted written messages between served agency locations or between other nets. In emergency operations, these nets may handle the majority of message originations and deliveries. Messages to or from outside the immediate area may be transferred to and handled by a different net specifically set up to traffic or messages outside the immediate area. Even if you expect to handle traffic primarily on VHF/UHF repeaters, understanding how these layers of nets operate will help you to optimize your use of the system. HF traffic nets can provide you additional practice and expose a new emergency telecommunication volunteer to traffic handling that you might not encounter on VHF/UHF. During an emergency nets handling local traffic and nets handling traffic outside the immediate area work together, so it's a good idea to understand emergency traffic from the both net operator's perspective.

Tactical Nets. In general, the tactical net(s) handle the primary on-site emergency communication. Their mission may be handling communications for a served agency, weather monitoring and reporting, river level gauging, or a variety of other tasks that do not

require a formal written message. Often a tactical net may be set up as a "sub net" to handle specific types of traffic during high volume emergency situations. In such cases an additional NCS may be assigned for the sub net.

Resource or Logistics Net. When incoming operators arrive on scene this is the net that they would check into to receive assignments, or to be reassigned as needs change. A resource net may also be used to locate needed equipment, or operators with specific skills. Several different resource nets may be used in large-scale events. One might be used for collecting new volunteers over a wide area, and other local nets could be used for initial assignments. If required due to geography or high net activity, a third net could handle on-going logistical support needs.

Information Net. An information net is usually an open net used to collect or share information on a developing situation, without overly restricting the use of the frequency by others. Net members send updated local information as needed, and official bulletins from the served agency may be sent by the NCS (if the net has one). The NCS and many of the participants monitor the frequency, but a "roll call" is seldom taken and stations may not be expected to check in and out of the net. The operation of an information net also serves as notice to all stations that a more formal net may be activated at any moment if conditions warrant.

Health and Welfare (H&W) Nets. Where third party messaging for the general public is allowed, these nets usually handle messages between concerned friends, families and persons within and outside of the disaster area. Most H&W nets will be on HF bands, but local VHF or UHF "feeder" nets may be needed within a disaster area. Band conditions, operator license constraints and specific use needs will most always determine which mode may be the best choice for determining the mode of certain net operations.

Checking Into an Emergency Net

There are two situations where you will need to "check in" to a net:
1. When you first join the net, and
2. When you have messages, questions or information to send.

If you are part of the organization operating the net, simply follow the instructions for checking into directed and open nets as discussed below.

To become part of a **directed net,** listen for the NCS to ask for "check-ins" and listen to any specific instructions, such as "check-ins with emergency traffic only." At the appropriate time, give only your call sign. If you have a message to pass, you can add, "with traffic." If it is an emergency message, say "with emergency traffic." The same is true for stations with priority traffic. Wait for a response before offering more information. Checking into a directed net when the NCS has not asked for check-ins is usually considered a bad practice. However, if a long period passes with no request, you might wait for a pause in the net's activity and briefly call the NCS like this: "Net control, W1FN, with traffic."

To check in to an **open net** for the first time, briefly call the net control station as above. If there appears to be no NCS, call anyone on the net to find out if anyone is "in charge" and make contact with them. If you are already part of the net and have a message to send, simply wait for the frequency to be clear before calling another station.

If you are not **part of the organization** operating the net, do not just check in and offer to assist. Listen for a while. Be sure you have something specific to offer before checking in, (such as the ability to deliver a message close to your location when none of the regular net members can). If they really do seem to need help that you feel you can provide, you might check in briefly to ask if they have a "resource" net in operation, then switch to that frequency. If not, make a brief offer of assistance to the NCS.

Do not be too surprised if you receive a cool reception to your offer of help. It is usually nothing personal. Emergency nets are serious business. Most emergency telecommunication managers prefer to deal with people with known training and capabilities, and with whom they have worked before. You may not have the experience, skills or official credentials they require—and they have no way of knowing what your true capabilities are. Some emergency telecommunication managers will assign you as an apprentice, logger, or as a "runner." If you are given such an opportunity, take it! It is all good experience and a great way to introduce yourself to the group. Better yet, become involved with your local emergency telecommunication group now—do not wait for the next disaster.

Passing Messages

If you told the NCS you have traffic to send when you checked in, he will probably ask you to "list your traffic" with its destination and priority. After you send your list, the NCS will direct you to pass each message to the appropriate station in the net, either on the net frequency, or another frequency to avoid tying up the net. When moving to another frequency to pass the message, always check to see if the frequency is in use before beginning.

When you are asked by the NCS to send your message, the standard procedure is for the NCS to tell the receiving station to call the sending station.

"Breaking" the Net

If the net is in progress, and you have emergency traffic to send, you may need to "break" into the net. Procedures for doing this vary from net to net, but the most common method is to wait for a pause between transmissions and simply say, "Break, PB2T." The NCS will say, "Go ahead PB2T," and you respond, "PB2T with emergency traffic."

Checking Out of an Emergency Net

Always let the NCS know when you are leaving the net, even if it is only for a few minutes. If the NCS believes you are still in the net, they may become concerned about your unexplained absence. This could result in someone being unnecessarily dispatched to check on your well-being.

There are three reasons for checking out of (leaving) a net.

1. The location of your station is closing. If the NCS has given you directions to close the location, simply acknowledge the request, and sign with your tactical call sign, if you are using one, and your call sign. If the order to close has come from a local official, state that your location has been closed, along with the name and title of the official who ordered it,

and sign off as above. Long "goodbyes" only tie up the net needlessly, and do not sound very professional.

2. You need a break and there is no relief operator. Tell the NCS that you will be away from the radio for a certain length of time, the reason and sign with your tactical call sign, if you are using one, and your call sign.

3. You have turned the location over to another operator. Tell the NCS that you have turned the station over to (give the new operator's name and call sign), and that you are leaving. Sign with your tactical call sign, if you are using one, and your call sign.

There are two special situations to be aware of: If someone in authority asks you, such as a law enforcement officer, to move your station, then move immediately and without argument. Notify the NCS of the situation at the first appropriate opportunity. If you are requested by someone in authority to turn off your radio, or to refrain from transmitting, do so immediately and without question. Do not notify Net Control until you have permission to transmit again, and can do so safely. There is usually a good reason for such a request. It may be an issue of security, or it may be a potential hazard, such as an explosive device that could be triggered by RF energy.

Levels of Nets

Network systems are often "layered" for greater operating efficiency. Some networks are designed to handle messages within specific areas, and others to handle messages destined outside the areas or incoming to the areas. Think of this much like you would a highway system. Local messages (cars) travel between destinations directly on local nets (local roads). When a message has to go to a distant city, it is passed to a regional net (highway), and if it is really distant, to a long distance net (interstate highway or autobahn). At the other end, it is returned to regional, then local nets for delivery.

Non-Voice Nets

Emergency nets may also use other modes of communication besides voice (phone). Traffic nets have used CW since the beginning of Amateur Radio, and it is still a viable option for long distance formal traffic. High-speed CW nets can actually handle more messages per hour than most voice nets. Packet communication on VHF and UHF is often used for local communication where accuracy and a record of the message are required. HF digital modes such as AMTOR and PACTOR are used on long distance circuits. Many groups are now experimenting with emergency communication applications for newer modes such as PSK31 on HF and VHF/UHF bands.
Most CW nets are directed nets. Packet nets are not generally directed by a human, due the automatic "store and forward" nature of the mode, and are usually operated as open nets with no NCS.

There are two systems which have received significant attention by many emergency telecommunication groups and offer digital message handling capabilities:
"WinLink 2000," an automatic system that blends radio and Internet transmission paths to permit rapid and seamless email message transfer to stations anywhere on Earth. For most emergencies, it will be possible for stations in the affected area to link to a WinLink 2000 PACTOR node outside the affected area, allowing contact with the outside world.

More recently, the D-Star digital voice and data protocol specification, developed as the result of research by the Japan Amateur Radio League (JARL), is an on-air and packet-based standard that is now widely deployed and sold by a major radio manufacturer. D-Star compatible radios are available on VHF, UHF, and microwave amateur radio bands. In addition to the over-the-air protocol, D-Star also has network connectivity, enabling D-Star radios to be connected to the Internet or other networks. It also has provisions for routing data streams of voice or packet data directly to specific call signs.

Practice and train using Digital as you would on any other mode.

How do you hold a training net on D-Star or Winlink? Digital modes are often not keyboard-to- keyboard in real time, and messages might take a while to get to their intended destination. Therefore, any attempt at a "conventional" net must be truly in slow motion. But without taking this time, net members will not know who else is up and operating, that equipment is working properly, and there are no "bugs" in the system. An emergency is not the time to see if your digital planning works – try it out in a drill or net before you really need it.

Chapter 9
Net Operating Guidelines

Introduction

Every organization needs an executive-level manager to oversee the entire operation and ensure that everything runs smoothly. Depending on the type of net, the Net Manager will be responsible for recruiting and training NCS operators, liaison stations and other net members.

As stated elsewhere in this guide, it is important for the less experienced emergency telecommunication volunteer to consult with more experienced emergency telecommunication operators in his area to make sure how nets are operated locally. The discussions set forth in this guide are examples of how nets can operate efficiently but local customs and practice should take precedence over the discussions set forth in this guide.

The Net Manager sets up the net's schedule and makes sure that one or more qualified NCS operators will be available for each session of the net. In a long-term emergency net, the Net Manager may also arrange for relief operators and support services. Some net managers may be responsible for more than one net.

The NCS

Think of the NCS as a "ringmaster" or "traffic cop." The NCS decides what happens in the net, and when. For example, if a station has a Priority message for a Red Cross shelter, and Medical Station has an Emergency message for Mercy Hospital, it is the NCS's job to make sure that the Emergency message is sent first. He decides when stations will check in, with or without traffic, and whether messages will be passed on the net's frequency or a different one. The NCS needs to be aware of everything going on around him and handle the needs of the net, its members and served agency as quickly and efficiently as possible. It can be a daunting task in a busy and challenging net.
The NCS can be located anywhere but should be in a position to hear most, if not all, stations in the net. This helps avoid time-consuming "relays." Some groups place their NCS at the command post for an emergency incident; others like to keep them away from the noise and confusion.

The NCS is in charge of one specific net but should not be responsible for the entire emergency telecommunication operation. That is the job of an emergency coordinator or similar emergency telecommunication manager. It is not possible to be in command of all aspects of an emergency response, and still run a net effectively, since both jobs require 100% of your attention.

Net Scripts

Many groups open and close their nets with a standard script. The text of the script lets listeners know the purpose and format of the net. Using a standard script also ensures that the net will be run in a similar format each time it operates regardless of who is acting as the NCS.

A typical net script might look like this:

Opening: This is [call sign], net control station for the _____ Emergency Net. This is a directed emergency net. Please transmit only when requested to, unless you have emergency traffic.

Any station with emergency traffic, please call now. (Stations call in and emergency traffic is passed.) Any station with priority traffic, please call now. (Stations call in and priority traffic is passed.)

All other stations with or without traffic, please call now. (Stations call in and any traffic is passed.)

Closing: I would like to thank all stations that checked in. This is [call sign] securing the -_____ Emergency Net at [date and time] returning the [repeater or frequency] to regular use.

A backup NCS needs to be readily available should there be an equipment failure at the primary NCS location, or if the primary NCS operator needs to take a break. There are two types of backup NCS. Either the Net Manager or the primary NCS, depending on the situation, appoints both. All members of the net should be made aware of the backup NCS assignment early in the net's operation.

The first type is at the same location as the primary NCS operator. The second is a station at a different location that maintains a duplicate log of everything happening during the net. Whenever possible, an offsite backup NCS should be maintained, even if an on-site backup is present. This is especially important during an emergency where antennas can be damaged or power lost. Equipment can fail even during less demanding operations.

Acting as a "fill-in" NCS

Even before you have had a chance to be trained by your group to act as a NCS operator, an opportunity might arise for you to handle the job temporarily. During an emergency, anyone and everyone can be asked to take on new and unfamiliar tasks in order to deal with a rapidly changing situation. Fortunately, basic NCS skills are not difficult to teach or learn. Here are some basic dos and don'ts:

-Remember that you are in control of the net but you should treat members with respect and accept suggestions from other experienced members.

-If you are taking over an existing net, try to run it much as the previous NCS did.

-Always follow a script if one is provided.

-Write your own if necessary, but keep it short and to the point.

-Handle messages in order of precedence: Emergency—Priority—Welfare—Routine.

-Speak clearly and in a normal tone of voice. Use good mic technique.

-Make all instructions clear and concise, using as few words as possible.

-Keep notes as you go along. Do not let your log fall behind.

-Write down which operators are at which locations. When one leaves or is replaced, update your notes.

-Ask stations to pass messages off the main net frequency whenever possible.

-All the reading and study in the world will not replace actual experience.

You should look for opportunities to practice being the NCS operator well before an emergency occurs.

Net Members

Operators at various sites are responsible for messages going to and from their location. They must listen to everything that happens on the net, and maintain contact with the served agency's people at the site. They assist the served agency with the creation of messages, put them into the appropriate format and contact the NCS when they are ready to be sent. Whenever possible, two operators should be at each site. When the station is busy, one can handle logging, message origination, and work with the served agency's staff while the other monitors the net, sends messages, and copies incoming traffic. During slower periods, one member can be "off-duty" for rest, meals or personal needs.

Bulletin Stations

In some nets, the NCS does not send out bulletins and other incident related information. That is the role of the "bulletin station." This station relays bulletins or those authorized by the served agency to all stations in the net. They may also be transmitted on a preset schedule, such as at the top and bottom of each hour. The bulletin station must be located at the served agency or have a reliable communication link to them.

Liaison Stations

Liaison stations pass messages between two different nets. The NCS or Net Manager, depending on the type of organization, usually assigns these stations. Messages may be passed as needed, or on a pre-set schedule such as every 30 minutes. In some cases, a liaison station will monitor one net full time. When a message must be passed to another net, they leave the net temporarily to pass it, and then return. The other net has a liaison station who does exactly the same thing, but in reverse.

In other situations, a single liaison station may need to handle messages going both ways between two nets. There are two ways to do this. You can use two radios to monitor both nets at the same time, a difficult task if either or both nets are busy. The radios antennas must be separated sufficiently to prevent interference between radios when one is used to transmit. In the second method, one radio is used, and the liaison station switches between the two nets on a regular schedule.

Relay Stations

While not a regular net position, a relay station is one that passes messages between two stations in the net that cannot hear each other. Relay stations are generally designated by the NCS on an "as needed" basis. If you can hear a station or stations that the NCS cannot, it is OK to volunteer to act as a relay station.

Workload and Shift Changes

Although it happens frequently, no operator should try to work excessively long hours. When you become tired, your efficiency and effectiveness decline, and your served agency is not getting the best possible service. Net managers and NCS operators should work with the emergency telecommunication manager to ensure that all net members get some rest on a regular basis. It is a good practice for any replacement NCS, liaison, or net member to monitor the net for at least fifteen minutes and review the logs with the present operator before taking over. This assures continuity in the net's operation.

Non-voice Modes

Packet modes include FM packet, HF packet and PACTOR. Because packet modes can provide an automatic connection between two stations, it is not really proper to speak of a "packet net." Although messages can be transmitted between two stations "keyboard to keyboard" as with RTTY or PSK31, it is usually better to transmit them as "traffic," using the bulletin board or mailbox facility of the terminal node controller (TNC). Packet messages are automatically routed and stored without any action by the receiving station's operator or a NCS.

Non-packet digital modes are not automatic, and may require a NCS operator to manage the net in much the same way as a phone or CW net. These include RTTY, PSK31, AMTOR and GTOR.

CW Procedures: Clean and accurate code sent at 10 words per minute is better than sloppy code sent at 30 words per minute. Sending speed is not a true measure of effectiveness, but accuracy is.

When propagation or interference makes communication difficult, or when the receiving operator cannot keep up, it is time to reduce the sending speed. Always send at a speed that the receiving station can copy comfortably.

There are variations used when passing traffic via CW, especially when both stations are operating "full break-in" mode (both stations are capable of receiving signals between each Morse character sent). The receiving station can "break" (stop) the sending station at any point for needed fills, instead of waiting for the entire message to be sent.

Interference Problems

If your net experiences interference, the NCS has several options. If the interference is coming from adjacent or co-channel stations that may be unaware of the emergency net, the NCS should politely inform them of the net and ask for their cooperation.

Alternatively, the NCS might ask an HF net to move over a few kHz. If the problem cannot be resolved in this manner, each net should have one or more alternative frequencies that it

can move to as required. If possible, the frequencies themselves should not be published or mentioned on the air.

Never discuss, acknowledge or try to speak with an intentionally interfering station. Many years of experience has proven that this only encourages the offender. If the interference is making communication difficult, simply announce to the net that everyone should move to the alternate frequency and sign off. Better yet, put a plan in place so that when interference occurs, all net members know to move to the alternate frequency without being told to do so on the air.

Chapter 10
Emergency Net Control Stations (NCS)

Introduction

Formal (directed) nets will always have one station "in control." This station is known as the "Net Control Station" (NCS), and its operator as the "NCS operator." Think of the NCS operator as sort of a "traffic cop," directing the orderly flow of messages. His or her skills are critical to the success of any emergency communication net. For this reason many emergency communication groups elect to have training and even classes designed to teach and train operators in NCS skills. Practice sessions are often helpful for this purpose, and many ARES groups schedule regular weekly practice sessions.

> **The primary job of the NCS operator is to ensure that messages with the highest precedence are sent first –** emergency, **then** priority, **then** health and welfare, **then** routine.

When Do You Need An NCS?

All formal (directed) nets require an NCS. Formal nets are used to maintain order when a large number of stations are in the net, or when a large volume of messages are being sent. The NCS operator decides who speaks when, in which order messages are passed, and keeps a log of which messages went where and when, and a list of messages that have yet to be passed.

Some informal nets will have a "standby" NCS, although by definition informal nets are not controlled. This person is there to keep things organized when necessary, to answer questions, keep the frequency clear, and to step in and "upgrade" the net to "formal" status if it becomes necessary. This often happens with initially light-duty nets that have the potential to grow as the situation evolves. Storm watch nets are a good example. During the "watch" phase, not much is happening other than informal sharing of information between observers. If a violent storm or a tornado appears, the traffic on channel will increase, and if damage occurs on the ground, the net could quickly evolve into a high-volume disaster relief net. Having an NCS operator on standby helps make

How Important Is A Well-Trained NCS Operator?

Have you ever listened to or participated in a poorly run net? One where routine messages are passed on-channel, while emergency or priority messages wait in line? Or where the NCS operator "loses his cool" and alienates half the net's members? Or nets where messages are not kept organized, are lost, changed, or misdirected?
The value of the NCS operator's skill is unquestionable. A well run net meets the needs of the served agency – a poorly run net can end Amateur Radio's relationship with the agency altogether.

The NCS operator must be a good organizer, and know how to defuse tension and stress with an appropriate sense of humor. The NCS operator also must have the ability to absorb new

terminology quickly, as there is no more fertile environment for the growth of jargon than in the emergency management community!

The Right Stuff

Here is a short list of basic pre-requisites for NCS for an emergency communications net:

-A clear speaking voice – someone who talks as though they have a mouthful of marbles won't do.

-Fluency in the language – if you have a thick accent or cannot use the language precisely, it may make it difficult for others to understand you accurately.

-The ability to handle mental and physical stress for long periods. Information and demands will be coming at you from all directions all at once, sometimes for hours on end. Can you handle it without losing your composure, or your voice? Can you think and act quickly when seconds count using prudence and are you able to make decisions under pressure?

-The ability to listen and comprehend in an often noisy and chaotic environment. Can you tune out all the distractions and focus only on the job at hand?

-Good hearing - If you have a hearing loss that makes it tough to understand human voices, NCS of a voice net is not the job for you. Hams with limited hearing problems may elect to act as NCS for a digital mode net, according to one's abilities.

-The ability to write legibly what you hear, as you receive it, and to make good notes as you go, not rely on memory.

-Above-average general knowledge and operating skills in the modes used (phone, digital, or CW).

Transferable Skills

Some of the skills you use in everyday amateur radio activities will be useful in your position as NCS operator.

-A well-designed and maintained station is critical to success. You must be able to choose the correct antenna, know how to get the best sound from your microphone, be radio agile, knowing how to operate, program and maintain the radio on short notice and have all controls and supplies within easy reach.

-You need to understand propagation so that you can choose the appropriate frequency as band conditions change. DXers learn how to pick weak signals out of the noise, and deal with crowded band conditions. Many of the skills used in contesting are applicable to controlling a net. Both activities involve dealing with many stations on the same frequency at the same time. The contester running a pile-up will try to contact as many stations as possible in the least amount of time. The mission of the NCS operator is to move as much traffic as possible in the least amount of time, accurately and effectively.

Learned Skills

A good NCS operator is trained, not born. Here are some skills you may need to learn to perform at your best.

-Working as a team player to achieve the goals of the net

-Effective leadership skills – keeping the team on track and motivated by developing a confident, self-assured management style

-Decisiveness – the ability to make quick and appropriate decisions

-Record keeping – log sheets (writing, thinking and talking all at once)

-Planning ahead – net scripts, assignments, materials on-hand

-HF propagation and antenna choices – knowing when to move to a different band

-Dealing with stress – a "burned-out" operator is a danger to the net

-Delegation – knowing when and how to "hand off" some jobs and responsibilities

-A working knowledge of your country's Incident Command System and how we fit in with the system

Learning and Practicing Your Skills

Book learning alone will not make you a competent NCS operator. It takes practice to learn these skills in a way that they will be ingrained and useful in a real emergency. Continued practice is necessary to maintain these skills once learned. Local nets on a weekly basis with rotation of NCS operators are a good way to gain practice, which is often done by many emergency telecommunication groups.

Net control skills can be learned and honed through classroom sessions, tabletop exercises, and regularly scheduled training nets. Actual emergency conditions can be simulated with periodic drills and simulated emergencies, and public service events such as road races, marathons and bike rides. Some emergency telecommunication groups have simulated emergency nets weekly. For example, some have simulated emergency weather nets during the severe weather season.

To begin your own NCS training, find out if your local group offers any formal training. Some will begin with tabletop exercises, in which a group sitting around a table will simulate a net operation, taking turns as NCS and net member stations. Tabletop exercises allow quick feedback and greater interaction among participants.

Other groups will simply let you take over as NCS for several scheduled training nets.

Before you do this, try to listen to other, more experienced, operators on your own net, and as many other formal nets as you can. Pay close attention to how they run the net, what scripts (if any) they use, and any mistakes they make.

If your group or local club provides communication support for events such as marathons, large parades, or races, these provide additional opportunities to get some "real world" NCS operator experience.

A real emergency is not the time to learn or practice new skills, unless there is no other option. A poorly trained or inexperienced NCS operator can do as much harm as good. Participation in regularly scheduled nets is important so that anyone who is or may become an NCS during a disaster or emergency can be effective and vital to the overall success of the mission.

What the NCS Operator is Not

The duties of the NCS operator should be limited to running the net. This is a full-time job all by itself. The NCS operator should not be in charge of the overall communication effort, or of any portion of the response beyond his or her own net and shift. The Net Manager generally handles the assignment of NCS operators, frequencies, and schedules, and may also recruit members for the net. Also, it is best for the Net Control Station to work away from any location that is also a significant originator or destination of message traffic.

Chapter 11
Net Control Station (NCS) Operator Practices

The following is a list of questions the NCS operator should answer before opening the net.

-**Can the NCS hear all the stations in the net from his location?** The NCS should be in a position to hear all the stations in the net whenever possible. Relays may be used, but they slow the operation of the net significantly. For best results, some area testing via simplex to see which stations can communicate with which others should be conducted well in advance so that during an emergency relay stations can properly be put in place to insure good communications.

-Is the NCS location sufficiently separated from the served agency's operations? It is good practice to assign net control duty to a station in a low-traffic location. The noise and commotion in an Emergency Operations Center (EOC) or Control Center can greatly degrade the ability to run a net well. Establishing net control at another location permits the EOC station to concentrate on passing traffic and working with the served agency. Of course, the NCS and the EOC station need to work together as a team. It is common for the overall incident to be managed from the EOC, while the off-site NCS assumes responsibility for managing check- ins and net traffic. In practice, it's not hard to work out a productive division of labor.

-Do you have the best performing antenna for the conditions? A "rubber duck" (short, flexible, helically-wound antenna) is not adequate unless you can see the repeater antenna, and if the repeater fails, you are out of business. A higher gain flexible or telescopic antenna would extend the range of the handhelds over that of the rubber duck antenna. On HF, an NVIS antenna (Near Vertical Incidence Skywave antenna) is essential for skip-zone communication. For long-range nets, conventional vertical, beam or dipole antennas, or a combination of these will work best.

-If you are running your radio with battery power, do you have at least one hour of battery capacity available? Ideally you will have a fully charged battery and access to backup batteries. If you are the only choice for NCS, make sure that you can run the net long enough to have someone else get ready to assume the duty so you can recharge your batteries when needed.

-Are you using a headset with a noise-canceling microphone? Even from home, background noise can affect how well you can hear and be heard.

-Do you have sufficient pencils/pens and paper to run the net for your shift? You will not be able to remember enough about the traffic or participants to be effective unless you write it down. A sheet to track net participants and their requests should also be kept on hand.

-For VHF/UHF repeater operation, are you familiar with the characteristics and control commands of the repeater system hosting your net? Your effectiveness as NCS may be adversely affected if you do not, particularly with linked systems.

-Do you have a runner, liaison, or logging person to support you? For large emergency events, all three are required. It is nearly impossible to handle the net, keep accurate and complete logs, and handle messages at the same time.

-Do you have a designated back-up net control station? In case you go off the air, another station should be ready to take control of the net.

-Do you have a designated relief operator? Everyone gets tired and the NCS must be the most alert operator on the net.

-**Opening and Closing the Net** Nets may be opened or closed on a specific schedule, or when the situation dictates. For instance, training and regular traffic nets may open at specific times, and may run for a specified period of time or as long as it takes to complete the net's business. Emergency nets are often opened and closed as needs dictate. Each net session should begin with the reading of a standard script that describes the purpose of the net and its basic procedures and protocols.

At the end of each net session, you can read a closing script, also briefly thanking members for participating, and reminding them of any future nets or other obligations. All scripts should be kept short and to the point.

The Importance of Message Precedence

In a communication emergency, one of the NCS operator's primary concerns is "information overload." When this happens, a message requesting "more bedpans for a shelter" may be sent before one requesting "a trauma team for a train wreck." This condition is usually caused by messages that are fed into the "system" in an unregulated manner. Failure to organize this information flow could result in critical messages being delayed or lost.

There are four message precedences:

-Emergency (relating to the immediate protection of life or property)

-Priority (served agency and other messages directly related to the emergency, but not as time sensitive as an Emergency precedence message.)

-Health & Welfare (Where permitted, inquiries or information about the whereabouts or condition of persons in the affected area.)

-Routine (Messages unrelated to any emergency: birthday greetings, net activity reports, etc.)

Highest Precedence

The primary job of the NCS operator is to ensure that messages with the highest precedence are sent first – emergency, **then** priority, **then** health and welfare, **then** routine.

Most emergency nets refuse to handle any routine messages at all, since they usually have little or no bearing on the emergency itself or the served agency's needs. Other nets may handle only emergency and priority messages, or primarily health and welfare messages.

Asking for Check-Ins

Ask for check-ins immediately after reading the opening script, and then periodically during the net's operation. If the net is handling only emergency and priority messages, but not welfare or routine messages, it is important to state this in the opening script and when asking for "check-ins with messages." If emergency precedence messages are likely, it is a good idea to ask for them first, then move on to priority, and finally welfare.

Try to ask for "check-ins with traffic only" as often as possible, and ask for "check-ins with or without traffic" at least every fifteen minutes, so that new stations may join the net. In a busy net, it can be difficult to balance the need to handle the current message backlog and still take check-ins on a regular basis. It is important to ask for check-ins with traffic frequently to ensure that priority or emergency messages get through expeditiously. When taking check-ins, NCS should read back the calls they received, and then ask if they missed anyone. This method can cut the time required for check-ins.

Time Tested Techniques

Listen! When asking for reports or soliciting traffic, listen carefully! This might seem obvious, but it is easy to miss critical information when operating under the stress of an emergency. Wear headphones and reduce any distractions around you.

Check-ins - After asking for check-ins, note on your net worksheet as many calls as you can before you acknowledge anyone. Acknowledge all stations heard by call, ask for fills on any partial calls heard and then ask if you've missed anyone.

Pair up stations to pass traffic on a different frequency whenever possible. This practice results in net "multi-tasking" and a higher rate of traffic handling. This is especially true when longer formal messages are being passed, or when a protracted discussion or exchange of information is required.

Every net has a particular style of operating, suited to the needs of the net. Most participants will catch on to the methods used, but if they do not, take time to explain. Things get done much more quickly if everyone uses the same techniques.

Be as concise as possible. Use the fewest words that will completely say what you mean. This will minimize the need for repeating instructions and messages.

Take frequent breaks. While you may not recognize the stress that being a NCS produces, it is constant, and will become evident in your voice. If you find yourself asking when your last break was, you know it is time to take one. Turn over the net to your backup at least every two hours and rest. Do not listen to the net – rest. Once rested, listen to the net for a few minutes before resuming as NCS.

Control the tone of your voice. Be as calm as possible. Tension tends to cause voices to increase in pitch, and net members will detect this change. When you use a calm tone, other

members of the net will tend to remain calm as well. Remember to speak with confidence and authority. A weak or indecisive demeanor undermines your effectiveness as NCS, and consequently the productivity of the net.

Legally Identify Yourself. In the heat of things, especially using tactical call signs, it is easy to forget the requirement to identify.

Net Disciplines

You can reasonably expect trained net members to:

-Report to the NCS promptly as they become available.
-Ask the NCS operator for permission to call another station.
-Answer promptly when called by the NCS operator.
-Use tactical call signs.
-Identify legally at the end of each exchange
-Follow established net protocol. Expectations aside, you must keep in mind that you are working with volunteers. You cannot order compliance -- you can only ask for cooperation.

When conducting a net using a repeater with a PL tone, don't forget to announce the PL tone! Valuable time can be lost trying to find it, and emergency messages could be waiting.

Probably the best way to enlist the cooperation of the net is to explain what you are doing in a calm and straightforward manner. This may involve supplying a small amount of real-time training. The one thing you must never do is criticize someone on the air. It is better to lead by example – it produces better results. If a problem persists, try to resolve it on the telephone or in person afterward.

Microphone Technique

Know how to use your microphone. The worst NCS operator is one that cannot be understood due to poor microphone technique.

Articulate, don't slur. If your natural speech is rapid-fire, you may want to train yourself to slow down a bit on the air.

Different microphones perform differently. Experiment to find the best microphone placement. Have another station listen while you make adjustments. There are no general rules that apply to all situations. If your microphone came with a manual, following its guidance is a good starting point, but you'll still want to experiment to find what works best for you. Have another station advise you on the best distance and angle from your mouth to the microphone, and the proper microphone gain setting. You may have to adjust your microphone technique to compensate for increased background noise – talking louder will likely cause over-modulation or distortion.

More Hints for Successful Operation:

Keep transmissions as short as possible without losing message clarity.

For voice nets, use only common, ordinarily understood words and standard “prowords” (procedure words). “Q” signals are only for CW or where there is a language barrier, and 10-codes are passé even for CB - most served agencies have abandoned codes in favor of plain language. Keep the net formal and professional, but friendly. An informal or casual style during an emergency net promotes sloppiness, and does little to impress served agencies.

If the net is a scheduled net, start on time! Tardiness indicates poor management and doesn’t inspire confidence in the NCS.

Use a script to promote clear and concise communication. Scripts can be used to open and close the net, and for periodic “housekeeping” announcements. If you don’t have a pre-printed script, take a moment to write one.

Frequently identify the name and purpose of the net. Advise listeners of the sub-audible squelch tone (CTCSS or DCS) required, if applicable. This can be part of your periodic “housekeeping” script.

If the net is an emergency operation, use your scripts to tell listeners where to find other nets, such as resource or specialized nets. In some cases, this may help prevent un-needed but well-meaning stations from checking-in just to offer their services, which distracts the net from its mission.

Be friendly, yet in control. Speak slowly and clearly with a calm, even, tone – not a monotone. Speak with confidence, even if you are inwardly nervous.

Acknowledge requests promptly and specifically so that net participants are not left wondering if they were heard or which one of several callers was recognized.

Ask specific questions – give specific instructions. This reduces the need for “repeats” and prevents confusion.

Have pencil and paper ready – write down ALL calls and tactical call signs. Practice writing down everyone’s calls when you are not the NCS.

Read your radio’s owner's manual and know your radio before an emergency occurs. Random fumbling with the knobs wastes valuable time and is very unprofessional.

When there is a "double" (i.e., when two or more stations transmit on the same frequency at the same time), listen to see if you can identify either station by call sign or by text. Then, ask all stations to stand by while you solicit clarification or repeats from each station involved, as needed.

During check-ins, recognize participants by their tactical call sign whenever possible—it helps to let everyone else know which stations are on the air and become familiar with what the tactical call signs are.

Don’t be afraid to ask for assistance if you need it. The net manager should be able to assist you or locate additional help. That is part of their job.

You will make mistakes. Acknowledging them will earn the respect and support of net members, but don't dwell on them.

NEVER think out loud. If you need a moment to consider what to do next, say something like "stand by" or "please wait" and un-key your microphone while you think.

Transmit only facts. If there is a real need to make an educated guess or to speculate, make it clear to others that it is only speculation and not fact.

Avoid becoming the source for general information about the event. If it is an emergency, refer event status questions to the proper public information net or to someone in charge of making announcements about the emergency incident. Avoid casual discussions about the served agency's response efforts on the air, since the press or the general public might be listening and take information out of context.

When necessary, use standard ITU phonetics. There is no such thing as "common spelling." Send all numbers as individual numbers, e.g., 334 is "three three four" not "three hundred thirty four."

Chapter 12
Net Manager (NM)

Introduction

The Net Manager has overall responsibility for the planning and operation of one or more nets. The Net Manager is generally appointed by and works with emergency telecommunication leadership to define the net's purpose, sets standards of operation, and communicates that information to net members.

Whether you have one net or a dozen, you need a Net Manager. You might ask, "Could the NCS (Net Control Station) operator do this job as well?" During an emergency, NCS operators might change every few hours. In addition, both jobs must be done simultaneously.

The NM may choose one or more assistants to take over when he or she needs a break, or to handle certain aspects of the net's operation, such as training. It is also the NM's responsibility to make sure that the NCS operators on the roster have received the proper training in the way nets should be conducted before appointing them as NCS.

During an emergency, "ad hoc" nets may be created to meet specific needs. These may either be assigned to the permanent NM, or to a temporary NM for the duration of the event. Those in such a position should be prepared in advance should this need arise and be trained in protocol of different types of nets, their purposes and how they should be conducted.

Duties

The Net Manager's duties include resource management and quality control. He/she makes certain that a NCS operator and alternate are assigned to each session, and that replacements are available for each shift. This person may also recruit net members for certain types of nets to ensure that delivery of messages is possible everywhere. The NM is also responsible for assigning regular liaison stations to move messages to and from other nets, although the NM may delegate this task to the NCS to handle on an ad hoc basis.

The nature of this job, like other leadership positions, demands excellent people and management skills. At times, the NM will need to work with a group of volunteers performing under stressful conditions. The NM's own operating and message handling skills should be superior so that the NM can help teach others and ensure that they are all properly trained before giving them an assignment.

The Net Frequency

In most cases, the Net Manager will choose the net's frequency(s). Scheduled and pre-planned nets usually operate on designated frequencies, but temporary nets often choose a frequency based on which bands and frequencies are available. HF nets that operate on a regular schedule will usually have less difficulty getting a clear frequency than those who

only operate when needed. Net frequencies on HF should always be listed as “plus or minus 5 kHz” to allow for interference.

One or more alternate frequencies should be chosen in advance, and should be known by all net members. In the case of VHF/UHF nets, alternate frequencies should be chosen for both repeaters as well as simplex frequencies since in an emergency, many repeaters may be off the air. In the event that interference or band conditions render the primary frequency unusable, net members should automatically switch to the alternate.

FM simplex nets should use a frequency that is seldom used by local hams for day-to-day conversations, and never on a national calling frequency.

Nets that use repeaters should make prior arrangements with the repeater’s owner. If a net uses a repeater as its primary meeting place, a backup simplex frequency should be chosen and publicized in the event the repeater fails. One way to do this is to give instructions that in the event of repeater failure, the first place to meet is the OUTPUT of the repeater. All NCS operators and responders must know and fully understand how to operate their individual radios so that they can adjust the offset for simplex duty.

Another ploy used by some emergency telecommunication units to provide a backup for their own repeater is to have an agreement with a local radio club to use their repeater in the event that the primary emergency telecommunication repeater fails during an emergency. This goes over very well if the emergency telecommunication unit also invites the radio club to use the primary emergency telecommunication repeater, if the radio club’s repeater goes down (during non-emergency periods). This win-win arrangement provides both organizations with a back up machine and fosters good relations.

Some Points for Net Managers to Remember:

-You are responsible for managing the net, but do so with tact and diplomacy. Teach net discipline by setting a good example, and take the net yourself from time to time to do so.

-Ensure that traffic on the net is handled in a timely manner. Do not let the net become too informal and waste time.

-Know your operators’ capabilities, and their locations, especially when you may need to go simplex and what their coverage range is, taking terrain and other factors into account. One way to gather such information is to organize periodic practice nets using simplex, in place of using the repeater. It is often surprising how many net members can be heard and can hear on simplex. Do not assume; you will never know unless you try it. A good practice exercise to keep operators sharp is to take the repeater out of service with no advance warning (just like it might during a true disaster) and find out how good your simplex coverage is.

-Know how and where your net fits into the overall net structure at all times, since the situation may change periodically. Working consistently with local emergency communications volunteers will help produce good results.

-Assign or identify liaison stations to move traffic from one net to the other(s).

-Assign an alternate NCS to stand by in case the primary NCS goes off the air.

-Get all the information you can (type of situation, needed station locations, potential shift lengths, frequencies, agency or agencies involved, etc.) before you put a net into service, but do not delay too long waiting for any single piece of information.

-Provide direction in the routing and handling of various types of messages. Determine the physical location of each served agency site early on to ensure proper routing.

-Monitor the net(s) to be sure proper procedures and message formats are being used.

-Training on proper net operation is crucial to success when a real emergency arises. A varied and interesting training schedule will help keep net members ready to go. The practice net on simplex mentioned previously is an interesting training session.

Chapter 13
Basic Message Handling

Introduction

Formal messages and informal messages are handled differently in various parts of the world. Readers are invited to inquire of experienced local and regional emergency telecommunication volunteers what the practice and procedures are for handling messages in their particular country or area. The following discussion is very general and is intended to simply introduce the subject of message handling.

Formal vs. Informal Messages

Both formal (written in a specific format) and informal (oral or written but not in a specific format) messages have their place in emergency communication. In general, informal messages are best used for non-critical and simple messages, or messages that require immediate action, those are delivered directly from the author to the recipient.

Formal messages are more appropriate when two or more people will handle them before reaching the recipient, or where the contents are critical or contain important details.

Informal Oral Messages

Some emergency messages are best sent informally in the interest of saving precious seconds. If you need an ambulance for a severely bleeding victim, you do not have time to compose and send a formal message. The resulting delay could cause the patient's death. Other messages do not require a formal written message because they have little value beyond the moment. Letting the net control station know where you are or when you will arrive need not be formal. The message is going directly to its recipient, is simple and clear, and has little detail. Many of the messages handled on a tactical net fit this description.

Formal Written Message Formats

Standardized written message formats are used so that everyone knows what to expect. This increases the speed and accuracy with which you can handle messages. Many volunteer emergency telecommunication organizations use a standard format used for passing messages on various nets. Regular practice with creating and sending messages in any standard format is recommended.

Components of a Standardized Message Format

The following components will be found in most types or versions of a standardized message:

The "**preamble**" sometimes referred to as "the header," consists of administrative data such as the message number, originating station, message precedence (importance) and date and

time of origination. The combination of the message number and the originating station serves as a unique message identifier, which can be traced if necessary.

The "**address**" includes the name, street address or post office box, city, state, and zip code of the recipient. The address should also include the telephone number with area code since many long distance Radiograms are ultimately delivered with a local phone call.

The "**text**" of the message should be brief and to the point, limited to 25 words or less when possible. The text should be written in lines of five words (ten if using a keyboard) to make it easier and faster to count them for the "check." Care should be taken to avoid word contractions, as the apostrophe is not used in CW. If a word is sent without the apostrophe, its meaning could be lost or changed. The contraction for "I will" (I'll) has a very different meaning when sent without the apostrophe! Contractions are also more difficult to understand when sent by phone, especially in poor conditions. Commas and other punctuation are also not used in formal messages. Where needed, the "period" can be sent as an "X" in CW and digital modes, and spoken as "X-RAY." The "X" may be used to separate phrases or sentences but never at the end of the text. Question marks are spelled out in text and spoken as "question mark," and sometimes as "query." Both the X and question mark should be used only when the meaning of the message would not be clear without them.

The "**signature**" can be a single name, a name and call sign, a full name and a title, "Mom and Dad," and occasionally a return address and phone number – whatever is needed to ensure that the recipient can identify the sender and that a reply message can be sent if necessary.

Sending a Message with Voice

When the receiving station is ready to copy, read the message at a pace that will allow the receiving station to write it down. Once you are done, if the receiving station has missed any portion of the message they will say, "say again all after____," "say all before," or "say again all between____ and ____."

In some nets, the practice is to say "break" and then unkey between sections of the message so that a station can ask for missing words to be repeated before going on (these repeated words are also known as "fills"). In many nets the entire message is read first before any fills are requested, to save time. Again, refer to your local practice for handling messages for guidance.

All numbers in groups are spoken individually, as in "three two one five," not "thirty-two fifteen," or "three thousand two hundred and five."

Time Savers

What NOT to say: When passing formal traffic, do not add unnecessary words. Since the parts of the header are always sent in the same order, there is no need to identify each of them. The only exception is the word "number" at the beginning of the header.

Message Handling Rules

Do not speculate on anything relating to an emergency! There may be hundreds of people listening to what you say (other Amateurs, and the media and general public using scanners) and any incorrect information could cause serious problems for the served agency or others. You do not want to be the source of any rumor. If your served agency requests an estimate, you can provide that information as long as you make it very clear that it is only an estimate when you send it. For example, saying "The estimated number of homes damaged is twelve" would be acceptable.

Pass messages exactly as written or spoken. Even more important than speed, your job as a communicator is to deliver each message as accurately as possible. Therefore, you must not change any message as you handle it. If it is longer than you would like, you must send it anyway. Apparently misspelled words or confusing text must be sent exactly as received. Only the original author may make changes.

Should you return a message to the author before first sending it if it seems incorrect or confusing? This is a judgment call. If the apparent error will affect the meaning of the message and the author is easily contacted, it is probably a good idea. Whenever possible, it is a good practice to read each message carefully in the presence of the author before accepting it. This way, potential errors or misunderstandings can be corrected before the message is sent.

Plain Text Lexicon for Tactical Communications

This lexicon is a subset of the lexicon is consistent with the Clear Text policy of the Incident Command System.

Word / Phrase	**Use for or to**
Affirmative	Yes
Available	Self-explanatory.
Available at residence	To indicate that you are at home and available for an assignment.
Can handle	To indicate that the equipment at hand is sufficient to handle to job.
Contact _____	Relay message to person indicated.
Copy, copies	Acknowledging message received and understood.
Disregard last message.	Self-explanatory.
Emergency Traffic	Gain control of the radio frequency to report an emergency.
Emergency Traffic Only	Used by Net Control or Net Supervisor to restrict all radio transmissions to an emergency in progress or a new incident.
Enroute	Proceeding to or responding to assignment.

Word / Phrase	**Use for or to**
ETA	Estimate time of arrival. Can be either a query as ”What is your ETA to ____?” or a statement as “My ETA to _____ is _____.”
Fire	Use to declare a fire emergency.
Go ahead	Indicates another ARES operator may transmit. E.G., “Go ahead St. John’s Shelter.”
How do you copy?	Signal report request.
In-service	An ARES operator can handle traffic at his/her assigned position.
Is _____ available for a phone call?	Self-explanatory.
Let me talk to _____	Use to engage traffic with a non-Ham.
Loud and clear	Signal reporting. Good signal strength (including full quieting), good, readable audio.
Negative	No
Out-of-contact	To indicate an ARES operator is on assignment but out of radio contact.
Out-of-service	An ARES operator at an assigned position cannot communicate due to equipment problems.
Repeat	Say your last message again.
Report on conditions	Self-explanatory.
Resume normal traffic	Used by Net Control or Net Supervisor to re-open the net to routine traffic.
Return to _____	Used by Net Control to direct operators back to the location specified.
Stand-by	Cease further transmissions and wait for queries, instructions, and so forth. From Net Control or station with whom you were communicating.
Stop transmitting	Self explanatory.
Uncovered	An ARES position lacking a radio operator.
Unreadable	Signal reporting: received signal is not clear. In most cases, try to add the specific trouble. E.G., “unreadable, background noise.”
What is your location?	Self-explanatory.

Chapter 14

Incident Command Systems

What is an ICS?

An Incident Command System (ICS) is a management tool designed to bring multiple responding agencies, including those from different jurisdictions, together under a single overall command structure. Before the use of the ICS became commonplace, various agencies responding to a disaster often fought for control, duplicated efforts, missed critical needs, and generally reduced the potential effectiveness of the response. Under ICS, each agency recognizes one "lead" coordinating agency and that person will handle one or more tasks that are part of a single over-all plan, and interact with other agencies in defined ways.

The term ICS is used in many countries but means different things dependent on the organization of their Emergency Services and how they are required to respond to a natural or man-made disaster. When building an emergency communications group in your own area, consideration should always be given to how Amateur Radio would integrate into the local systems. Groups who are not seen to be working with the system will not be allowed to work in the system. An emergency is not the time to be debating who is in charge.

Incident Command Systems are based upon simple and proven business management principles. In a business or government agency, managers and leaders perform the basic daily tasks of planning, directing, organizing, coordinating, communicating, delegating and evaluating. The same is true in an Incident Command System, but the responsibilities are often shared among several agencies. These tasks, or functional areas as they are known in the ICS, are performed under the overall direction of a single Incident Commander (IC) in a coordinated manner, even with multiple agencies and across jurisdictional lines. ICS' also feature common terminology, scalability of structure and clear lines of authority.

The Incident Commander

The initial IC is usually the most senior on-scene officer from the first responding agency. The IC is responsible for the management of the incident and starts the process by helping to set initial incident objectives, followed by an "Incident Action Plan" (IAP).

In a small incident, the IC may perform all the ICS functions without aid, but in a larger incident, he or she will usually delegate responsibilities to others. The IC still has overall responsibility for the incident, regardless of any duties delegated.

The persons filling certain ICS positions may change several times during an incident as the needs of the response change. For instance, in the early stages of a hazardous materials spill, the Incident Commander may be a fire department officer.

An ICS Structure: Common Themes

Flexible and modular organization

Operating sections may be scaled up or down, depending on the needs of the situation. In a small, single agency response, the IC may handle many or all functions. As the size and complexity of a response increase, and as other agencies become involved, the various tasks can be re-assigned and sub-divided. For instance, if the only responding agency is the fire department, communications will be handled according to existing department policies. If the incident expands, more agencies become involved and other communication assets are required. This is where Amateur Radio may be called upon and needs to know the structure it is working within.

Unity of command

Each individual participating in the operation reports to only one supervisor. This eliminates the potential for individuals to receive conflicting orders from a variety of supervisors, thus increasing accountability, preventing freelancing, improving the flow of information, helping with the coordination of operational efforts, and enhancing operational safety. This concept is fundamental to the ICS chain of command structure.

Common terminology

Individual response agencies previously developed their protocols separately, and subsequently developed their terminology separately. This can lead to confusion as a word may have a different meaning for each organization.

When different organizations are required to work together, the use of common terminology is an essential element in team cohesion and communications, both internally and with other organizations responding to the incident.

An incident command system promotes the use of a common terminology and has an associated glossary of terms that help bring consistency to position titles, the description of resources and how they can be organized, the type and names of incident facilities, and a host of other subjects. The use of common terminology is most evident in the titles of command roles, such as *Incident Commander*, *Safety Officer* or *Operations Section Chief.*

Management by objective

Incidents are managed by aiming towards specific objectives. Objectives are ranked by priority; should be as specific as possible; must be attainable; and if possible given a working time-frame. Objectives are accomplished by first outlining strategies (general plans of action), then determining appropriate tactics (how the strategy will be executed) for the chosen strategy.

Span of control

To limit the number of responsibilities and resources being managed by any individual, an ICS would normally require that any single person's span of control should be between three and seven individuals, with five being ideal. In other words, one manager should have no more than seven people working under them at any given time. If more than 7 resources are being managed by an individual, then they are being overloaded and the command structure needs to be expanded by delegating responsibilities (e.g. by defining new sections, divisions, or task forces). If fewer than three, then the position's authority can probably be absorbed by the next highest rung in the chain of command.

How Does an Emergency Communications Group "Fit Into" The ICS

Involvement in any incident where ICS is used is by "invitation only"—there is no role for off- the-street volunteers. The relationship of an emergency communications group to the ICS structure will vary with the specific situation. If your group is providing internal communication support to only one responding agency, and has no need to communicate with other agencies that are part of the ICS, you may not have any part in the ICS structure itself except through your served agency.

In certain situations, an emergency communications group might serve one or more agencies simultaneously. As the responsibility for managing the incident shifts from one agency to another, the emergency communications group's mission may shift to assisting the new lead agency, or simply end. In some cases, your group might begin by supporting your own served agency, and end up supporting a new and unfamiliar agency. The choice of whether to use your emergency communications group's services may be made by the served agency or Incident Commander, depending on the specific situation and the degree of ICS structure in use.

It is important for a less experienced emergency telecommunication volunteer to discuss the incident command system that is used in their local area or their own country and become familiar with the basic structure and functioning of that command system.

Chapter 15
Preparing for Deployment

Prepared for What?

Remember the Boy Scout motto, "Be Prepared"? Nearly one hundred years ago, a young British Boy Scout asked Sir Robert Baden-Powell, the founder of Scouting, what exactly it was he should be prepared for. Baden-Powell's famous answer was, "Why, for any old thing, of course!"

The same should be true of emergency telecommunication volunteers. You never know which challenges an emergency situation will offer. You might have ac power, or just the batteries you bring along. Safe drinking water may be available, or you may have only your canteen.

Sometimes you can find out in advance what sort of conditions are likely for your assignment, but many times no one will know— particularly during the early stages of an emergency.

Being prepared for an emergency communication deployment involves a wide range of considerations, including radio equipment, power sources, clothing and personal gear, food and water, information, and specialized training. No two deployments are the same, and each region or country offers its own specific challenges.

Jump Kits

The last thing you should need to do when a call for assistance comes is think of and locate all the items you might need. Any experienced emergency responder knows how important it is to keep a kit of the items they need ready to go at a moment's notice. This is often called a "jump kit" or "go kit." Without a jump kit, you will almost certainly leave something important at home, or bring items that will not do the job. Gathering and packing your equipment at the last moment also wastes precious time. It is important to think through each probable deployment ahead of time, and the range of situations you might encounter.

Here are a few basic questions you will need to answer:

-Which networks will you need to join, and which equipment will you need to do so?

-Will you need to be able to relocate quickly, or can you bring a ton of gear?

-Will you be on foot, or near your vehicle?

-Is your assignment at a fixed location or will you be mobile?

-How long might you be deployed—less than 48 hours, or even a week or more?

-Will you be in a building with reliable power and working toilets, or in a tent away from civilization?

-What sort of weather or other conditions might be encountered?

-Where will food and water come from?

-Are sanitary facilities available?

-Will there be a place to sleep?

-Do you need to plan for a wide variety of possible scenarios, or only a few?

-Can some items do "double duty" to save space and weight?

Other questions may occur to you based on your own experience. If you are new to emergency telecommunication or the area, consult with other members of your group for their suggestions.

Most people seem to divide jump kits into two categories: one for deployments under 24 hours, and one for up to 72 hours. For deployments longer than 72 hours, many people will just add more of the items that they will use up, such as clothing, food, water and batteries. Others may add a greater range of communication options and backup equipment as well.

Jump Kit Idea List

-Something to put it in—one or more backpacks, suitcases, plastic storage tubs, etc.
-Package individual items in zip-lock bags or plastic kitchen containers

Radios and Accessories:

-Hand-held VHF or hand-held dual-band radio (some people also like to bring a spare)
-Spare rechargeable batteries for handhelds
-Alkaline battery pack for handhelds
-Alkaline batteries
-Speaker-mic and earphone for handhelds
-Battery chargers, AC and DC for handhelds
-Mobile VHF or dual-band radio (and a spare)
-HF radio
-Multi-band HF antenna, tuner, heavy parachute cord or nylon mason's twine
-VHF/UHF gain antennas and adapters (roll-up J-Pole, mobile magnetic mount)
-Coaxial feedlines, jumpers
-Ground rod, pipe clamp and wire (tools to drive ground rod)
-AC power supplies for VHF/UHF mobile and HF radios, accessories
-Large battery source for VHF/UHF mobile and HF radios, with charger
-All related power, data, audio and RF cables and adapters
-Small repair kit: handtools, multi-meter, connectors, adapters, fuses, keyparts
-Materials for improvisation: wire, connectors, small parts, insulators, duct tape

-Flashlight and spare batteries or hand crank LED flashlight
-Photocopies of manuals for all equipment
-Headphones, for noisy areas and privacy with proper connector, adaptors
-Specialized gear for packet, ATV or other modes
-Multi-band scanner, weather radio
-Personal cellphone, pager, spare batteries and chargers
-Pencils, writing pads, pencil sharpener

Personal Gear:

-Portable field shelter (tents, tarps, tables, chairs, battery/gas lights) in plastic storage tubs
-Clothing for the season, weather, and length of deployment
-Toilet kit: soap, razor, deodorant, comb, toiletpaper
-Foul-weather or protective gear, warm coats, hats, etc. as needed
-Sleeping bag, foam pad, pillow, earplugs
-High-energy snacks
-Easily prepared dried foods that will store for long periods
-Eating and cooking equipment if needed
-Water containers, filled before departure
-First aid kit, personal medications and prescriptions for up to one week
-Money, including a large quantity of coins for vending machines, tolls, etc.
-Telephone calling card

Information:

-ID cards and other authorizations
-Copy of Amateur Radio license
-Frequency lists and net schedules
-Maps, both street and topographic
-Key phone numbers, e-mail and Internet addresses
-Contact information for other members in your emergency telecommunication group
-Copy of emergency plans
-Resource lists: who to call for which kinds of problems
-Operating Supplies
-Pre-printed message forms
-Log sheets or books
-Standard forms used by the served agency
-Letter or A4 size notepads
-Stickynotes
-Paper clips and rubber bands
-Blank envelopes
-Stapler, spare staples

Sub-Dividing Your Kits

You may want to divide your jump kit into smaller packages. Here are some ideas:

-Quick deployment kit: hand-held radio kit, personal essentials, in a large daypack
-VHF/UHF, HF kits for fixed locations

-Accessory and tool kit
-Emergency power kit
-Short and long term personal kits in duffel bags
-Field kitchen and food box in plastic storage tubs

You may not want to pre-pack some items for reasons of expense or shelf life. Keep a checklist of these items in your jump kit so that you will remember to add them at the last minute.

Pre-Planning

When the time comes, you need to know where to go, and what to do. Having this information readily available will help you respond more quickly and effectively. It will not always be possible to know these things in advance, particularly if you do not have a specific assignment.

Answering the following basic questions may help.

-Which frequency should you check in on initially?
-Is there a "backup" frequency?
-If a repeater is out of service, which simplex frequency is used for the net?
-Which nets will be activated first?
-Should you report to a pre-determined location or will your assignment be made as needed? Learn about any place to which you will likely be deployed to familiarize yourself with its resources, requirements and limitations. For instance, if you are assigned to a particular shelter, you might ask your emergency telecommunication superiors to schedule a visit, or talk to others who are familiar with the site.
-Will you need a long antenna cable to get from your operating position to the roof?
-Are antennas or cables permanently installed, or will you need to bring your own?
-Will you be in one room with everyone else, or in a separate room?
-Is there dependable emergency power to circuits at possible operating positions?
-Does the building have an independent and dependable water supply?
-Is there good cell phone coverage inside the building?
-Can you reach local repeaters reliably with only a rubber duck antenna, or do you need a more efficient antenna or one with gain?
-If the repeaters are out of service, how far can you reach on a simplex channel?
-Will you need an HF radio to reach the net? If you will be assigned to an emergency operations center, school, hospital or other facility with its own radio system in place, learn under what conditions you will be required or able to use it, where it is and how it works. In addition to radios, consider copiers, computers, fax machines, phone systems and other potentially useful equipment. Consider escape routes. If you could be in the path of a storm surge or other dangerous condition, know all the possible routes out of the area. If you will be stationed in a large building such as a school or hospital, find the fire exits, and learn which parking areas will be the safest for your vehicle.

Training & Education

If a served agency offers emergency telecommunication volunteers job-specific training in areas related to communication, take it. Your emergency telecommunication managers should help you to learn how the served agency's organization works. Learn their needs and how

you can best meet them. Work within your own emergency telecommunication organization to get any additional training or information you might need. Many emergency management agencies or national governments offer additional training in areas such as radiological monitoring, sheltering, mass casualty response and evacuation.

Your own group may offer general or agency-specific training in message handling and net operations under emergency conditions. If your group has its own equipment, it should offer opportunities for members to become familiar with its setup and operation in the field.

On your own, set up and test your personal equipment under field conditions to be sure it works as expected.

Participate in any drills or exercises offered in your area. Some are designed to introduce or test specific skills or systems, others to test the entire response.

Chapter 16
Emergency Communication Radio Equipment Choices

Transceivers: VHF/UHF

The most universal choice for emergency telecommunications is a dual band FM 35-50 watt mobile transceiver. Radios in this class are usually rugged and reliable, and can operate at reasonably high duty cycles, although an external cooling fan is always a good idea if one is not built-in.

Handheld transceivers should be used only when extreme portability is needed, such as when "shadowing" an official or when adequate battery or other dc power is not available. Handheld radios should not be relied upon to operate with a high duty-cycle at maximum power, since they can overheat and fail.

Both portable and mobile dual-band radios can be used to monitor more than one net, and some models allow simultaneous reception on more than one frequency on the same band (Sometimes known as "dual watch" capability). Some mobiles have separate external speaker outputs for each band. For high traffic locations, such as a Net Control or an emergency operations center, a separate radio for each net is a better choice since it allows both to be used simultaneously by different operators. (Antennas must be adequately separated to avoid "de-sensing.")

Many dual-band transceivers also offer a "cross-band repeater" function, useful for linking local portables with distant repeaters, or as a quickly deployable hilltop repeater. True repeater operation is only possible if all other mobile and portable stations have true dual-band radios. Some so-called "dual" or "twin" band radios do not allow simultaneous or cross-band operation—read the specifications carefully before you purchase one.

Transceivers: HF

Operation from a generator equipped emergency operations center can be done with an AC powered radio, but having both ac and dc capability ensures the ability to operate under all conditions. Most 12 Volt HF radios fall in either the 100-watt or QRP (less than 5 watts) categories. Unless power consumption is extremely important, 100-watt variable output radios should be used. This gives you the ability to overcome noise at the receiving station by using high power, or to turn it down to conserve battery power when necessary.

Do not use DC to AC inverters to power HF radios. Most use a high-frequency conversion process that generates significant broad-spectrum RF noise at HF frequencies that is difficult to suppress. Direct dc powering is more efficient in any case.

Voltage Tolerance and Current Drain

Some transceivers nominally powered using 12 volts DC actually have a rather narrow range of voltage (e.g., 13.0 to 13.8 volts) over which they will operate properly, and even a high-

quality battery part way through its discharge cycle can easily fall below such a tolerable range. Transceivers with a wide range of acceptable input voltages (e.g., 11.5 to 15 volts) are preferable in limited-power situations; they will keep operating as the external battery discharges.
Similarly, some transceivers draw much more power than others during receive. If your chosen rig has a current drain on the high side, look for menu settings that will lower the overall drain, especially if you will be operating from a limited power source.

Radio Receiver Performance

For radios on all bands, several aspects of a radio receiver's performance can affect its suitability for emergency telecommunication. These include sensitivity (ability to receive weak signals), selectivity (ability to reject signals on adjacent frequencies) and intermodulation rejection (ability to prevent undesired signals from mixing within the receiver and causing interference). If you are inexperienced at comparing radio specifications, be sure to ask for guidance from another, more experienced, ham.

When operating near public service and business radio transmitters, an FM receiver's "intermodulation rejection" is important. Mobile radios generally have better intermodulation rejection than handheld radios, but you should review each individual radio's specifications. External intermodulation (band pass) filters are available, but they add to the expense, complexity, size and weight of the equipment. Bandpass filters will also prevent you from using a broadband radio to monitor public service frequencies.

Some older "ham bands only" FM mobile radios have better front-end filtering than newer radios with broadband receive capability, making them more immune to intermodulation and adjacent channel interference. Receiver filters are important for effective HF operation. Choose appropriate filters for the types of operations you are most likely to use, including CW, RTTY and phone.

Digital Signal Processing (DSP) may be the single most important filtering feature available. Internal or external DSP circuits can allow clear reception of signals that might not otherwise be possible in situations with heavy interference.

"Noise blankers" are used to reduce impulse noise from arcing power lines, vehicle and generator ignition systems, and various other sources. While most all HF radios have some form of noise blanker, some work better than others. Test your radio in suitably noisy environments before designating it for emergency telecommunication use.

VHF/UHF ANTENNAS

A good antenna, mounted as high as possible without incurring large feedline losses, is more important than high transmitter power. Not only does it provide gain to both the transmitter and receiver, but a higher gain antenna may also allow output power to be reduced, thus prolonging battery life. In relatively flat terrain, if possible use a mast-mounted single or dual-band antenna with at least 3dBd gain.

If you are operating in a valley, the low angle of radiation offered by a gain antenna may actually make it difficult to get a signal out of the valley. Low or "unity" gain antennas have "fatter" radiation lobes and are better suited for this purpose. Unity gain J-poles are rugged,

inexpensive and easily built. For directional 2-meter coverage with about 7-dBd gain, a three or four element Yagi can be used. Collapsible and compact antennas of this type are readily available. For permanent base station installations, consider a more rugged commercial 2-way collinear antenna. Most 2- meter versions will also perform well on 70cm. Commercial open dipole array antennas will work well for a single band, and are more rugged than a fiberglass radome encased collinear antenna.

A magnetic mount mobile antenna is useful for operating in someone else's vehicle. They can also be used indoors by sticking them to any steel surface, such as filing cabinets, beams or ductwork, even up-side down.

Hand-held radio antennas, known as "rubber duckies," have negative gain. Use at least a ¼ wave flexible antenna for most operations, and consider a telescoping 5/8-wave antenna for long- range use in open areas where the extra length and lack of flexibility will not be a problem.

"Roll-up J-pole" antennas made from 300 ohm twin-lead wire can be tacked up on a wall or hoisted into a tree with heavy-duty string. In addition to unity gain, the extra height can make a big difference. Even a mobile 1/2 wave magnetic mount antenna can be used with hand-helds when necessary.

HF ANNTENNAS

There is no single perfect antenna for HF operation. Your choice depends on the size and terrain of the area you need to cover, and the conditions under which you must install and use it.

For local operations (up to a few hundred kilometers), a simple random wire or dipole hung at a less than 1⁄4 wavelength above the ground works well and is easy to deploy. This is known as a "Near Vertical Incidence Skywave" (NVIS) antenna. The signal is radiated almost straight up and then bounces off the ionosphere directly back downward. During periods of high solar activity, NVIS propagation works best on 40 meters during the day, switching to 80 meters around sunset. During low parts of the sunspot cycle, 80 meters may be the most usable daytime NVIS band, and 160 meters may be needed at night. The new 60-meter band available in many parts of the world is also ideal for NVIS operation.

An antenna tuner is necessary for most portable wire antennas, (especially for NVIS antennas), and is a good idea for any HF antenna. The antenna's impedance will vary with its height above ground and proximity to nearby objects, which can be a real problem with expedient installations. An automatic tuner is desirable, since it is faster and easier to use, and many modern radios have one built in. Include a ground rod, clamps and cable in your kit since almost all radios and tuners require a proper ground in order to work efficiently.

For communication beyond 300 kilometers, a commercial trapped vertical may work, although it has no ability to reject interfering signals from other directions. Mobile whip antennas will also work, but with greatly reduced efficiency. The benefits of a mobile antenna are its size and durability.

Directional (beam) antennas offer the best performance for very wide area nets on 10 to 20 meters, since they maximize desired signals and reduce interference from stations in other

directions. This ability may be critical in poor conditions. Beam antennas also have a number of limitations that should be considered. They are usually expensive, large, and difficult to store and transport. In field installations, they can be difficult to erect at the optimum height, and may not survive storm conditions. One strategy is to rely on easily installed and repaired wire dipole antennas until conditions allow the safe installation of beam antennas.

On HF, the choice between coaxial cable and commercial (insulated—not bare wire) "ladder" line will depend on your situation. Ladder line offers somewhat lower loss but more care must be taken in its routing, especially in proximity to metal objects, or where people might touch it. Coaxial cable is much less susceptible to problems induced by routing near metal objects or other cables.

Operating Accessories

Headphones are useful anywhere, and are mandatory in many locations. Operators in a Command Post where multiple radios are in use must use headsets. They are also beneficial in locations such as Red Cross shelters, to avoid disturbing residents and other volunteers trying to get some rest.

Some radios and accessory headsets provide a VOX (voice operated transmit) capability. During emergency telecommunication operations this should always be turned off and manual "push-to-talk" buttons used instead. Accidental transmissions caused by background noise and conversations can interrupt critical communications on the net. As an alternative to VOX, consider using a desk or boom microphone and foot switch to key the transmitter. A microphone/headset combination and foot switch also works well.

Batteries

Battery power is critical for emcom operations. AC power cannot usually be relied upon to be available for any purpose, and portable operation for extended periods is common. Batteries must be chosen to match the maximum load of the equipment, and the length of time that operation must continue before they can be recharged.

NiCad, NiMH and Li-Ion: For handheld transceivers, the internal battery type is determined by the manufacturer. NiMH batteries store somewhat more energy than NiCad batteries for their size. Many smaller radios are using Lithium Ion (LIon) batteries, which have much higher power densities, without the so-called "memory effect" of NiCads. Many handhelds have optional AA alkaline battery cases, and are recommended emcom accessories. Common alkaline batteries have a somewhat higher power density than NiCad batteries, are readily available in most stores and may be all you have if you cannot recharge your other batteries. Most handheld radios will accept an external 13.8Vdc power connection for cigarette lighter or external battery use.

External batteries of any type can be used with a handheld, as long as the voltage and polarity are observed. Small 12-15 volt gel cells and some battery packs intended for power tools and camcorders are all possibilities. For maximum flexibility, build a DC power cable for each of your radios, with suitable adapters for each battery type you might use. Molex plugs work well for power connections, but Anderson power poles can withstand repeated plugging and unplugging without deterioration.

National standardization within a country or region allows easier swapping and sharing of equipment if needed. You should check with experienced emergency telecommunication volunteers in your area to determine the standard connector used. If there is no standard, encourage your fellow emergency telecommunication operators to adopt one.

Lead Acid

There are three common types of lead-acid batteries: flooded (wet), VRLA (Valve Regulated Lead Acid), and SLA (Sealed Lead-Acid). Wet batteries can spill if tipped, but VRLA batteries use a gelled electrolyte or absorptive fiberglass mat (AGM technology) and cannot spill. SLA batteries are similar to VRLA batteries, but can be operated in any position—even up-side down. All lead-acid batteries are quite heavy.

Lead acid batteries are designed for a variety of applications. "Deep-cycle" batteries are a better choice than common automotive (cranking) batteries, which are not designed to provide consistent power for prolonged periods, and will be damaged if allowed to drop below approximately 80% of their rated voltage. Deep cycle batteries are designed for specific applications and vary slightly in performance characteristics. For radio operation, the best choice would be one specified for UPS (uninterruptible power source) or recreational vehicle (RV) use. For lighting and other needs, a marine type battery works well. For best results, consult the manufacturer before making a purchase.

Sealed lead acid (SLA) or "gel cells," such as those used in alarm or emergency lighting systems, are available in smaller sizes that are somewhat lighter. These batteries are also the ones sold in a variety of portable power kits for Amateur Radio and consumer use. Typical small sizes are 2, 4, and 7Ah, but many sizes of up to more than 100Ah are available. SLA batteries should never be deeply discharged. For example, a 12 volt SLA battery will be damaged if allowed to drop below 10.5 volts. Excessive heat or cold can damage SLA batteries. Storage and operating temperatures in excess of 75 degrees F. or below 32 degrees F. will reduce the battery's life by half. Your car's trunk is not a good place to store them. Storage temperatures between 40 and 60 degrees will provide maximum battery life.

Battery "Power Budgeting"

The number of ampere/hours (Ah—a rating of battery capacity) required, called a "power budget," can be roughly estimated by multiplying the radio's receive current by the number of hours of operation, and then adding the product of the transmit current multiplied by the estimated number of hours of transmission and by the duty cycle for that mode. For a busy net control station, the transmit current will be the determining factor because of the high percentage of transmit time. For low-activity stations, the receiver current will dominate. The value obtained from this calculation is only a rough estimate of the ampere/hours required. The Ah rating of the actual battery or combination of batteries should be up to 50% higher, due to variations in battery capacity and age.
Don't confuse the percent of time transmitting with "duty cycle," which is mode-specific (e.g., 100% for FM and digital, 50% for CW and 30% for uncompressed SSB).

Battery Chargers

You should have two or more batteries so that one can be charging while another is in use.

NiCad and NiMH batteries

The type of charger required depends on the battery—for instance; most NiCad chargers will also charge NiMH, but not Li-Ion batteries. Several aftermarket "universal" chargers are available that can charge almost any battery available. A rapid-rate charger can ensure that you always have a fresh battery without waiting, although rapid charging can shorten a battery's overall lifespan.

Lead-acid batteries

Always consult the battery's manufacturer for precise charging and maintenance instructions, as they can vary somewhat from battery to battery. It is best to slow-charge all batteries, since this helps avoid over-heating and extends their over-all life span.
In general, automotive and deep cycle batteries can be charged with an automobile and jumper cables, an automotive battery charger, or any constant-voltage source. If a proper battery charger is not available, any DC power supply of suitable voltage can be used, but a heavy-duty isolation diode must be connected between the power supply and the battery. (This is important, since some power supplies have a "crowbar" overvoltage circuit, which short-circuits the output if the voltage exceeds a certain limit. If a battery is connected, the crowbar could "short-circuit" the battery with disastrous results.) The output voltage of the supply must be increased to compensate for the diode's voltage drop. Take a measurement at the battery to be sure.

Wet Batteries

These should be charged at about 14.5 volts, and VRLA batteries at about 14.0 volts. The charging current should not exceed 20% of the battery's capacity. For example, a 20- amp charger is the largest that should be used for a battery rated at approximately 100 Ah. Consult the battery's manufacturer for the optimum charging voltage and current whenever possible.

Deep cycle batteries do not normally require special charging procedures. However, manufacturers do recommend that you use a charger designed specifically for deep cycle batteries to get the best results and ensure long life.

SLA or "gel- cell": Gel-Cell batteries must be charged slowly and carefully to avoid damage. All batteries produce hydrogen gas while recharging. Non-sealed batteries vent it out. SLA batteries do what is called "gas recombination." This means that the gas generated is "recombined" into the cells. SLA batteries actually operate under pressure, about 3 psi. for most. If the battery is charged too quickly, the battery generates gas faster than it can recombine it and the battery over-pressurizes. This causes it to overheat, swell up, and vent, and can be dangerous and will permanently damage the battery. The charging voltage must be kept between 13.8 and 14.5 volts. Wherever possible, follow the battery manufacturer's instructions. Lacking these, a good rule of thumb is to keep the charging current level to no more than 1/3 its rated capacity. For example, if you have a 7Ah battery, you should charge it at no more than 2 amps.

The time it takes for a SLA battery to recharge completely will depend on the amount of charge remaining in the battery. If the battery is only 25% discharged then it may recharge in a few hours. If the battery is discharged 50% or more, 18-24 hours may be required.

Solar panels and charge controllers

These are readily available at increasingly lower costs. These provide yet another option for powering equipment in the field when weather and site conditions permit their use. When choosing solar equipment, consult with the vendor regarding the required size of panels and controller for your specific application.

DC to AC inverters

While direct DC power is more efficient and should be used whenever possible, inverters can be used for equipment that cannot be directly powered with 12VDC. Not all inverters are suitable for use with radios, computers or certain types of battery chargers. The best inverters are those with a “true sine-wave” output. Inverters with a “modified sine-wave” output may not operate certain small battery chargers, and other waveform-sensitive equipment. In addition, all “high-frequency conversion” inverters generate significant RF noise if they are not filtered, both radiated and on the ac output. Test your inverter with your radios, power supplies and accessories (even those operating nearby on dc) and at varying loads before relying upon it for emergency telecommunication use.

Effective filtering for VHF and UHF can be added rather simply (using capacitors on the DC input, and ferrite donuts on the AC output), but reducing HF noise is far more difficult. Inverters should be grounded when in operation, both for safety and to reduce radiated RF noise.

As an alternative to an inverter, consider a mid-sized 12V computer UPS (uninterruptible power source). Smaller, square-wave UPS units are not designed for continuous duty applications, but larger true sine-wave units are. Most true sine-wave units use internal batteries, but with minor modifications can be used with external batteries. The larger commercial UPS units run on 24 or 48 volts, and require two or four external batteries in series. UPS units will have a limit on the number of depleted batteries they can re-charge, but there is no limit to the number of batteries that can be attached to extend operating time.

Generators are usually required at command posts and shelters for lighting, food preparation and other equipment. Radio equipment can be operated from the same or a separate generator, but be sure that co-located multiple generators are bonded with a common ground system for safety. Not all generators have adequate voltage regulation, and shared generators can have widely varying loads to contend with. You should perform a test for regulation using a high-current power tool or similar rugged device before connecting sensitive equipment. A voltmeter should be part of your equipment any time auxiliary power sources are used.

Noise levels can be a concern with generators. Some are excessively noisy and can make radio operations difficult and increase fatigue. A noisy generator at a shelter can make it difficult for occupants to rest, and can result in increased levels of stress for already stressed people. Unfortunately, quieter generators also tend to be considerably more expensive. Consider other options such as placing the generator at a greater distance and using heavier power cables to compensate. Placing a generator far from a building can also prevent fumes from entering the building and causing carbon monoxide poisoning, an all-too-common problem with emergency generators.

Several other devices may be helpful when dealing with generators or unstable AC power sources. High quality surge suppressors, line voltage regulators and power conditioners may help protect your equipment from defective generators. Variable voltage transformers ("Variacs") can be useful to compensate for varying power conditions.

Equipment for Other Modes

If you plan to operate one of the digital modes (packet, APRS, AMTOR, PSK31, etc), then you will also need a computer and probably a TNC or computer sound card interface. Some newer radios have built-in TNCs. Be sure to identify all the accessories, including software and cables, needed for each mode. Include the power required to operate all of the radios and accessories when you are choosing your batteries and power supply. The internal battery in your laptop computer will probably not last long enough for you to complete your shift. Be prepared with an external DC power supply and cable, or a DC to AC inverter. If you need hard copy, then you will also need a printer, most of which are AC powered.

Scanners and Other Useful Equipment

In addition to your Amateur Radio equipment, you may find a few other items useful.

-Multi-band scanning radio (to monitor public service and media channels)

-Cellular telephone (even an unregistered phone can be used to call emergency services)

-Portable cassette tape recorder with VOX (for logging, recording important events)

-AM/FM radio (to monitor media reports)

-Portable television (to monitor media reports)

-Laptop computer with logging or emcom-specific packet software

Testing the Complete Station

After making your equipment selection (or beforehand if possible), field test it under simulated disaster conditions. Simulated emergency operations can add the element of multiple, simultaneous operations on several bands and modes over an extended period. Try to test all elements of your system together, from power sources to antennas, and try as many variations as possible. For instance, use the generator, and then switch to batteries. Try charging batteries from the solar panels and the generator. Use the NVIS antenna while operating from batteries and then generator. This procedure will help reveal any interactions or interference between equipment and allow you to deal with them now—before proper operation becomes a matter of life and death.

Chapter 17
Emergency Activation

How Will I know?

The actual method by which emergency telecommunication volunteers are notified of activation will be determined locally, but this lesson outlines some of the most popular methods. To begin with, you must be registered with a local emergency telecommunication group in advance in order to be on their notification list. "Last minute" volunteers are extremely difficult to integrate into an already confusing emergency response. Join the group well in advance of any emergency, get any training they offer, and be ready when a call comes.

Every emergency telecommunication group should have developed a formal, written plan with any of its served agencies to activate their members when needed. The plan should be developed in detail and then reduced to a simple "checklist" that both served agency officials and emergency telecommunication managers can keep nearby at all times. It should detail the circumstances under which emergency telecommunication activation might occur, who will call whom, and the various methods that can be used to contact them. The checklist can also list the actual telephone numbers and other contact information for each individual listed in the order that it is to be used. This information should be verified and updated on a regular schedule. Each member should know the plan and follow it closely.

Initial Notification by a Served Agency

It is a good practice to have three or more members serve as "activation liaisons" to any served agency. When the emergency telecommunication volunteers are needed, it is one of these members who is called first. **Never rely on a single point of contact.** If that person is unavailable for any reason, the served agency should have one or more alternatives to try. They may be called by phone at work or at home or on their cell phone. Any served agency should have all possible telephone numbers, including fax and mobile, and even e-mail addresses.

Group Alerting Systems

Once a liaison has been notified, a number of group alerting methods may be used. The most common ones are described below. No one method should be relied upon, since emergency conditions may render it useless. Commercial paging systems and ham repeaters might be off the air, phone lines down, and Internet service disrupted. Again, a written plan and checklist should be developed well in advance, and updated periodically.

Telephone Tree: In this system, the liaison calls two members, who each call two other members and so on until the entire group has been notified. If any one person cannot be reached, the person calling must then call the members that person would have called had they been reached. This method insures that the "tree" is not broken. Messages should always be left on all answering machines and voice mailboxes.

Text Messaging: Even when voice cell phone systems are overloaded, there may be text messaging capabilities. Depending on your cell phone, it may be possible to create lists of

contacts and quickly send text messages to each person on the list. Recognize, however, that text messages sent over cellular phone systems can be delayed for several hours or more in times of heavy use.

Paging: Some groups use a two- tone, POCSAG (digital), or similar paging signal on a local Amateur repeater with wide coverage, activating commercial voice or digital pagers that have been modified to monitor the repeater's frequency.

A low-cost method of "paging" a group using an Amateur repeater uses a specific Continuous Tone Coded Squelch System (CTCSS) tone. Members leave their radios turned on in the "CTCSS decode" mode when they are not actively listening to the repeater. When the correct CTCSS tone is turned on for emergency telecommunication activation, everyone can hear the transmissions.

Since many newer radios include CTCSS decoding as a standard feature or low-cost option, this method is generally simple to implement. The tones may need to be generated by the repeater itself, since many repeaters will not "pass through" received tones. If the repeater is not operating, a mobile operating simplex on the repeater's output frequency from a high or central location can often work quite well.

E-mail: While e-mail might not immediately reach members anywhere they happen to be, it is a good backup method as long as it continues to function. Many people have full time high-speed Internet connections at home and the office, and most people check their e-mail frequently. Someone who has otherwise been unreachable may check their e-mail even several hours later, just as they might check an answering machine or voicemail box.

Self-Activation: If you become aware of an incident or situation that might require the activation of your emergency telecommunication group, you should take immediate steps to make yourself available. Depending on your group's activation plan, this might mean monitoring the assigned net or served agency frequencies, or making contact with one or more appropriate persons in the emergency telecommunication group or served agency. Remember, if you are not specifically authorized to directly contact served agency personnel or travel to an incident location, do not do it. Know your plan and follow it.

I Have Been Notified—Now What?

Your group's activation plan should tell each member what steps to take immediately after learning of emergency telecommunication activation. In most cases, the first step should be to check in on a specific frequency or repeater. If a repeater is used as the primary gathering point for members, a back-up simplex frequency (the repeater's output frequency works well) should be specified in the event that the repeater is no longer operating. In other cases, some members may also have specific assignments. These might include making contact with the served agency, going directly to a specific location such as a command center, or making certain preparations. These members should quickly check into the "activation" net to let emergency telecommunication managers know that they have been reached and are responding.

One of the liaison stations should be available on the net to provide additional information from the served agency and directions to members as they check in. If a member is pre-assigned to act as NCS for the "activation" net, that person should take over the task as soon

as possible to free up the liaison to work with the served agency or take other action. Some groups simply have the first person signing on act as a temporary NCS until an assigned NCS checks in. Again, it is important to have more than one person assigned to take on the NCS duties in the event that anyone is unavailable.

En Route

While you are headed home to pick up your jump kit or other gear, or while you are on your assigned location, there are several things you may need to do. Check into and continue to monitor the activation net for further information or instructions. Fill your vehicle with fuel and pick up any supplies you may need, including alkaline batteries for radios and lights, food, water, and other supplies on your checklist. Contact your spouse, children or other family members to let them know what is happening and where you will be. Give them any instructions they will need to be safe. Tell them when you will next try to contact them, and how to contact you if necessary. Knowing that everyone is OK can let you do your job without needless worry, and, of course, the same is true for them.

Chapter 18
Setting Up, Operations and Shutting Down

Responding After the Activation

If you already have your assignment, confirm that it is being activated by monitoring and checking into the local activation net. If you do not have a standing assignment, you should check into an activation net and make yourself available for an assignment. It might be a "resource" logistics net if one is active, or the general "tactical" command activation net. (Since local procedures vary widely, you should get to know your group's specific plans and procedures well in advance.)

After you have gathered your equipment and supplies, filled the gas tank and are ready to respond, you may need to do several things, depending on local plans and the nature of the emergency. You may be asked to check in to a specific net to let them know you are en route, and then periodically to report your progress, particularly if travel is hazardous.
In some cases, you may be asked to proceed to a "staging" or "volunteer intake" area to wait for an assignment. This could take some time, especially if the situation is very confused. Often, the development of the response to the emergency is unclear and it will take some time to develop a cohesive and uniform response plan for that incident. You should expect the situation to be fluid as each incident is unique and to respond accordingly. Be prepared to wait patiently for a determination to be made and an assignment to be given. In other cases, such as the immediate aftermath of a tornado or earthquake, you may be forced to make expedient arrangements as you go. Travel may be difficult or impossible, so you may need to do what you can, where you can. Nets may be established on an ad-hoc basis using whatever means are available.

Who Is In Charge?

At each station, the emergency telecommunication manager should appoint one member of the emergency telecommunication group to take a leadership role as "station manager," with full responsibility for all operations at that site. This person serves as a point of contact, information and decisions for the team with the incident commander and with other groups aiding in the response. This helps avoid confusion and arguments.

When you accept a position as an emergency telecommunication volunteer, you do so knowing that you will often need to follow the directions of another person. Cooperation and good teamwork are key elements that result in an efficient and effective emergency telecommunication operation. As the situation arises, you may have to step into a role of a leader to keep the operation moving forward. Expect to work with others. Expect that there are times you are the follower. Expect that other times, you may be the leader.

Arriving at the Site

If you are assigned to a facility operated by a served agency, such as a shelter, introduce yourself to the person in charge as an "emergency communicator" assigned to serve that location. They will be busy, so get right to the point:

-Identify yourself and explain that you have been assigned to set up a communication station for that location, and by whom.

-Inform them that you would like to set up your equipment and get on the air.

-Ask if another communicator has already arrived.

-Ask if they have a preference for the station's location and explain your needs.

-If you are the first communicator to arrive, be prepared to suggest an appropriate location—one that can serve as both an operating and message desk, has feed line access to a suitable antenna location, access to power and telephone, and is just isolated enough from the command center to avoid disturbing each other.

-Ask if there are any hazards or considerations in the immediate area that you should be aware of, or cause you to relocate later.

-If no building or other suitable shelter is available, you may need to set up your own tent, or work from your car. Choose a location that provides shelter from wind, precipitation and other hazards, and is close enough to the served agency's operations to be convenient but not in each other's way.

Being a Good Guest

In many cases, you will be occupying a space that is normally used by someone else for another purpose. Respect and protect their belongings and equipment in every way possible. For instance, if you are in a school and will be using a teacher's desk, find a way to remove all the items from its surface to a safe place for the duration of operations.

A cardboard box, sealed and placed under the desk usually works well. Do not use their office supplies or equipment, or enter desk drawers or other storage areas without specific permission from a representative of the building's owners. Some served agencies will seal all filing cabinets, drawers and doors to certain rooms with tamper-evident tape upon arrival to protect the host's property and records.

When installing antennas, equipment and cables, take care not to damage anything. For instance, avoid using "duct" tape to fasten cables to walls or ceilings, since its removal will usually damage the surface. If damage is caused for any reason, make note of it in your log and report it to the appropriate person as soon as possible.

Initial Set Up and Information Gathering

In most cases, your first priority will be to set up a basic station to establish contact with the net. Pack that equipment in your vehicle last so that you can get to it first. If you arrive as a team of two or more, station setup can begin while others carry in the remaining equipment. Set up and test the antenna for proper SWR, and then check into the net. Test to find the lowest power setting that produces reliable communication, especially if you are operating with battery or generator power, to conserve power for extended operations. High power should also be avoided whenever lower power will work just as well to prevent interference with other radio systems, telephones and electronic equipment.

Once your basic station is on the air, you can begin to work on other needs. Some of these things may already be known by the emergency telecommunication managers if they have a working relationship with this particular served agency.

-Check for working telephones, faxes, Internet and other means of communications

-Learn about the served agency's operations and immediate needs at that site

-Install additional stations or support equipment
-Make a list of stations within simplex range
-Identify possible alternative message paths
-Find restroom facilities
-Determine water and food sources, eating arrangements
-Review overall conditions at the site, and how they will affect your operations
-Find a place to get some occasional rest
-As soon as possible, ask a member of the served agency's staff to spend a few moments to discuss the agency's operational needs
-What are the most critical needs?
-Whom do they need to communicate with, and what sort of information will need to be transmitted?
-Will most messages be short and tactical in nature, or consist of long lists?
-Will any messages be too confidential for radio?
-Are phones and fax still working?
-What will traffic needs be at different times of day?
-How long is the site anticipated to be open?
-Will there be periodic changes in key agency staff?
-You may also need to provide agency staff with some basic information on how to create a message, show them how to use message forms, and instruct them on basic procedures to follow.
-Be sure to let them know that their communications will not be private and "secure" if sent by Amateur Radio, and discuss possible alternatives.

Ending Operations

Emergency telecommunication operations may end all at once, or be phased out over time. Several factors may affect which operations end, and when:
-Damaged communication systems are restored and returned to service
-Traffic loads are reduced and can be handled with normal systems
-Shelters and other locations are closed

How you are notified to end operations will depend on the policies of your emcom group and the served agency, and the specific situation. For instance, even though a shelter manager has been told to shut down by the served agency, your orders may normally come from a different person who may not be immediately aware of the shelter's closing. In this case, you might need to check with the appropriate emcom manager before closing your station. Once the decision to close your station has been received and verified, be sure that the person in charge of the location is aware that you are doing so, and if necessary, why.

File and package all messages, logs and other paperwork for travel. Return any borrowed equipment or materials. Carefully remove all antennas and equipment, taking care to package and store it correctly and safely. Avoid the temptation to toss everything into a box with the intention to "sort it out later," unless you are under pressure to leave in a hurry. In the event you are re-deployed quickly, this will save time in the end.

Departure

Several actions may be necessary when leaving. First, be sure to leave the space you used in as good a condition as possible. Clean up any messes, remove trash and put any furniture or equipment back where it was when you arrived. If you sealed desktop items in a box for safekeeping, simply place the box on the cleaned desk. Do not unpack the items and attempt to replace them on the desk. This will provide proof to the desk's owner that you took steps to protect their belongings, and helps keep them secure until their owner takes possession again. Do not remove tamper evident tape or similar seals placed by others unless told to do so by the appropriate person, or in accordance with the agency's policy.

Thank all those who worked with you. Even a simple "thanks" goes a long way, compared to hearing not a single word. Do not forget the building's owners or staff, the served agency staff or others you worked with, and any other emergency telecommunication personnel. This is also the time for any apologies. If things did not always go well, or if any damage was caused, do your best to repair the relationship before departing. These simple efforts can go a long way toward protecting relationships between all groups and individuals involved.

The Debriefing

After each operation, your emergency telecommunication group, and perhaps even the served agency, will probably want to hold a meeting to review the effectiveness of the operation. There may be issues that occurred during operations that you will want to discuss at this meeting. Events may have occurred within the served agency that involved communications you handled. If you try to rely entirely on your memory or logbooks, you will probably forget key details or even forget certain events altogether.

To prevent this from happening, keep a separate "de-briefing" diary, specifically for use during this meeting. Some entries might only refer briefly to specific times and dates in the station operating log, or they may contain details of an issue that are not appropriate in the station log.

If you will be required to turn over your station logs immediately at the end of operations, your de-briefing diary will need to contain full details of all events and issues for discussion. Such information might include:

-What was accomplished?
-Is anything still pending? Note unfinished items for follow-up.
-What worked well? Keep track of things that worked in your favor.
-What needed improvement?
-Ideas to solve known problems in the future.
-Key events
-Conflicts and resolutions

During the de-briefing, the session should be organized into (a) what worked well, and (b) what could be improved for the next operation. Change criticisms and judgment statements into a constructive manner by saying, "This method might have worked better if..." rather than "This method was stupid."

Also, avoid personal attacks and finger pointing. In most cases, interpersonal issues are dealt with most effectively away from the group meeting.

Chapter 19
Operations and Logistics

Choosing Phone Net Frequencies

Unlike commercial and public safety radio users, Amateurs have a vast amount of radio spectrum to use in meeting the needs of an emergency. Most local and regional emergency telecommunication communication takes place on 2 meter or 70 centimeter FM, or on 40, 60 or 80 meter SSB/ CW. The choice made is based on the locations to be covered, the availability of repeaters, distance, terrain, and band conditions.

VHF and UHF FM are preferred for most local operations because the equipment is common, portable, has a clear voice quality and the coverage is extended by repeater stations. VHF and UHF communication range is determined by terrain, antenna height and the availability of repeaters.

For larger areas or in areas without repeaters, HF SSB may be needed. Most local emcom operation is on the 40 or 80-meter bands using Near Vertical Incidence Skywave (NVIS) propagation. For long-haul communication needs and international operations, 15 or 20-meter nets may be the best option. Many emergency telecommunication groups will have pre-selected a number of frequencies for specific purposes. The complete list of these frequencies should be in your jump kit, and pre-programmed into your radios.

For wide area coverage including international traffic handling, the IARU has selected a number of HF frequencies. These are designated as "centers of activity" and the emergency communications activity could be + or – 20 kHz. IARU Regions 1, 2 and 3 differ slightly on some of the "CoA" frequencies.

Region 1	Region 2	Region 3
3.760 MHz	3.750 or 3.895 MHz	3.600 MHz
7.110 MHz	7.060, 7.240 or 7.290 MHz	7.110 MHz
14.300 MHz	14.300 MHz	14.300 MHz
18.160 MHz	18.160 MHz	18.160 MHz
21.360 MHz	21.360 MHz	21.360 MHz

Know Your Area Resources In Advance

Become familiar with the coverage and features of each permanent repeater and digital message system in your area, and pre-program your radios with the frequencies, offsets and CTCSS tones. Your emergency telecommunication group should determine which of the area repeaters are used for emergency communication in your area. Will they be available for exclusive emergency telecommunication use, or must they be shared with other users? Information to find out includes:

-How does it identify itself?
-Are there any "dead spots" in critical areas?
-How much power is required to reach the repeater with a clear, quiet, signal from key locations?

-Does the repeater have a courtesy tone, and what does it sound like? Do the tones change depending on the repeater's mode?

-How long is the "time-out timer"?

-Is it part of a linked system of repeaters?

-What features does it have, and which touch-tone commands or CTCSS tones activate them?

-For net frequencies that support digital communication systems, such as packet radio bulletin board messaging systems, PACTOR, PSK31 and RTTY:

-Which software do they use?

-Do the digital systems have mailboxes or digipeater functions?

-Which other nodes can they connect to?

-Can traffic be legally passed over an Internet link automatically or manually?

-How many connections can they support at once?

Network Coverage Concerns

Most emergency telecommunication managers rely on simplex operation when planning their VHF or UHF FM nets for one reason—repeaters often do not survive disasters or are overwhelmed with the amount of traffic. Repeaters that do survive and are usable are considered a bonus. Since simplex range is limited by terrain, output power, antenna gain and height, operation over a wide area can be a challenge. Almost any structure or hills can block signals to some degree. Don't overlook SSB on the VHF or UHF bands; it can support communication over surprising distances and over rough terrain.

To avoid last minute surprises, your group should pre-test all known fixed locations in your area for coverage. For instance, test simplex coverage from each official shelter to the Red Cross office and the government's command center or other key locations, and mobile coverage in the same areas. If needed, there are several ways to improve simplex range:

-Use an antenna with greater gain

-Move the antenna away from obstructions

-Use a directional antenna

-Increase antenna height

-Increase transmitter output power as a last resort.

In a fast moving situation with poor simplex coverage and no repeater, it can be helpful to place a mobile station on a hilltop or office building where they can communicate with, and relay for, any station in the net. A mobile relay station can also allow communications to follow a moving event, such a wildfire or flash flood. That station becomes, in effect, a "human repeater." Although an expedient "work-around," this slow and cumbersome process can reduce net efficiency by more than half.

A modern aid to this kind of operation is the "simplex repeater." This device automatically records a transmission, and immediately re-transmits it on the same frequency. A better solution is a portable duplex repeater that can be quickly deployed at a high point in the desired coverage area. The coverage of this repeater does not have to be as good as a permanent repeater—it just has to reach and hear the stations in your net. Portable repeaters have been used successfully from the back seat of a car, using a mobile antenna, and parked on a ridge or even the top floor of a parking garage. Portable masts and trailer-mounted towers have also been used successfully.

If all stations in the net have dual-band radios or scanners, a strategically located mobile radio may be operated in "cross-band repeater" mode. If you use your dual-band mobile in this manner for an extended period, use the low or medium power setting to avoid overheating and damaging your radio. Consider using a fan to further reduce the likelihood that your radio will be damaged from overheating.

For a permanent repeater to be useful in a disaster, it must have emergency power and be in a location and of such construction that it can survive the disaster. Agreements with repeater owners should be in place to allow emergency operations to the exclusion of regular users.

Frequency and Net Resource Management

While we may have a large amount of frequency resources, in actual practice our choices are limited to the available operators and their equipment. Net managers may occasionally need to "shift" resources to meet changing needs. In the early stages of an emergency, the tactical nets may require more operators, but in later stages, the health and welfare traffic might increase.

In addition to the main net frequency, each net should have several alternate frequencies available. These should include one or more "back up" frequencies for use in the event of interference, and one or two frequencies to be used to pass traffic "off net."

Message Relays

When one station cannot hear another, a third station may have to "relay" the messages. Although this is a slow and cumbersome process, it is often the only way to reach certain stations. If relays must be used, move the stations involved off the main net frequency to avoid tying up the channel for an extended period.

Radio Room Security

To protect your equipment and the messages you handle, and prevent unnecessary distractions, it is best to allow only the operators who are on duty to be in the room. Avoid leaving the radio room and equipment unattended and accessible. It is never a good idea to allow members of the press to be in the room without specific permission from the served agency.

Record Keeping

Most served agencies will expect you to keep records of your operations. These records will certainly include original copies of any messages sent, station logs, memos, and official correspondence. Some may even require you to keep "scratch" notes and informal logs. Depending on agency policy, you may be required to keep these records in your own possession for a time, or to turn some or all records over to the agency at the end of operations. In some agencies, your station records are permanent and important legal documents and must be treated as such. It is important to know your served agency's policy on recordkeeping in advance so that you can comply from the very beginning of operations.

Your station operating logs should probably contain the following information:

-Your arrival and departure times

-Times you check in and out of specific nets
-Each message, by number, sender, addressee and other handling stations
-Critical events—damage, power loss, injuries, earth tremors, other emergencies
-Staff changes—both emergency telecommunication and site management, if known
-Equipment problems and issues

Every individual message or note should be labeled with a time and date. In the case of scratch notes, place dates and times next to each note on a sheet, so that information can be used later to determine a course of events.

If you expect to operate from the location for more than a day or two, establish a message filing system so that you can retrieve the messages as needed. A "portable office" type file box, expanding file or any other suitable container can be used to organize and file the messages. This is also an efficient way to allow another operator to pick up where you left off, even if they arrive after you leave. Effective record keeping allows them to come up to speed quickly.

Dealing With Stress and Egos

Any unusual situation can create personal stress—disasters create incredible amounts of it. Most people are not used to working under extreme stress for long periods, and do not know how to handle it. They can become disoriented, confused, unable to make good decisions or any decisions at all, lose their tempers, and behave in ways they never would any other time. Nervous breakdowns are common among those who get overwhelmed and have not learned to manage stress and stress-causing situations.

Especially in the early hours of a disaster, the tendency is to regard every situation or need as an "emergency," requiring an immediate response. You might get a barrage of requests for action. You might not have the extra seconds it requires to fully consider the options, and to prioritize your actions. The result is an overload of responsibility, which can lead to unmanageable levels of stress. While you cannot eliminate disaster-related stress, you can certainly take steps to reduce or control it.

Tips to help manage stressful situations:
-Delegate some of your responsibilities to others.
-Only take on those tasks that you can handle.
-Prioritize your actions—the most important and time-sensitive ones come first.
-Do not take comments personally—mentally translate "personal attacks" into "constructive criticism" and a signal that there may be an important need that is being overlooked.
-Take a few deep breaths and relax. Do this often, especially if you feel stress increasing. Gather your thoughts, and move on.
-Watch out for your own needs—food, rest, water, medical attention.
-Do not insist on working more than your assigned shift if others can take over.
-Get rest when you can so that you will be ready to handle your job more effectively later on.
-Take a moment to think before responding to a stress-causing challenge—if needed, tell them you will be back to them in a few minutes.
-If you are losing control of a situation, bring someone else in to assist or notify a superior.

-Do not let a problem get out of hand before asking for help.
-Keep an eye on other team members, and help them reduce stress when possible.

Long Term Operations

As soon as it becomes clear that the situation is not going to return to normal for a while, you and your group should make plans for extended emergency telecommunication operations. Hopefully, your emergency telecommunication group and served agency have prepared contingency plans for this, and all you will have to do is put them into action. If not, here are some potential needs to consider:

-Additional operators to allow for regular shift changes, and those who go home.
-Replacement equipment, as operators leave with their own gear or gear fails.
-Food and water.
-A suitable place to sleep or rest.
-Generator fuel.
-Fresh batteries, sanitation facilities (bring your own TP), shelter.
-Message handling supplies, forms.
-Alternate NCS operators, backups.
-Additional net resources to handle message traffic.

Battery Management

If you are operating on battery power, you will eventually need to recharge your batteries. As discussed earlier, some batteries need more time to recharge than others, and this time needs to be taken into account in your planning. Deep cycle marine batteries, for instance, can require a full day or longer to fully recharge. Sealed lead-acid (SLA) batteries, also known as "gel-cells," require up to 18 hours to recharge depending on the size of the battery. NiCad, Li-Ion and similar batteries can be recharged quite quickly, although repeated rapid charge cycles can reduce overall battery life.

If you are using slow-charging batteries, you may need to have enough on-hand to last the entire length of the operation. If your batteries can be charged quickly, some means must be provided for doing so. Some chargers can be powered from a vehicle's 12-volt system, and are a good choice for emergency telecommunications. If no local means of charging is available, your logistics team may need to shuttle batteries back and forth between your position and a location with power and chargers.

Generator and Power Safety

Take some care in the placement of generators so that they will not be a problem for others. Engine noise can make it difficult for shelter residents and volunteers to get much needed rest. Exhaust fumes should not be allowed to enter the building or nearby tents or vehicles. Carbon monoxide tends to settle, so exhaust components should be carefully located so that fumes cannot settle into inhabited basements or other enclosed areas below the generator. A position "down-wind" of any occupied location is best. Even when vehicles are not included, internal combustion engines can be a cause of carbon monoxide poisoning. Propane powered engines produce as much or more CO as gasoline or diesel engines.

AC extension cables used to connect to generators or other power sources should be rated for the actual load. Consider radios, lights, chargers and other accessories when calculating the

total load. Most extension cables are rated only for their actual length, and cannot be strung together to make a longer cable without "de-rating" the cable's capacity.

Equipment—Leaving Yours Behind?

You are exhausted, and ready to head for home, but the emergency telecommunication operation is far from over. You brought along a complete station, and when you leave, the next operator is not nearly as well equipped. Should you leave your equipment behind for the next operator?

You have several options here—and they are all yours to choose from. No one can, or should, tell you to leave your equipment behind. If you feel comfortable that someone you know and trust will look after your gear, you may choose to leave some or all of it behind. If you do, be sure every piece is marked with at least your name and call sign. Do not leave behind anything the next operator does not truly need. Also, remember that even if you leave the equipment in the possession of someone you know, you still have the ultimate responsibility for its operation and safety. Emergency stations are difficult places to control and monitor. If your equipment is stolen, lost or damaged, you should not hold anyone responsible but yourself. Conversely, if someone leaves their equipment in your care, treat and protect it better than you would your own, and be sure it is returned safely to its owner.

Accepting Specialized Assignments

In the world of modern emergency telecommunications, you may be asked to handle other assignments for the served agency that may or may not include communicating. Some emcom groups may have strict policies against doing other tasks. In the days when radios were difficult to operate under field conditions and required constant attention, this was important. The other common reason given is that you have volunteered to be a communicator, not a "bed pan changer." It is true that some agency's staff will abuse the situation when they are short of help, but if both the agency's staff and emergency telecommunication group are clear about any limits beforehand, the problem should not arise.

Today, most emergency telecommunication groups will permit their members to be cross-trained for, and perform, a variety of served-agency skills that also include communicating. Examples are damage assessment and many logistics jobs.

If your group still has a "communication only" policy, are you really meeting your agency's needs? Is it necessary to have a damage assessment person and a communicator to do that job? What would happen to your agency if each driver also had to bring along a dedicated radio operator? Can one person do both jobs?

These issues should be discussed within your emergency telecommunication group and policies established.

Chapter 20
Safety and Survival

Introduction

Disaster relief volunteers sometimes become so involved with helping others that they forget to take care of their own families and themselves. The needs of disaster victims seem so large when compared with their own that volunteers can feel guilty taking even a moment for their own basic personal needs. However, if you are to continue to assist others, you need to keep yourself in good condition. If you do not, you risk becoming part of the problem. If your family is not safe and all their needs are not taken care of, worrying about them may prevent you from concentrating on your job.

Home and Family First

Before leaving on an assignment, be sure you have made all necessary arrangements for the security, safety and general well being of your home and family. Family members, and perhaps friends or neighbors, should know where you are going, when you plan to return, and a way to get a message to you in an emergency. If you live in the disaster area or in the potential path of a storm, consider moving your family to a safe location before beginning your volunteer duties. Take whatever steps you can to protect your own property from damage or looting, and let a neighbor or even local police know where you are going, when you plan to return, and how to reach you or your family members in an emergency.

In addition to your emergency telecommunication deployment checklists, you might want to create a home and family checklist. It should cover all their needs while you are gone. Here are some ideas to get you started:

House Checklist:

-Board up windows if you are in a storm's path
-Put lawn furniture and loose objects indoors if high winds are likely
-Move valuables to upper levels if flooding is possible
-Heating fuel tanks should be filled
-Drain pipes if below-freezing temperatures and power loss are possible
-Shut off power and gas if practical and if structural damage is possible
-If you live in earthquake country, have an automatic shutoff valve on the gas line

Family Checklist:

-Designate a safe place to stay if needed, preferably with friends or relatives
-Reliable transportation, with fuel tank filled
-Adequate cash money for regular needs and emergencies (not ATM or credit cards)
-House, auto, life and health insurance information to take along if evacuated
-Access to important legal documents such as wills, property deeds, etc.
-Emergency food and water supply. AM/FM radio and extra batteries
-Flashlight and extra batteries, bulbs
-Generator, fuel and safe operating knowledge

-Adequate supply of prescription medications on hand
-List of emergency phone numbers
-Pet supplies and arrangements (shelters will not take pets)
-List of people to call for assistance
-Maps and emergency escape routes
-A way to contact each other
-A plan for reuniting later

Should You Leave At All

There are times when your family may need you as much or more than your emergency telecommunication group. Obviously, this is a decision that only you and your family can make. If a family member is ill, your spouse is unsure of their ability to cope without you, if evacuation will be difficult, or any similar concern arises, staying with them may be a better choice. **If there is ever any doubt, your decision must be to stay with your family.** This is also something you should discuss, and come to an agreement with your spouse about well before any disaster, in order to avoid any last minute problems. You can still lend assistance by assisting with net control functions even while staying with your family.

You First—the Mission Second

Once you are working with your emergency telecommunication group, you will need to continue to take care of yourself. If you become over-tired, ill or weak, you cannot do your job properly. If you do not take care of personal cleanliness, you could become unpleasant to be around. Whenever possible, each station should have at least two operators on duty so that one can take a break for sleep, food and personal hygiene. If that is not possible, work out a schedule with the emergency telecommunication managers or your NCS to take periodic "off-duty" breaks.

Food

Most people need at least 2000 calories a day to function well. In a stressful situation, or one with a great deal of physical activity you may need even more. Experienced emergency telecommunication managers and served agency personnel will usually be aware of this issue and take steps to see that their volunteer's needs are met. If you are at a regular shelter, at least some of your food needs may be taken care of. In other situations, you may be on your own, at least for a while. High calorie and high protein snacks will help keep you going, but you will also need food that is more substantial. You may need to bring along some freeze-dried camping food, a small pot, and a camp stove with fuel, or some self-heating military-style "Meal, Ready to Eat" (MRE) packages.

Water

Safe water supplies can be difficult to find during and after many disasters. You will probably use 13-22 liters of water each day just for drinking, cooking and sanitation. In extremely hot or cold conditions, or with increased physical activity, your needs will increase significantly. Most disaster preparedness checklists suggest at least one gallon per person, per day.

Many camping supply stores offer a range of water filters and purification tablets that can help make local water supplies safer. However, they all have limitations you should be aware of. Filters may or may not remove all potentially harmful organisms or discoloration, depending on the type. Those with smaller filter pores (.3 microns is a very tight filter) will remove more foreign matter, but will also clog more quickly. Iodine- saturated filters will kill or remove most harmful germs and bacteria, but are more expensive and impart a faint taste of iodine to the water. Most filters will remove Giardia cysts. All water filters require care in their use to avoid cross- contamination of purified water with dirty water.

Purification tablets, such as Halazone, have a limited shelf life that varies with the type, and give the water an unpleasant taste. The tablets will do nothing for particulate (dirt) or discoloration in the water. Be sure to read and understand the information that comes with any water purification device or tablet before purchasing or using it.

You may be able to use unscented household chlorine bleach. After filtering out any particulates by pouring the water through several layers of densely woven cloth, put 1/8 teaspoon of bleach in a gallon of water, mix well, and allow it to sit for thirty minutes. If it still smells slightly of bleach, you can still use it.

If you have no other means, boiling for at least five minutes will kill any bacteria and other organisms, but will not remove any particulate matter or discoloration. Boiling will leave water with a "flat" taste that can be improved by pouring it back and forth between two containers several times to reintroduce some oxygen.

Sleep

Try to get at least six continuous hours of sleep in every twenty-four hour period, or four continuous hours and several shorter naps. Bring fresh soft foam earplugs and a black eye mask to ensure that light and noise around you are not a problem. An appropriate sleeping bag, closed-cell foam pad or air mattress, and your own pillow will help give you the best chance of getting adequate rest. If caffeine keeps you awake, try to stop drinking coffee, tea, or other beverages containing caffeine at least four hours before going to bed. Allowing yourself to become over-tired can also make falling asleep difficult.

Personal Hygiene

If you pack only a few personal items, be sure they include toothpaste and toothbrush, a comb, and deodorant. If possible, bring a bar of soap or waterless hand cleaner, a small towel and washcloth, and a few extra shirts. Waterless shampoo is available from many camping stores. After two or three days without bathing, you can become rather unpleasant to be around—think of others and make an attempt to stay as clean and well-groomed as you can under the circumstances.

Safety in an Unsafe Situation

Many disaster assignments are in unsafe places. Natural disasters can bring flying or falling debris, high or fast moving water, fire, explosions, building collapse, polluted water, disease, toxic chemicals, and a variety of other dangers. While you may focus on the job assigned you, never lose "situational awareness." You should always be aware of your surroundings and the dangers they hold. Never place yourself in a position where you might be trapped,

injured or killed. Try to anticipate what might happen and plan ahead. Always have an escape plan ready in the event that conditions suddenly become dangerous. Do not allow yourself to become "cornered"—always have more than one escape route from buildings and hazardous areas.

Wear appropriate clothing. Depending on the weather, your gear might include a hard hat, rain gear, warm non-cotton layers, work gloves and waterproof boots. In sunny climates, include a shade hat, long sleeved shirt, long pants and sunscreen. Always bring several pairs of non- cotton socks and change them often to keep your feet clean and dry.

Create seasonal clothing lists suitable for your climate and the types of disasters you might encounter. As a volunteer communicator, you will not generally be expected to enter environments that require specialized protective clothing or equipment. Do not worry about purchasing these items unless required by your served agency.

Avoid potentially dangerous areas. Industrial buildings or facilities may contain toxic chemicals, which can be released in a disaster. Dams can break, bridges can wash out and buildings can collapse. Areas can become inaccessible due to flooding, landslides, collapsed structures, advancing fires or storm surges. If you can avoid being in harm's way, you can also prevent yourself from becoming part of the problem rather than part of the solution.

Be prepared to help others find or rescue you should you become trapped or isolated. Carry a police or signal whistle and a chemical light stick or small flashlight in your pocket. Let others know where you are going if you must travel anywhere, even within a "safe" building. Try not to travel alone in dangerous conditions—bring a "buddy."

Shelter

In most cases, you will not need your own shelter for operating or sleeping. You may be able to stay or work in the command center, evacuation shelter or even your own vehicle. However, in some cases a tent, camp trailer, motor home or other suitable shelter may be necessary. Your choice will depend on your needs and resources.

Tents should be rated for high winds, and should be designed to be waterproof in heavy weather. Most inexpensive family camping tents will not survive difficult conditions. Dome tents will shed wind well, but look for published "wind survival" ratings since not all dome designs are equal. Your tent should have a full-coverage rain fly rather than a single waterproof fabric. The tent's bottom should be waterproof, extending up the sidewalls at least six inches in a "bath-tub" design, but bring an extra sheet of plastic to line the inside just in case. (Placing a plastic ground cloth under a tent will allow rain to quickly run under and through a leaky tent floor.) Bring extra nylon cord and long ground stakes to help secure the tent in windy conditions. If you are not an experienced foul weather camper, consider consulting a reputable local outfitter or camping club for advice on selecting and using a tent.

Medical Considerations

If you have a medical condition that could potentially interfere with your ability to do your job, it is a good idea to discuss this with your physician ahead of time. For instance, if you are a diabetic, you will need to avoid going for long periods without proper food or medication,

and stress may affect your blood sugar level. Persons with heart problems may need to avoid stressful situations. Even if your doctor says you can participate safely, be sure you have an adequate supply of appropriate medications on hand, and a copy of any prescriptions. Let your emergency telecommunication manager and any work partners know of your condition so that they can take appropriate actions if something goes wrong. Wear any medical ID jewelry you have. Keep a copy of any special medical information and emergency phone numbers in your wallet at all times. We know you want to help, but your emergency telecommunication manager needs to know and then can make an appropriate assignment.

Protect Your Eyes and Sight

If you wear eyeglasses or contact lenses, bring at least one spare pair. If you use disposable contact lenses, bring more than enough changes to avoid running out. Some contact lens wearers may want to switch to glasses to avoid having to deal with lens removal and cleaning under field conditions. If you have any doubts, consult your eye doctor ahead of time. Bringing a copy of your lens prescription along may also be a good idea, especially if you are likely to be some distance from home for a while.

Sunglasses may be a necessity in some situations and should always be carried in sunny climates. Working without them in bright sun can cause fatigue, and possibly eye damage. If you are in an area with large expanses of snow or white sand, prolonged periods of exposure can cause the retina to be burned, a very painful condition commonly known as “snow blindness.” Since no painkiller will help with retinal burns, it is best to use good quality UV blocking sunglasses at all times, and avoid prolonged exposure. If you do not normally wear eyeglasses, consider a pair of industrial safety glasses or goggles to protect your eyes from smoke and ash, wind-blown water, dust and debris. Keep all spare eyeglasses or safety glasses/goggles in a felt-lined hard-shell storage case to prevent scratching and breakage.

Sample Personal Survival and Comfort Needs Checklist

(Modify according to your own situation)

-Suitable size backpack or duffel bag for clothing and personal gear
-Plastic storage tub for food, cooking gear
-Toilet kit—soap, comb, deodorant, shampoo, toothbrush, toothpaste
-Toilet paper in zipper-lock freezer bag
-Small towel and washcloth
-Lip balm
-Facial tissues
-Sunscreen
-Insect repellent
-Prescription medications (1 week supply)
-Copies of medication and eyeglass/contact lens
-Prescriptions
-Spare eyeglasses or contact lenses and supplies
-Hand lotion for dry skin
-Small first aid kit
-Non-prescription medications, including painkiller, antacids, anti-diarrheal, etc.
-Extra basic clothing—shirts, socks, underwear
-Gloves, for protection or warmth
-Pocket flashlight and extra batteries

-Folding pocketknife
-Sleeping bag, closed-cell foam pad or air mattress, pillow
-Ear plugs (soft foam type in sealed package)
-Opaque eye mask
-Outer clothing for season and conditions (rain gear, parka, hat, face mask, etc)
-Hardhat
-Reflective vest, hat
-Travel alarm clock
-Chemical light sticks
-Police or signal whistle
-Dust masks
-Phone/e-mail/address list for family, friends, neighbors, physician, pharmacy
-Emergency contact/medical information card in your wallet
-Spare car and house keys
-High energy or high protein snacks
-Food—Freeze-dried or MREs
-Coffee, tea, drink mixes
-Plate or bowl, knife, fork and spoon, insulated mug
-Camp stove, small pot, fuel and matches
-Battery or other lantern
-Water, in heavy plastic jugs
-Water purification filter or tablets
-Magnetic compass, maps
-Duct tape, parachute cord

Pack individual items or kits in zipper-lock freezer bags to keep dry, clean, & neat.

Chapter 21
Learning Opportunities

Introduction

If you want to improve your skills and competence in just about any activity, then "practice, practice, practice."

So it is with emergency communication skills. If you want your performance in the next big disaster to be flawless, practice is essential. Fortunately, there are plenty of opportunities to do so if you take the time to seek them out.

Regularly Scheduled Nets

Many local emergency telecommunication groups hold regularly scheduled training nets. Well-designed nets will vary the format and goals frequently in order to keep them interesting. One month may be devoted to learning about the served agency's new damage report form, and another with moving health and welfare messages to and from the area impacted by a wide-area disaster.

Local Classroom and On-Air Training Sessions

Your emergency telecommunication organization and/or served agency may offer a variety of educational opportunities. Some served agencies may offer job specific training, such as an introductory course to disasters, mass care overview, shelter operations and damage assessment courses. Smaller training sessions may deal with the use of certain forms or procedures. In addition to regular nets, special on-air training sessions may be held on a repeater or simplex frequency as an alternative to classroom sessions when the subject is simple or utilizes a net environment.

Public Service Events

In some countries it is permissible to use Amateur Radio to support public events. Some of the best practice for tactical disaster communication is your local "athon". It does not matter if it is a bike-athon or walk-athon or marathon, but the larger the event, the better the experience. A large, fast moving event closely simulates the conditions experienced in disaster communication situations. Even a smaller or slower event will allow you to practice tactical net operating skills or experiment with various modes under field conditions.

So, get out there and "practice, practice, practice!"