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October 1992

(Note: The following article originally appeared in the October 1992 issue of *73 Magazine*.)

Do you want to have a successful ham radio emergency group? This article tells how the hams in Boulder, Colorado progressed from being an ordinary emergency group to a statewide example of what hams could achieve. We were on the outside during emergencies; now we are an integral part of the county-wide emergency plan. Packet radio can also become your key to being accepted by public safety agencies. Our operational procedures and equipment are also explained, as they have been refined through three major forest fires.

A Little History

After a major flood in the mid-1970's, a local ham radio emergency group was formed. Boulder County Amateur Radio Emergency Services (BCARES) was active for a number of years but fell into dormancy by the mid 1980's. We were like many ham emergency groups; we had an army surplus communications van with lots of radios, but we were rarely called to serve. If volunteers are never used, they eventually lose interest.

Two things happened to change this: First, the county communications center was persuaded by BCARES that packet radio might be useful. Second, Boulder County suffered a major forest fire. Grants were obtained from IBM and the federal government for a demonstration packet radio system in a suitcase, using a Radio Shack model 100 portable computer, a battery-powered printer, a TNC (Terminal Node Controller or radio modem) and an ICOM IC-2 two-meter radio. The system was somewhat crude, but it worked. Actually, two forest fires burned at the same time, stretching all local resources, including communications, to the limit. In one day, hams were able to set up three packet stations and one portable digipeater. One station was established at the county communications center, with two stations at the fire command centers, near the fire lines. The county was very impressed with the speedy delivery of hard copy, the relative security of the messages, and the hams' flexibility.

Were there problems with packet radio at these first fires? Sure, lots of problems: batteries went dead, systems stopped working, radio contact was noisy and many others. Luckily, ham ingenuity solved or worked around the difficulties, and the system was used for several days, with only occasional periods "off the air". When the packet system was down or overloaded, messages were handled by voice, on a two-meter repeater.

After the 1988 fire, and every succeeding emergency, we had a critique and figured out what we needed to improve. We held exercises, some of which were disasters in themselves! As a result, we rewrote the ham radio emergency plan for Boulder County. In the 1989 forest fire, which destroyed 40 homes, things went more smoothly, and BCARES became accepted as a key element in emergency planning. Packet radio is now written into the county flood and fire plans; BCARES is to be paged automatically when a situation reaches the critical point. At the start of the most recent forest fire, the county radio dispatchers were visibly relieved when BCARES arrived, because we take a lot of the traffic load from the public safety radio channels.

The Old Stage Road Forest Fire

Perhaps the best way to explain how BCARES operates is to tell the story of one emergency from beginning to end. This is the story of our third major forest fire, which burned a dozen houses in Boulder County in November 1990. It started early on a Saturday morning. The first that BCARES knew of it was when a

sheriff's officer knocked on the door of one of our members, and asked him to evacuate his home. He called the head of BCARES, who began a callout in the middle of the night, anticipating the need. Soon after, we were paged by the county communications center, which requested packet links from the communications center to the fire base and the evacuation center. A voice net was set up on a local two-meter repeater.

The Red Cross requested help at two additional locations. For the first time, we had enough equipment to set up packet at all sites, so we decided to operate with one voice coordination frequency, and all five packet stations connected to the same packet bulletin board. (In past emergencies, the hams serving the Red Cross had handled traffic by voice on a separate frequency).

During the two days of the fire, a total of 225 messages were sent via packet radio. Forty-eight hams participated, putting in a total of 350 hours of volunteer time.

One new area that BCARES is beginning to exploit is ham fast-scan TV. In the Old Stage fire, a TV transmitter was set up on top of a hill, giving an overall view of the fire. For the first time, the dispatch center could actually see what was going on, rather than just imagine it through radio traffic. They loved it! On the second day, the fire base requested a receiver too; they were too close to the fire to get the big picture!

Organizing the Hams

A key to success is having several experienced people at the net control site. Our experience is that one ham alone cannot do a good job of coordinating an operation; it is much better to have one ham at the mike and one in the background, thinking. This also means a smooth transfer when the ham at the mike needs to take a break. When most of the traffic is handled by packet, the voice frequency is relatively quiet, and the net control usually does not have to work too hard after things are running.

In a major event with multiple sites, coordinating people is a big job, too big for one person to do well. We have certain people preassigned to key sites and to management of personnel. We use six hour shifts, based on a survey of our members' preferences. This allows people to work a half day and help with the emergency, too. We generally assign three hams to each site. This provides one person for voice, one for packet, and one to deliver messages or provide relief. One of these three hams is the team leader for that site.

BCARES has a list of fifty official members and a list of other people upon whom we can count; we assign the most experienced members to key sites and key jobs, and fill out the staffing with others. We often accept volunteers who we do not know, but pair each with a ham who is experienced in our procedures.

Most of the hams are assigned by telephone, but we usually monitor a two-meter frequency as well. At 9 PM each night, a net is run to finalize assignments for the following day. The staffing frequency is different than the operational frequency. People asking questions or sharing information are referred to the staffing frequency, to keep the operational frequency clear.

Packet and Message Handling

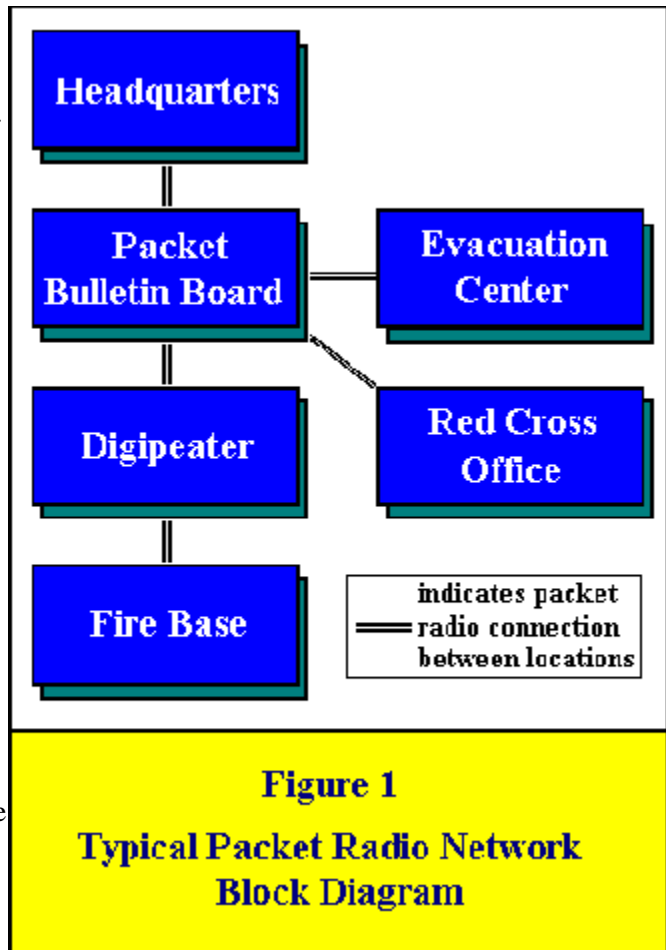
Do not forget these traffic handling basics: every message needs a number, an addressee, a destination and a signature. The sender's signature is perhaps the most important item. The sender's title and agency should be included with the name. We have developed a standard message format; packet's error checking features make word count unnecessary for local communications.

The basic procedure at each site is simple. When a ham receives a written message, he checks it to make sure it is signed, addressed and legible. Then he SENDs the message to the appropriate site, typing it directly (via

packet radio) into the bulletin board. When the message is finished, the other station receives a one-line notice of mail, then READs the message. After receiving the message, the station acknowledges by voice; i.e., "Fire base, this is dispatch, acknowledging your message 123." The acknowledgement is accepted with a "Thank you," and the message is torn off the printer and delivered. We use tactical calls, such as "fire base," rather than ham calls, on both voice and packet. This minimizes confusion when the ham at the fire base mike takes a break or goes home.

Why is Packet Successful?

The most important fact is that all of the agencies that we serve like the hard copy messages. The police and fire departments have voice communications, but hard copy from point to point is something else. Packet's automatic error checking also provides protection against garbled messages. In most instances, receiving a computer printed message is much better than trying to interpret cryptic notations scrawled on cards. Most of the traffic that BCARES handles relates to logistics. (i.e., "Please send 50 shovels." "We need 35 meals at the fire base at 5 PM".) In addition to providing hard copy, we provide additional communications operators, as well as additional frequencies.



Packet Hardware and Software

Our present packet system consists of four parts: portable packet systems, fixed packet systems, mountaintop digipeaters and a packet bulletin board.

The portable packet systems consist of Toshiba T-1000 laptop MS-DOS computers, two ICOM IC-228 two-meter transceivers, (one for packet and one for voice), a TNC, a battery-powered thermal printer, a 20 amp-hour lead-acid gel-type battery, a battery charger and antennas. To keep this from being a backbreaking load, it is broken into two suitcases, plus beam antennas.

The fixed packet systems are standard MS-DOS computers, but with a TNC and a 2-meter radio. These computers are available for general use in the dispatch center or other area, but can be switched rapidly to be used as packet stations when needed.

The software that we use on the fixed and portable computers is Pak-Comm, by Kalt and Associates. However, we generally use the computers as "dumb terminals" with printers, because most of the "smarts" are in the bulletin board.

We also use mountaintop digipeaters to provide coverage to remote areas of the county. We are now upgrading these digipeaters with ICOM IC-228 radios.

The bulletin board uses a 150 watt radio at a hilltop site, and an MS-DOS XT-type computer. The TNC is an internal unit made by Digital Radio Systems of Clearwater, Florida. The PacketCluster bulletin board software is available from Pavillion Software of Hudson, Massachusetts. The key feature of this software is that it allows many different stations to be interconnected through the bulletin board at the same time. This means that one does not need to connect to and disconnect from each station to send a message. The message flow does not stop if a station is already connected to someone else. The message is typed into the bulletin board at the operator's speed, and when the message is ready, the other station receives a one-line notice of the message. The basic commands, SEND and READ, are simple enough to be readily learned even by those not "computer literate." Direct connection from one station to another is usually simpler if only two stations are involved, but with multiple stations, the bulletin board makes life a lot easier. The bulletin board is available for general use until an emergency is declared.

BCARES does not use the PacketCluster software features that allow transmitting DX spotting bulletins, or connecting to other bulletin boards. Another bulletin board is available to send messages to other parts of the state or across the country, but we have never had occasion to use it in a real emergency.

Packet Problems and Pitfalls

Packet can be wonderful, but it can also be a big problem. We have spent innumerable hours discussing and experimenting with TNC parameters. After several years, we have settled on the parameters in Table A. These assume a PacketCluster bulletin board, but seem to work well for general purposes. Perhaps the most important parameter is FRACK, which defines the time between retry transmissions. People get impatient, and tend to set FRACK very low. However, if multiple stations on the same frequency do this, everybody ends up transmitting at the same time, and nobody gets any traffic through. If you want a real disaster, have 4 or 5 stations typing on the same frequency, with FRACK set to about 2. The weaker stations will soon retry out and be disconnected.

Table A: Recommended TNC Parameter Settings		
MAXFRAME	1	
DWAIT	16	Low power stations use 8. (If you're using an older TAPR 1 TNC, use 4 or 2 if on low power.)
FRACK	8	
RETRY	10	
CHECK	0	
AX25L2V2	ON	
SLOTTIME	10	If supported
PPERSIST	ON	If supported
PERSIST	63	If supported (Low power stations use 128.)

Channel overload can be a real issue, even with correct parameter settings. In an overload situation, weak stations will be disconnected, and it will take forever for a message to get through. There are two ways to deal with it:

1. Use more than one frequency. We recently upgraded our bulletin board to use two frequencies, and estimate that we have almost doubled our traffic handling capability. A lower-tech solution is having the net control tell two packet stations to QSY to another packet frequency. To minimize interference, we do not operate on the national packet frequency of 145.01 MHz.
2. Limit or shut down lower-priority traffic. If you are handling disaster relief traffic, do not allow health-and-welfare inquiries to bog down the system. If you have an emergency message, order the other stations to stop typing.

A key to maintaining control is to require all packet stations to simultaneously monitor a voice frequency. This makes coordination and debugging problems much easier. We use a voice two-meter repeater and a packet two-meter frequency, with digipeaters if necessary. There is some interference, but it is usually not a big problem. A packet monitoring station, most often manned by a packet expert from his home, can also be useful in spotting problems and suggesting solutions.

Relationship of BCARES to Other Groups

The relationship of BCARES to the public safety organizations is virtually unique. Unlike a conventional ARES group, chartered by the ARRL, BCARES is chartered by the county communications center, which dispatches police, sheriff, fire, and other agencies. We are also sponsored by the Office of Emergency Preparedness (Civil Defense). By being government chartered, we are more accountable to the organizations that we serve. Boulder County's three ham radio clubs jointly support BCARES. The head of BCARES is recognized by the ARRL as the Emergency Coordinator for Boulder County, and BCARES is also legally the local RACES organization, but these titles are not important in our local emergency operations.

BCARES's first responsibility and primary focus is assisting the county-wide communications center; any other requests for assistance are met only if resources are available. We primarily provide local communications via VHF packet and voice, although the public safety organizations know that we have other capabilities, such as HF, autopatch, etc. BCARES has never used traditional "long-haul" HF communications capability.

Traditionally, ham groups have been associated with the Red Cross or the local civil defense organization. Incoming health and welfare inquiries are a major part of what hams do in emergencies. These are worthwhile endeavors, but can limit the ham role. In some ways, the primary accomplishment of BCARES is that it has expanded the role of hams in emergency communications. To keep within our focus, BCARES does not plan to handle health and welfare traffic; we have determined that this is primarily the Red Cross' responsibility.

In Boulder County, the Red Cross has a separate group of hams that assist them with communications. BCARES and the Red Cross hams enjoy a cooperative working relationship; we share resources and hold joint exercises. We have discussed the possible merger of the two groups, but the agencies that we serve feel that they prefer two more focused organizations, rather than one group that tries to be all things to all people.

How to Make Your Group Successful

BCARES has been successful by maintaining a focus on serving our "customer," the county-wide communications center. A close relationship between the head of BCARES and an official of the countywide communications center has also been beneficial. The chairman of BCARES works closely with this official on both personal and professional levels. In effect, the people of the communications center depend on the head of BCARES to assure that the hams meet the communication center's needs.

How can you make your emergency service group successful? Sell yourself to someone who needs you. The first step is to sell your group to an agency, in order to get them to "try the hams out," either by being included in one of their disaster exercises or in a real emergency. Choose an agency which which the hams have connections, or an agency that often has a need for supplementary communications. The second step is to be successful in your trial. The key here is not to promise more than you can deliver. Be realistic. Plan ahead, practice, and then get the job done. Plan for equipment problems, and have backup equipment to ensure success. Focus on helping the agency, rather than getting written up in the local newspaper or getting your name in a ham magazine. Participate in the annual disaster exercises for the organization that you serve.

People are impressed by technology, and you will probably be more successful selling something that they don't already have. Most public safety organizations already have lots of HT's and people with clipboards. Do a demonstration of packet radio, and hand them the hard copy. Perhaps a live TV picture would be useful; do a small demonstration, and persuade them to give you a try.

If you focus on serving one agency, and do what they need you to do, your group can be successful. Perhaps your group, like BCARES, will hear, "In a disaster, the dispatch center calls the hams before they order food."

1996 Update

The software used on the portable packet stations is no longer Pak-Comm, but is now custom software written by [KDØRC](#) that allows off-line formatting of messages.

BCARES now has about 100 members, and uses TV more than in the past.

The separate Red Cross group no longer exists. BCARES now assists the Red Cross as requested by the communications center.
