Non-Ham Radio Communications Systems By Glen Sage, W4GHS

Amateur Radio (Ham Radio) provides outstanding systems with various modes to provide communications back to the Baptist Mission Boards both state and national. It also provides communications back to the homes of team members that have responded to the disaster. The great challenge is providing communications between the command/communications trailer to workers in the field and from trailer to trailer and from worker to worker. If ham resources were available this would provide a more extended range in all these applications. With the large diversity of operations in the field (mud out, chain saw crews, shower trailers, feeding trailers etc.) during deployment it is necessary to rely on commercial handheld units to provide for short-range communications from these multi-locations due to a lack of hams being available.

The handhelds of choice for SouthBears of Virginia is the Motorola BPR40s. This rig is very simple with eight channels (simplex frequencies) that are selected with a rotary knob that is numbered 1 though 8. These units are licensed under the FCC call of WQIX708. All these HTs have the frequencies coordinated so all channel numbers correspond with the same frequency on all units. The parts of these HTs are the antenna, which is a "rubber duck". The microphone is a small condenser mike that is built into the unit and is located on the front of the HT near the speaker grill. The mike button, known as the push to talk button (PTT) is located on the side of the HT. This unit will operate for a full 8-hour shift if you transmit for only about 45 minutes during that shift. In most applications, you would not transmit this long. You can recharge your battery after your day of work and this is completed in 5 hours or less. You can leave the unit in the charger overnight and it will not overcharge but will shift to a "trickle" mode after it becomes fully charged. The operation of these units is very straightforward. Occasionally you will want to discharge your batteries completely to avoid them developing memory.

The Federal Communications Commission (FCC) licenses these units and requires an identification to be given at the end of your communications or every 15 minutes, if your conversation last over 15 minutes. If you are not operating the base station this identifications can be with a tactical call. These calls may be assigned by the command center and might be such names as "Kitchen one, Shower one, Comm. Center, etc. These names will usually correspond to your location or function. The

Communications Center (EMCOMM) will need to ID with the FCC call of WQIX708 every 15 minutes. When you ID, do not rush or slur your speech because it must be readable to be a legal ID. The base station will also maintain a list of all the tactical calls to comply with FCC rules. The base station will maintain a log sheet with notes on all communication that is taking place. The command center will usually maintain the position of Net Control Station. If a formal net is in place you will need to contact net control and receive permission to call another station. This would be done in the following manner, "Net Control this is Kitchen, over. Kitchen this is net control, go ahead. Net Control I need to speak with "Mud Out Two". "Kitchen, call your station". Mud Out Two this is Kitchen Two, I need a count for those from your crew that will be coming for the evening meal, over. This is Kitchen Two, I have seven workers for the evening meal, and we are also in need of drinking water to finish our shift here. Please send 2 gallons of drinking water as soon as possible. Over. This is Net Control, water will be delivered to your location within the hour, over. This is Mud Out two, Roger, out.

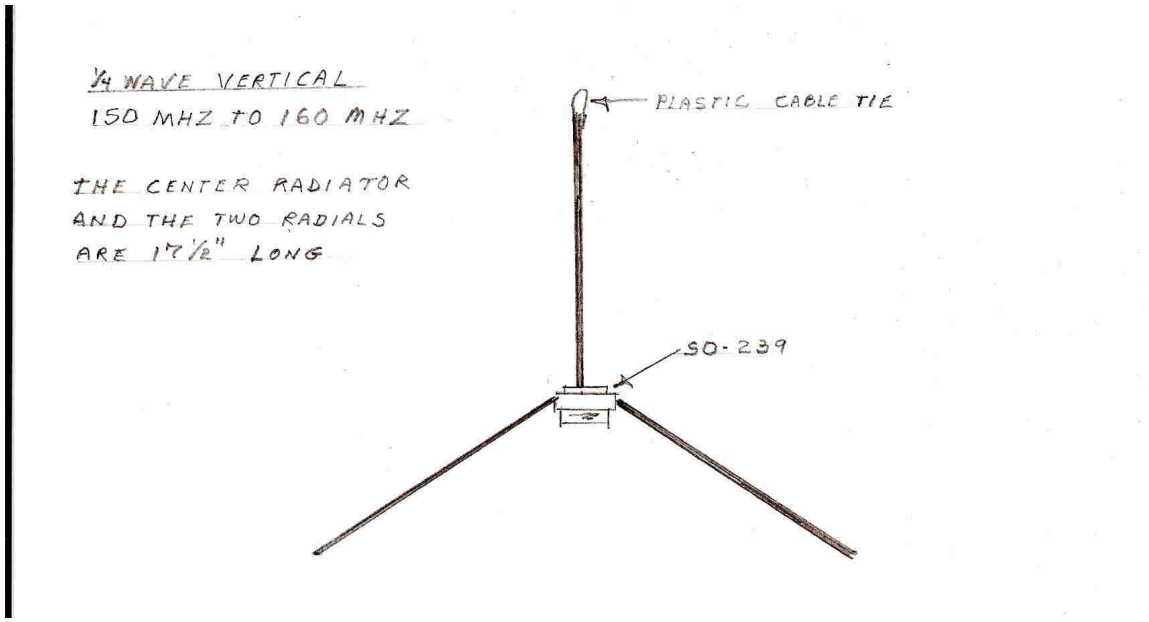
In the above exchange, the net control is insuring that only one item of business is being handled at a time. The net control is like a "traffic cop" that assures that you don't have someone making a call until the last item of business has been completed. When you finish your comments and you say "over", the other person knows that you are now listening for his answer. When you have called net control or anther station and have cared for your business you will say "out" at the end of your comments. Net control will then know that you have finished with your business and everything has been reset for new rounds of communications. If things are very slow the net may be "informal". This means there is no net control directing the net. If you want to make a call, you just listen to make sure that no one is using the frequency. You then make your call such as "Sandbag Unit 4 (always list the station you are calling and then your call) this is base." Base would respond, "This is base go ahead sandbag unit 4. This is Sandbag 4, we are going to be out of bags within the hour, we are using 200 bags per hour, please advise on the number of bags that your can send and estimated time of arrival "Over". This is Base, wait one, (this means that he needs a little time before he answers your question) this is Base, I will have a thousand bags at your location in 30 minutes or 1330 hours "over". This is Sandbag unit 4, roger, "out". The frequency is now available for other people to call as needed. The "roger" denotes that you understand and the "Out" means this completes the communications.

There are situations that distance and terrain is a real test of the communications system using the small HTs at 5 watts output. This may require the use of relay or changing the equipment setup. Before going to a relay system, make sure that you are getting the most from your available equipment. Be sure that you are holding your HT in a vertical position. If you are holding an HT sideways, it is like turning a 5-watt rig into 1-watt rig. If you are right on top of the other station it will not make a difference but if your are operating at distances it can be the difference of

being heard or not. If your batteries are low it will cause your output to drop. At that point you need to drop a new battery pack in. The area that you can make the biggest impact on communications range is with the use of a more effective antenna. The stock antenna that comes with HTs is a rubber duck. This is a very inefficient antenna. It is compact and convenient but not efficient. At short range it works great. When you are challenged by distance, you need to go another way.

This means removing the rubber duck and installing an adapter that will allow a coax cable to be connected with a PL259 connector and a gain antenna. This will allow you to elevate your antenna which will improve both your receive and transmit signal. The poorest antenna will improve your signal over a rubber duck by 5 db compared at the same height (A rubber duck has a minus 3 db gain). This is like increasing your power from 5 watts to about 15 watts.

The antenna shown below is a homemade antenna that cost less that $5.00 to build but it improves operations by light years. I tried one today on VHF using a 5-watt HT and worked a repeater on Apple Orchard Mountain that is located over 125 air miles from my location. I could have worked a station over 200 miles from my location through this repeater using a 5-watt HT.



This antenna is constructed using 3 pieces of 17 ½" insulated solid #12 wire and a SO-239 connector. The ideal way to hoist this antenna into place is with a roll of duct tape for weight. You tie one end of a 3/16" cord to the roll of duct tape and you can throw the tape over limbs as high as 35 feet with this system. Attach the other end of the cord though the loop (cable tie) and attach your coax to the SO-239 and pull on the lose end (one attached to the roll of duct tape) of your cord until your

antenna reaches the apex of your cord. Tie off the other end. Your HT now is like a base station.

The illustrations below show why a gain antenna improves your performance.

FIG 1

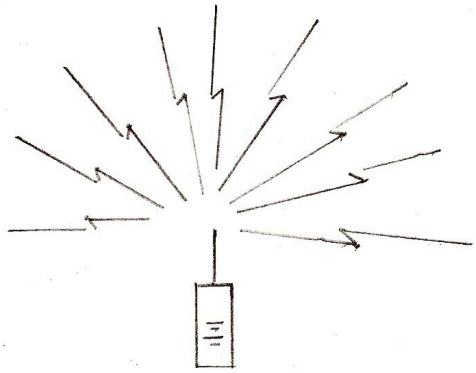
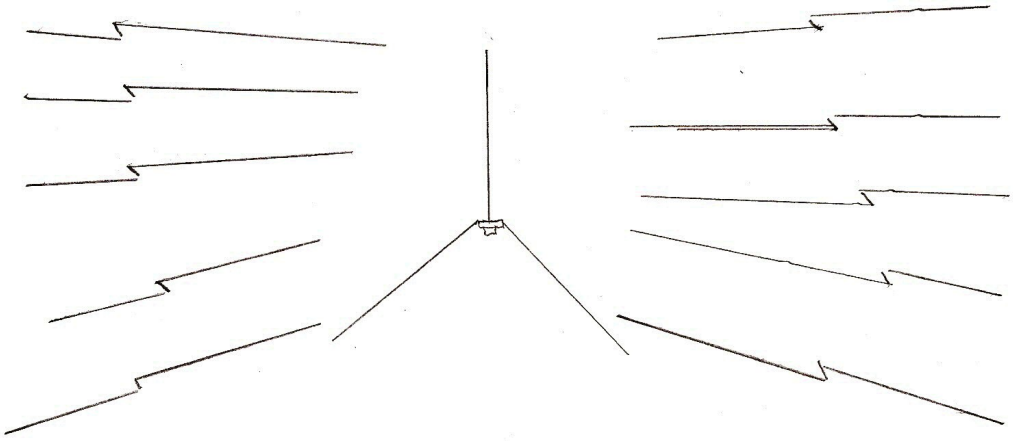


FIG 2 VHF HT WITH RUBBER DUCK ANTENNA



¼" WAVE VERTICAL - 8 DBI GAIN AT 25' HEIGHT

When you operate with a radio that has 5 watts output an antenna of any type will not increase your power. It can redirect your power to give you the most effective radiation pattern. When you raise this antenna higher it does two things for you. One is that it increases the distance of your line-of-sight to the horizon. For example if you are on a high mountain you may be able to see many miles in all directions. There are peaks in Virginia that you can see 5 states from this mountain location. That means that with a 5 watt HT and a rubber duck you can talk with stations in those 5 states. If you raise your antenna to an elevation of 25 feet above ground

elevation you increase your line-of-site to the horizon and your radio range. A second thing that happens is that your antenna radiation pattern is changed for the better. If you didn't increase your line-of-site just the increase of height of 5 feet to 25 feet gives you a pattern that would equal to increasing your power from 5 watts to 25 watts. You may ask how does this happen. Figures 1 & 2 above illustrates how this happens. The HT has a minus gain due to its short size and it has a coil (inductor) inside the coating of the antenna that allows the transmitter to see a 50 ohm load which is a perfect match but it also waste some energy in the form of heat. Its radiation pattern is like a dome. That means that a lot of your signal goes straight up and heats the clouds, this only has a benefit if you are trying to talk with an airplane.

In figure two you see the ¼ wave vertical has a flat pattern with most of its signal going parallel to the ground. This means that it has a low angle of radiation and that is what your want. Its energy is focused toward the horizon in all directions and increases your range and signal straight toward distant points. A beam type antenna keeps your signal to a low angle of radiation and focuses all the energy in one direction. With an eleven-element beam your signal would have the effect of increasing from 5 watts to 75 watts in the direction you antenna is pointed.

If you are working on a house and having problems reaching another station, going to the upper floor may help. In an urban setting going to one of the higher floors and moving to a window facing the direction you wish to talk will help. If your have a microphone connected to your HT and you have the rig attached to your belt, disconnect the rig from your belt. Hold it well above ground level in a vertical position. Having the HT against your body will allow much of its energy to be absorbed by your body. These are just a few ways of increasing the effectiveness of low powered equipment.

If you use a mast pole, you can make up a copper "J" pole for about $15.00 and it will compete with antennas that cost over $100.00.

Prior to deployment make sure that you have a good charge on all your batteries for your HT. It you charged your batteries a couple of months earlier you will not have fully charged batteries two months later.