

Using CROSSBAND Repeaters (CBRs) -

By Neil Robin, WA7NBF - March 14, 2009

Background Information:

Most of us have not used specialized repeaters that provide fill-in communications when normal duplex repeaters don't cover an area or are out of service. SIMPLEX communications suffer from limited range and may not be effective in an emergency or Public Service event.

In the summer of 2008 we did some experiments using CBRs to extend range of communications. Further information can be found at the [Airborne Crossband Repeater Project](#) page.

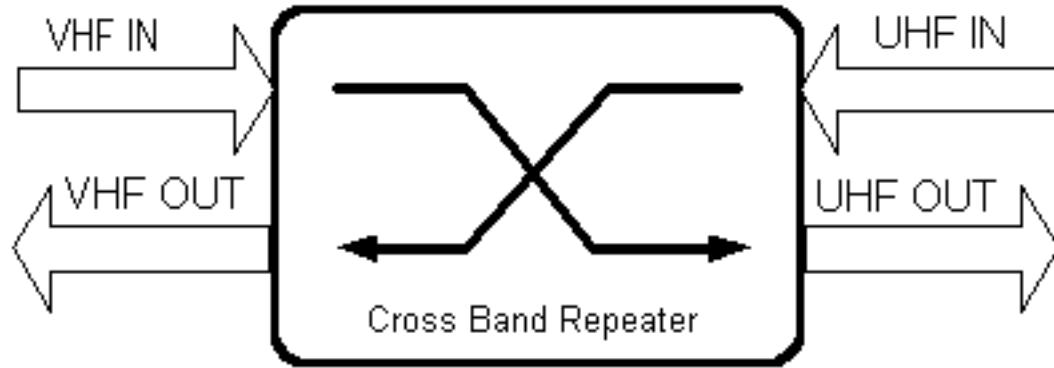
Emergency or portable repeaters fall into two classes:

- 1. Simplex Repeaters**
- 2. Cross Band Repeaters**

Of course you could attempt to build a portable full duplex repeater but the main hang-up is the duplexer size, bulk and criticalness of set-up. In short, they are impractical for portable use. Some have built UHF portable units but fewer amateurs use these frequencies. Building highly selective duplexers is easier as you go up in frequency but you need critical test equipment and the knowledge to properly use it.

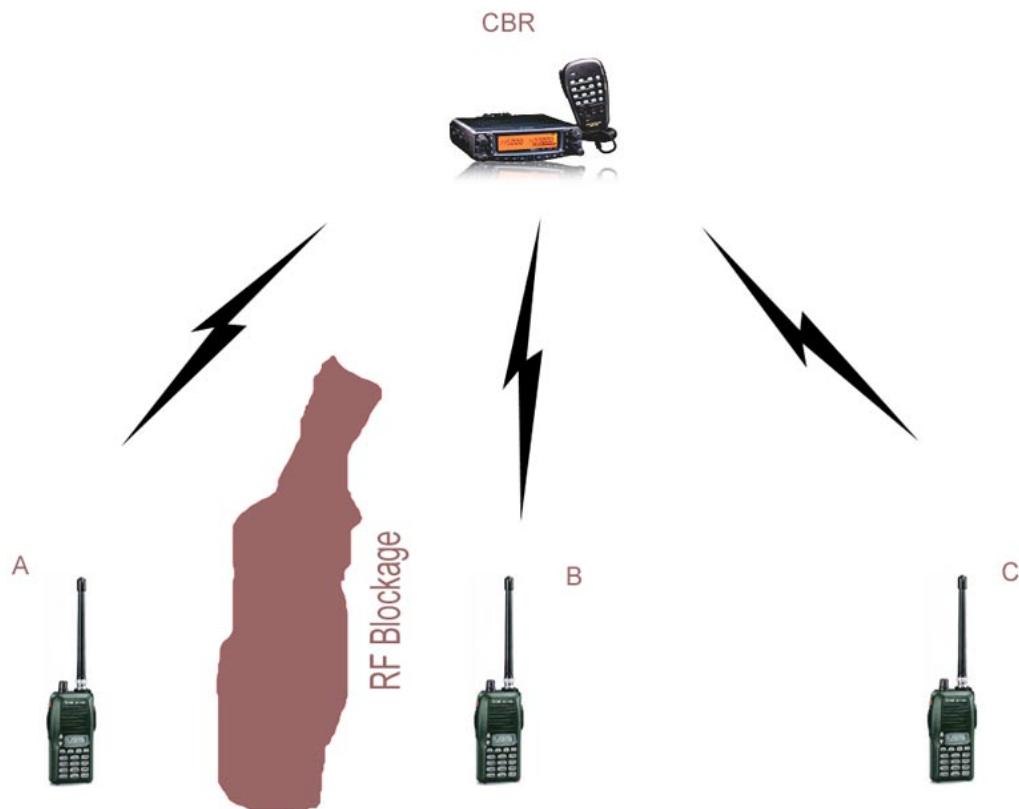
Approach #1 is the most straightforward approach and requires nothing more than a recording memory along with a transceiver. First, the receiver listens for the signal and then when the squelch drops, it plays back the recorded transmission into the transmitter. Sounds simple but operators have lots of trouble understanding its operation because few have been exposed to it. It ends up being confusing and most organizations get discouraged and drop its use.

Approach #2 is much more practical because it works nearly identical to a normal repeater. Rather than having duplexers, it uses two bands such as 144 MHz and 440 MHz with transmission between them in both directions. Many multiband mobile style radios have a crossband setting and are easy to set up and can work with full duplex repeaters as well.



Limitations of Crossband:

1. Users should ideally have dual band handhelds that match the CBR frequencies to gain maximum flexibility. But, in some cases a single band radio can be made to work with good planning.
2. Placement of the CBR unit so that all stations have adequate repeated signal. UHF has slightly reduced range over VHF.
3. Solving the "hidden transmitter problem" in a simplex system. If all stations can hear the CBR but not each other then a new problem must be considered. The CBR allows range extension by transponding only.



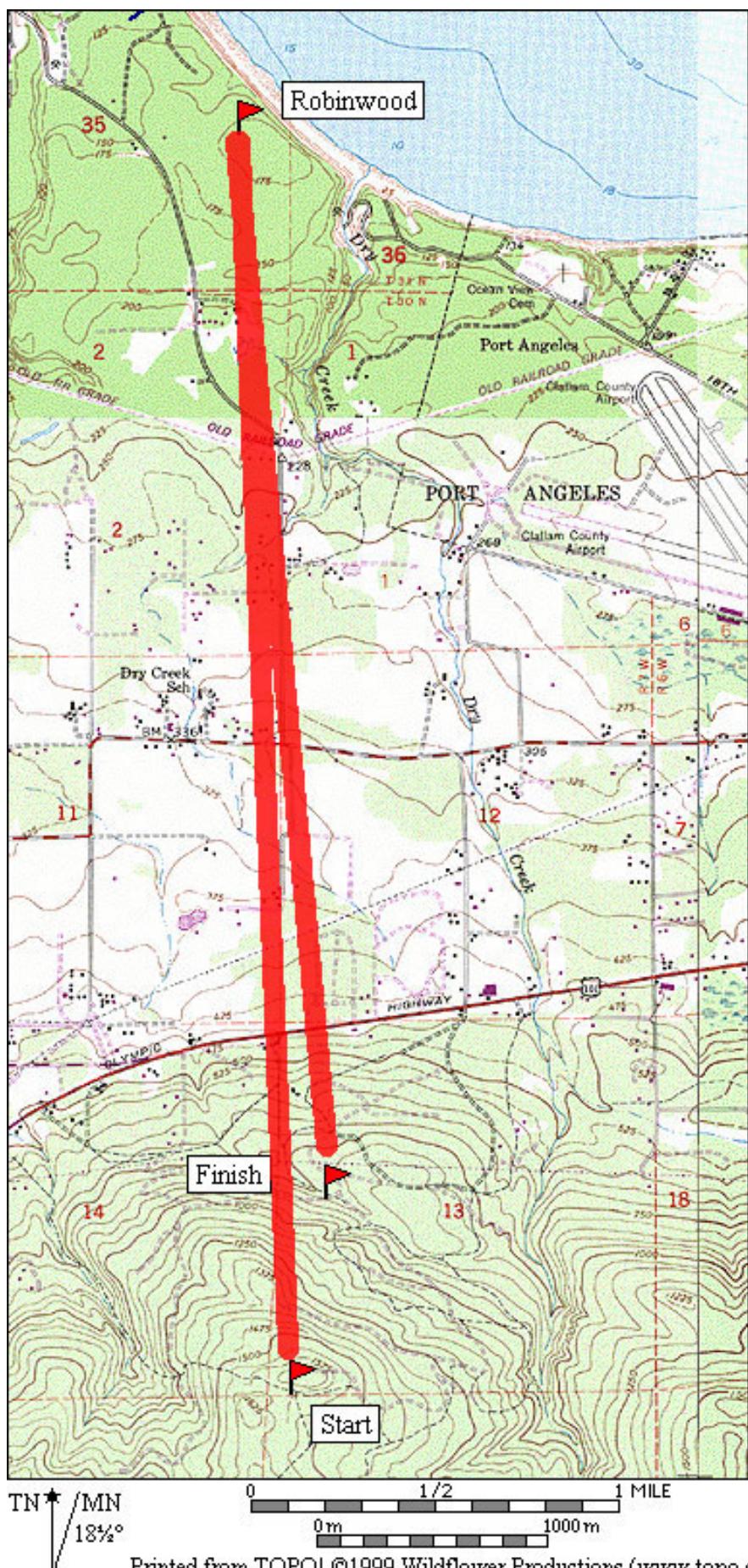
Now let's take a look at the above diagram to see what we mean by "the hidden transmitter" effect. Notice that station "A" and "B" are separated by terrain that won't allow RF propagation at VHF/UHF frequencies. It will also be assumed that station "C" cannot communicate with "A" because of this same restriction. If the important path to maintain was between "A" and "C" then we could use a CBR between the two of them. Let's **put "A" on UHF** and **"C" on VHF** going through the CBR. Station "B" and any others not shown, must be able to communicate to the network also. If we put "B" on UHF, then "B" and "A" cannot communicate directly to each other because the CBR only relays to station "C". We're forced to put **"B" on VHF** because that's the only way we can reach "A". This requires that "B" and "C" have a direct path to each other so they can communicate since they will not involve the CBR in their point to point communications.

Special Case--using CBR with full duplex repeater(s):

It becomes obvious that CBRs do well when one or two stations are hard to reach but the rest work well together on a normal full duplex repeater channel. The most common use of CBR's is to extend the range of 1-2 stations and this works well with repeaters like Stripped Peak, 146.760 MHz which we tried on Feb 24th and again on March 10, 2009 for ARES net checkin with excellent results. Other stations didn't even know that we were using CBR until we told them. It's important to understand the extension possibilities of a CBR since its battery operated and can be set up in a matter of minutes at strategic points in the geography. You have eliminated the "hidden transmitter" problem on the VHF side in this configuration.

An even more interesting effect is linking two full duplex repeaters, one VHF and one UHF using a CBR. This is done in Victoria. The "hidden transmitter" problem is totally eliminated.

EXAMPLE - Using a CBR for Dry Hill Bike Race:



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I thought that we could try an experiment during the April Dry Hill Downhill Bike Race. I'll have a CBR set up at my home QTH to see if we can improve communications? In the past, FINISH had trouble hearing the START station.

On the map to the right is shown the terrain of the Dry Creek Downhill Bike race. In particular, the START and FINISH along with my home QTH, Robinwood, which is about three+ miles to the north. The red lines show the radio path from my home to those operating positions. Although they're less than one mile apart, its heavy vegetation so signals are spotty. By placing a CBR at my home which is nearly 4 miles away, we should be able to solve this problem. The START would operate on UHF and the FINISH on VHF. Even though the distance is much further to my QTH, its open terrain with few trees as the location of the race site is on the side of a hill facing North. The overall path loss is much less than through the trees. Problem solved... well not quite!

We also have stations between start and finish that need to be part of the communications. Ideally, we should all be able to hear and reach each other. If a station just North of START were to operate on VHF, then he would have good communications to START by CBR. However, FINISH may have difficulty hearing him because he is not repeating through the CBR to FINISH. Remember, FINISH was assigned to the VHF channel. This puts both stations on the same band, VHF, and separated by a forest that may block the signals.

Rule:

If one or more stations can't hear the rest in a simplex (or Duplex) network, move them to a secondary band (UHF) and use a CBR to reach them. However, any stations moved in this manner must be able to hear each other w/o the use of the CBR.

In other words, all stations on a given band must be able to communicate directly with each other (SIMPLEX) on that band since the CBR is not used in in-band communications.

Back to the race: With all this in mind, START and the upper course station, JUNCTION will probably operate UHF simplex and the rest will stay on VHF simplex. This will also depend on who has UHF and we might have to move people depending upon handheld capability.

If anything goes wrong, we will just meet back on the VHF frequency as we have in the past.

Advanced CBR-Summary:

One note that should be made is that if participants of an event had Cross Band Handhelds, you could operate with this system in a full duplex mode. That is , you can transmit at the same time that you are receiving. The problem is, most amateurs don't own full cross band HT's, only dual banders which does not allow for this mode of operation. Set up details for future events will be posted at sign-up postings.

Another crossband resource:

[**SIMPLEX CROSS-BAND REPEAT OPERATION – WB3GCK**](#)



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