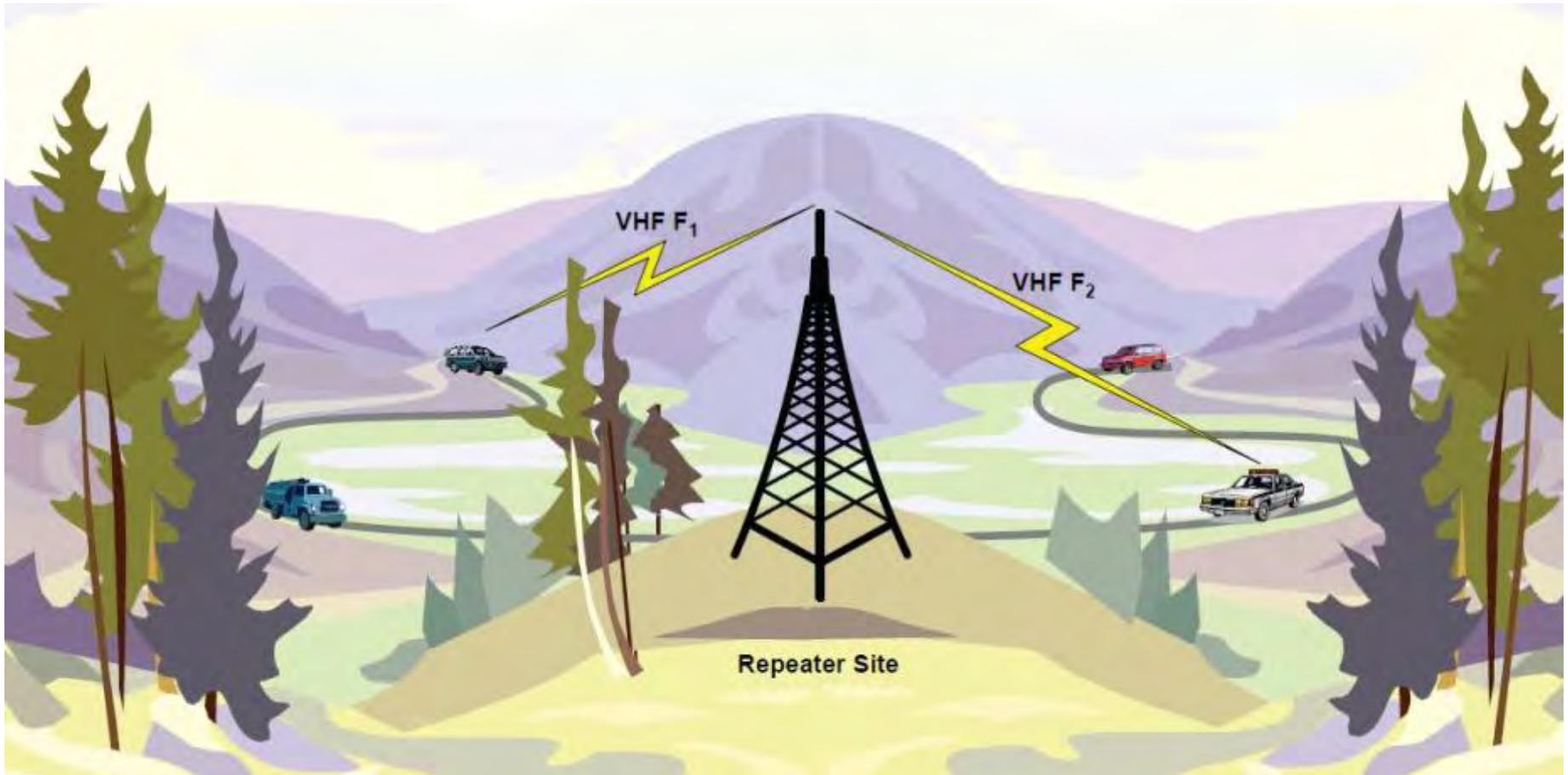


# Concept of How to Configure Your Handheld and Mobile Radio for Use on a Repeater System

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Calgary Amateur Radio Association 2015 Learning Conference



Limitations of "Standalone" Radios such as Handhelds and Vehicle Mounted Mobiles.

Short Range of Coverage

"I can't hear you"



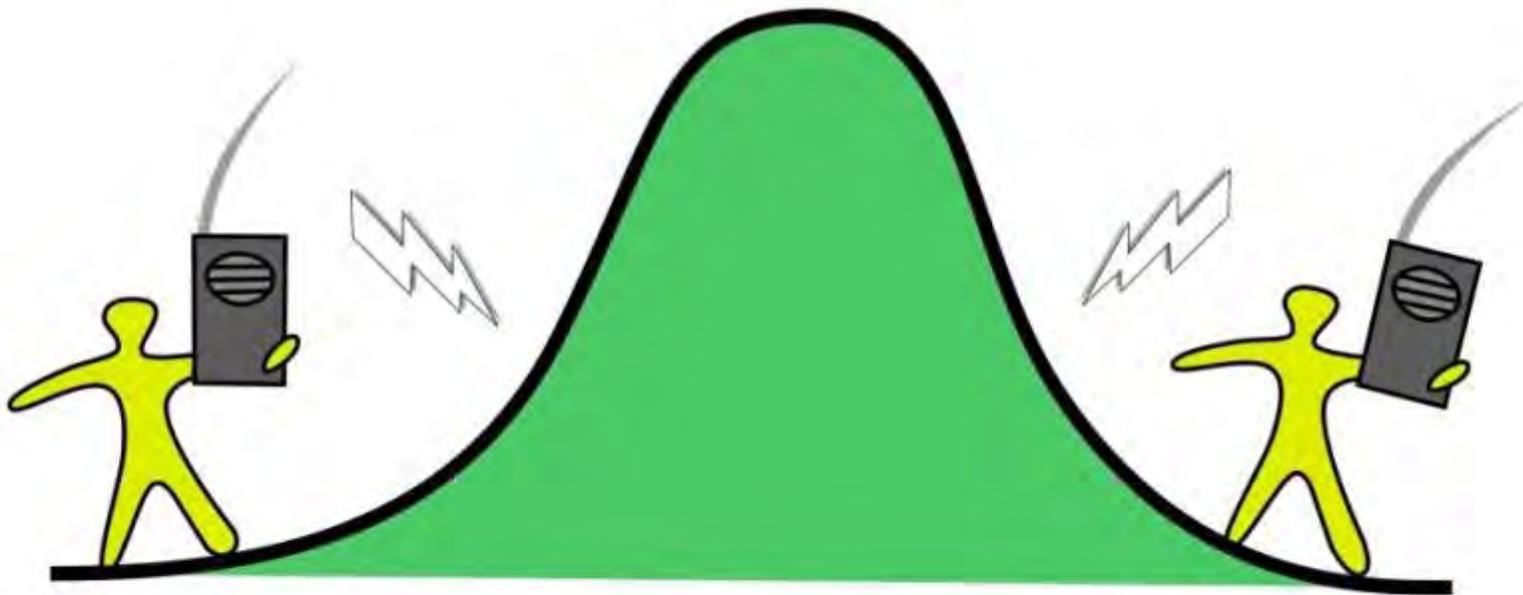
"Nope, I still can't hear you either!"



Signal easily blocked by major obstacles such as mountains, valleys, urban infrastructure

**"I can't hear  
you ..."**

**"I can't hear  
you either!"**



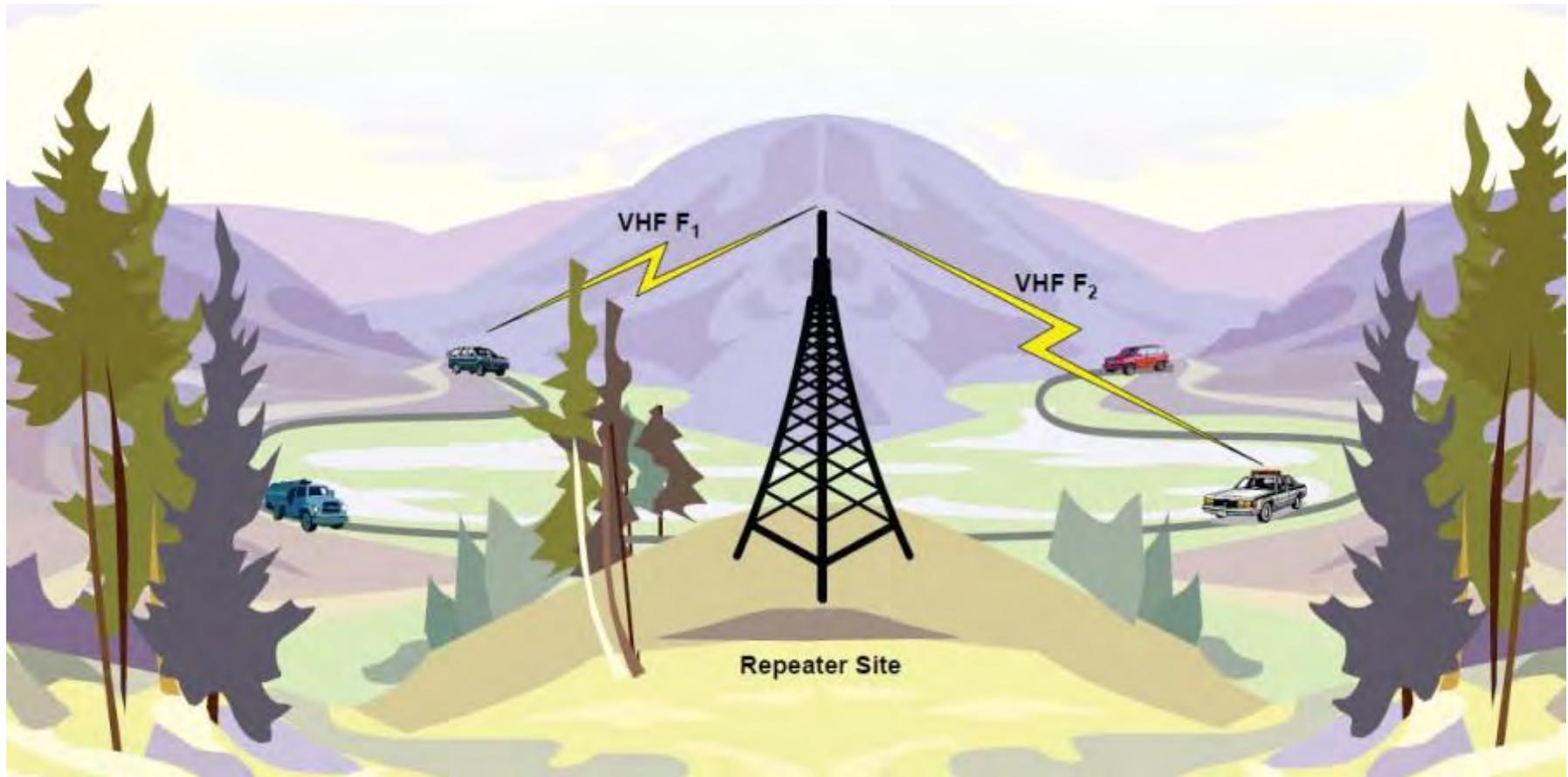
## What is a “Repeater” Radio?

A repeater is basically a two way radio that receives a signal on one frequency, and simultaneously retransmits it on another frequency. It can retransmit with much greater power than received, and can send over a much wider area. A good example is where users are scattered in various areas separated by mountains; if a repeater is situated on top of a central mountain, it can gather signals from surrounding valleys, and rebroadcast them to all surrounding valleys. Handy!

From there, repeater stations can be “linked” together to connect a series of repeater radios, each in a different area. With this, every time a user transmits on his mobile or handheld, his call will be heard simultaneously over all the repeater transmitters.

And, yes! Repeater stations can now be connected via the internet. This internet linking is called IRLP – Internet Relay Linking Project. For example, a repeater in Calgary can link, via the internet, with an IRLP repeater anywhere in the world. You can carry on a two way radio conversation with someone in a faraway land with the assistance of the internet.

## Locating of Repeater Stations



The higher the better. Yes, there are even satellite repeaters for amateur radio.

In places that afford the best coverage in as many directions as possible.

**First We Need to Examine a  
Repeater Radio Before We Look at  
How to Set Up Other Radios to  
Communicate with a Repeater  
Radio**

## **Transmit and Receive Frequencies (Frequency Pairs)**

Each repeater in a province has a transmit (TX) and receive (RX) frequency assigned to it by a provincial frequency coordinator.

Southern Alberta's coordinator is Ken Oelke VE6AFO

## Offset

The offset is the difference between the frequency for the incoming signal (RX) and the frequency for the transmitted signal (TX).

<u>Band</u>	<u>Offset</u>
6 m	1 MHz
2 m	0.600 MHz
1.25 m	1.6 MHz
70 cm	5 MHz
33 cm	12 MHz
23 cm	20 MHz

## Offset Direction

On the 2 meter band, 144 – 148 MHz (VHF), the rule of thumb is,

if the transmit (TX) of the repeater is below 147 MHz, the receiving frequency (RX) is 0.6 Megahertz lower. This is known as a negative offset.

If the TX frequency is 147 Mhz or above, then the RX frequency is 0.6 MHz Megahertz above, a positive offset.

This is only a rule of thumb; it is not compulsory.

For the 70 centimeter band, 430 – 450 MHz (UHF), the offset is + 5 MHz

## Tones

In congested areas, there may be other radio users on the same frequency, resulting in needless continuous attention to the radio by a user to hear if there is a call coming in pertaining to him/her.

Another problem with repeaters is there can often be a lot of just plain “noise”, from intermodulation, nearby low quality radio transmitters, passing vehicle RF systems, commercial/industrial equipment with RF features, atmospheric conditions, etc.. This results in the repeater constantly engaging and dropping resulting in wearing it out, or exceeding its duty cycle and overheating, or, if battery powered, exhausting it’s stored power.

It also results in other users not being able to use the repeater if something else has it “keyed up”.

## **CTCSS “Continuous Tone Coded Squelch System”**

Radios transmitting to a repeater transmit, simultaneously, a tone that is inaudible to the human ear, measured in Hertz (cycles per second i.e. ‘frequency’). They transmit this sub audible tone continuously while their Push to Talk (PTT) key is held down. The repeater won’t “open up”, and do its job of retransmitting the signal, unless it hears the tone, at the correct frequency, that it is programmed to do.

• Available CTCSS tone frequency list

(Hz)

No.	Freq.								
01	67.0	12	94.8	23	136.5	34	177.3	45	218.1
02	69.3	13	97.4	24	141.3	35	179.9	46	225.7
03	71.0	14	100.0	25	146.2	36	183.5	47	229.1
04	71.9	15	103.5	26	151.4	37	186.2	48	233.6
05	74.4	16	107.2	27	156.7	38	189.9	49	241.8
06	77.0	17	110.9	28	159.8	39	192.8	50	250.3
07	79.7	18	114.8	29	162.2	40	196.6	51	254.1
08	82.5	19	118.8	30	165.5	41	199.5		
09	85.4	20	123.0	31	167.9	42	203.5		
10	88.5	21	127.3	32	171.3	43	206.5		
11	91.5	22	131.8	33	173.8	44	210.7		

## CTCSS Tones Proprietary names

PL – Motorola “Private Line”

CG – General Electric “Channel Guard”

QC - RCA “Quiet Channel”

CT – ICOM “C-Tone”

QT – Kenwood “Quiet Talk”

TG – Johnson Corp “Tone Guard”

CG – Johnson Corp “Call Guard”

TL - Zetron “Tone Lock”

QC - Ritron “Quiet Call”

... and so on

## CDCSS / DCS “Continuous Digital Code Squelch System”

Digital Code Squelch (DCS) used in digital radios.

Proprietary names

DPL – Motorola “Digital Private Line”  
etc.

## Time-out Cutoff

This is to discourage long winded talkers. Some repeaters are in great demand and the idea is to share.

Also to release the repeater in case someone is inadvertently sitting on their microphone ... .. YEP, this happens a lot !! The timer setting is usually two to three minutes.

## Courtesy Tone

This is a tone sound, which can also be reset to other sound files, that is broadcast by the repeater, each time the repeater 'drops' and switches to receive mode from transmit mode. It lets everyone know that someone else can take a turn talking.

## **Hang Time or Drop Out Time**

The short pause between when a user releases the PPT button on his rig and when the repeater drops.

The next user of the repeater needs to allow a pause before pressing the PTT button on his/her rig or else the first second or so of the transmission will be cut off.

## **Certification to Operate an Amateur Repeater Station**

To set up and operate a “same band” repeater radio, Industry Canada’s “Advanced” Amateur Radio Operator License is required.

**OK !**

**Now we can adjust the settings of  
our handhelds, mobiles, and base  
stations to use a repeater !**

## Let's Set Up a Radio to Use the 2 meter Band on CARA's VE6RYC Repeater on Nose Hill

Band	VHF 144-148 MHz
Mode	frequency modulated "FM"
Transmit Frequency	146.250 MHz
Offset value	0.600 MHz
Offset direction: +/-	"minus"
Receive frequency	146.850 MHz

Tone type	CTCSS for VE6RYC on the 2 metre band
Tone RX	110.9 Hz
Tone TX	110.9 Hz

## **Time out Function**

Again, to discourage long winded talkers. Again, to release the repeater in case someone is inadvertently sitting on their microphone.

## Broadcast Power

Hi/Med/Lo: e.g. on a mobile 50W / 10W / 5W. Be aware that if you have a mobile set to High power, other radios nearby may not be able to receive your signal. This is due to a phenomenon known as 'desensing'. In this case simply turn down the power on your radio to the next level and see if others next to you can receive you.

## **Band width “narrow banding / channel spacing”**

If the area you are in has a high demand for channel pairs, there may be an effort in place to squeeze as many ‘channels’ out of a band as possible. In that case, be sure you are using higher quality equipment and set your band width to ‘narrow’. This will make sure that the frequency that your radio transmits on will deviate, as in the case of the 440 band, not more than a total range of 30 kHz. For example, for the TX on your rig, the TX nominal frequency of 146.250 MHz should be between 146.235 Mhz and 146.265 MHz.

## **Set up and Save to a Channel**

After you have manually set each of the above parameters, you can save these settings into a memory for instant recall in the future.

## Scan Inclusion

Scanning is where you can set your radio to quickly listen to a designated subset of your preset channels. The 'scan inclusion' function simply adds or subtracts each channel to the scanning set. The rig will listen in on each channel for a few milliseconds. If signals are present it will pause on that RX frequency for a length of time that is preset by the user.

Common presets are:

'STOP' = stop scanning,

'TIME' = pause for a few (preset) seconds, then move on, even if the received station is still transmitting. Usual settings are 1-10 seconds

'BUSY' = pause for as long as the received station continues to transmit.

## Name the Channel

VE6RYC, or 'Club Stn', or 'city north', etc.

Rigs offer at least six characters

## **Deleting a Channel**

A handy feature if your radio has a limited number of channel memories, or if you just don't need a preset anymore.

## Locking the Settings

Very important !! You don't want to inadvertently bump your radio and cause your it to go 'off channel' resulting in losing contact with a net. You could spend a long time wondering why there is dead air. It happens a lot!

Once you select your channel, lock it!

## What is a “Cross Band Repeater” Radio?

A cross band repeater radio is basically the same as that of a same band repeater, except that it uses the dual bands of VHF and UHF. Input (RX) signals that arrive on a UHF frequency will be output (TX) on a VHF frequency. And vice versa.

Mobile rigs are the main application of cross band technology. The beauty of this system is that a vehicle, that is part of a wide ranging net, and which might be dozens of kilometres from a same band repeater, can be positioned in a remote location. Some handhelds can do cross banding as well.

Personnel with short range handhelds on a UHF frequency can then roam the area around that vehicle and still remain in contact with the main net. Examples of this are search and rescue (SAR) groups focusing on an isolated area, or an ambulance crew that has to walk from their vehicle to retrieve a patient from a ravine.

Locating of cross band repeaters: As with any radio, for best propagation, the higher the better, and with as few obstructions as possible (terrain, buildings, forest, ...).

## **Cross Band Licensing Requirements**

To set up and operate a “cross band” repeater radio, Industry Canada’s “Basic” Amateur Radio Operator License is all that is required.

## Write a Summary of How to Program Your Own Radio

Write your own “quick reference” summary of how to quickly set up your own radio for repeater use.

See the ones I made up for my Wouxun KG-UVD1P handheld and my Yaesu FT-897D portable base station. Download these samples from the CARA web site [cara.memberlodge.com](http://cara.memberlodge.com) from under the “Tech Resources” tab.



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If your are in to sailing the high seas or off roading in the middle of no where, HAM radio could help be your link to the world. Sailors can use Amateur radio from the middle of the ocean to contact the

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2014 Linking Conference Documents  
Solar Indices and Propagation  
**Radio Programming Guides (Simplified)**  
Tech Talk  
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DIGITAL MODES

## Want to Learn More About Repeaters?

For more detailed info on repeater systems and linking systems, please see the technical documents on CARA website [cara.memberlodge.com](http://cara.memberlodge.com) , under the “Tech Resources” tab.

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Thank You