EMERGENCY MEASURES RADIO GROUP	**EMERGENCY MEASURES RADIO GROUP**
AMATEUR RADIO RAC EMERGENCY SERVICE	**OTTAWA ARES**

Two Names - One Group - One Purpose

Cross Band Repeaters

Course Introduction

Course Number: EMRG-403

Course Name: Using Cross Band Repeaters

Instructor Led: Optional

Prerequisites:

- None

What You Should Learn From This Course:

- From this course you should understand the benefits, limitations and proper methods to set up and use a cross band repeater

Recommended Reading:

- EMRG-409 Intro To CTCSS
- Read your radio manual if your radio has cross band repeat capability.

What Is An In Band Repeater

- Transmit & Receive are in the same band. This is a typical Amateur VHF or UHF repeater used every day.
- Requires a Duplexer to separate Receive and Transmit signals, or separate antennas several hundred feet apart

DUPLEXER

Adds or separates signals from the same band, where the signals are close enough together in frequency, that the attached equipment is not able to reject the unwanted signal.

- Tunable to Pass the desired frequency and Reject the undesired frequency
- Used for repeaters and full duplex base stations

What Is A Cross Band Repeater

- Transmit & Receive are in different bands, typically VHF and UHF
- Supports uni-directional or bi-directional repeating
- Several configurations;
  - fixed site used to link neighbouring systems
  - mobile permanently installed in a vehicle
  - movable, made from mobile or portable radios.
- Can use separate antennas for each band, or a Diplexer and dual band antenna

DIPLEXER

Adds or separates signals from different bands, where the signals are far enough apart in frequency, that the attached equipment is able to reject any unwanted signal without impacting the desired frequency.

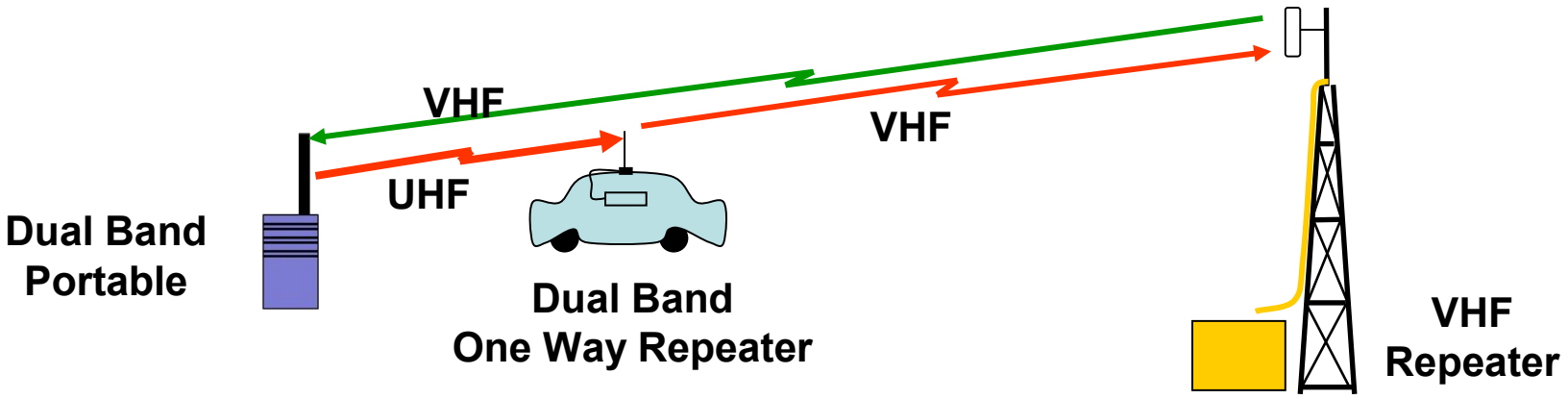
- Not tunable -fixed frequency bands
- Used for multi band radios with a single multi band antenna

The Value Of Cross Band

- Interoperability - Used by Public Safety to link agencies on different bands
- Extends portable radio coverage
  - Used every day by Public Safety as a Vehicle Repeater
  - Used by Amateurs to extend range, or extend coverage into a building, such as a shelter in an emergency.
- Compact compared to an in band repeater.
  - Easy to make portable unit
  - Some Amateur mobile radios have a built in cross band repeater capability.

One Way Repeat
(Uni-Directional)

One way repeating used when the portable radio can hear the repeater, but cannot transmit back due to distance, buildings or lower power.



One Way Repeater receives from the portable radio on a simplex frequency on another band, and transmits to the repeater on the repeater input frequency

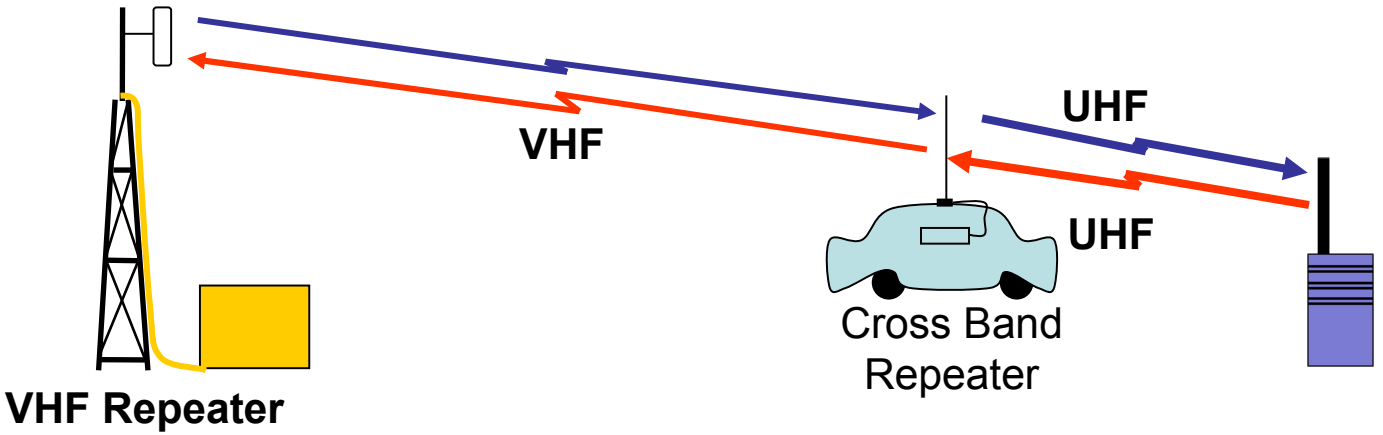
One Way Repeat continued (Uni-Directional)

- Two configurations;
  - **Cross Band**: One Way Repeater and portable radio must be dual band
  - **In Band**: One Way Repeater must have a duplexer
- Benefits:
  - Repeater tail is not a problem. The one way repeater is not receiving from the main repeater
  - Full duplex operation when dual band radios used (talk & listen at same time)

Two Way Repeat

(Bi-Directional)

- Bi-directional repeating used when portable radio cannot receive the repeater reliably, AND cannot transmit back to the repeater due to distance, buildings, lower power.
- Portable radio transmits and receives on simplex frequency to cross band repeater and cross band repeater transmits and receives on repeater frequencies.



Two Way Repeat

(Bi-Directional)

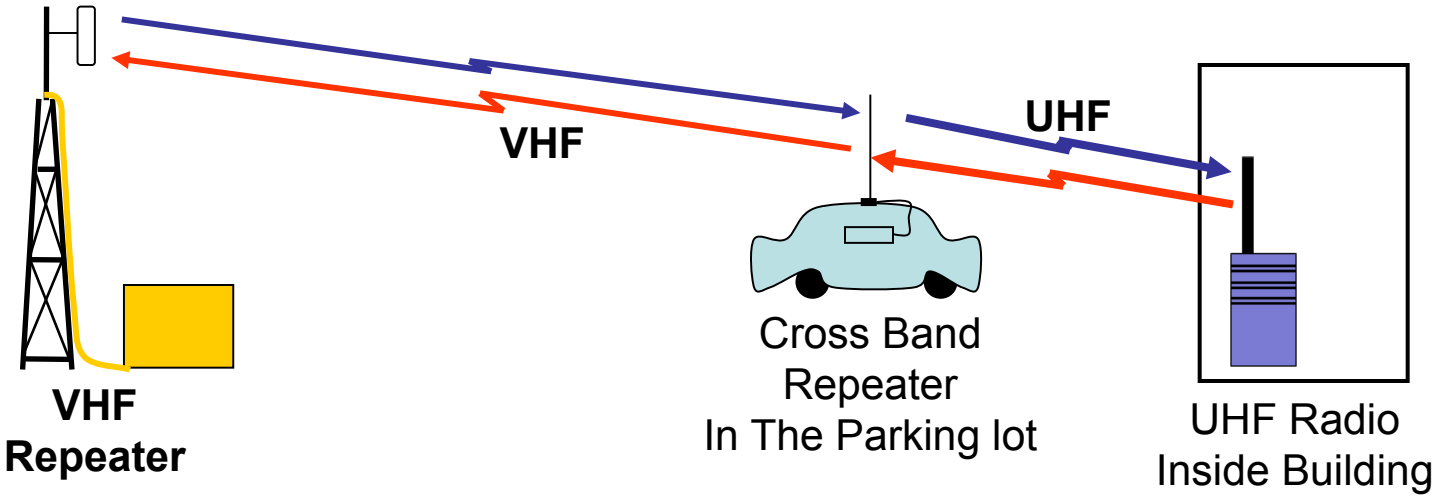
Benefits:

- Extends Receive and Transmit for reliable communications in both directions
- UHF portable has good building penetration, while VHF has greater range

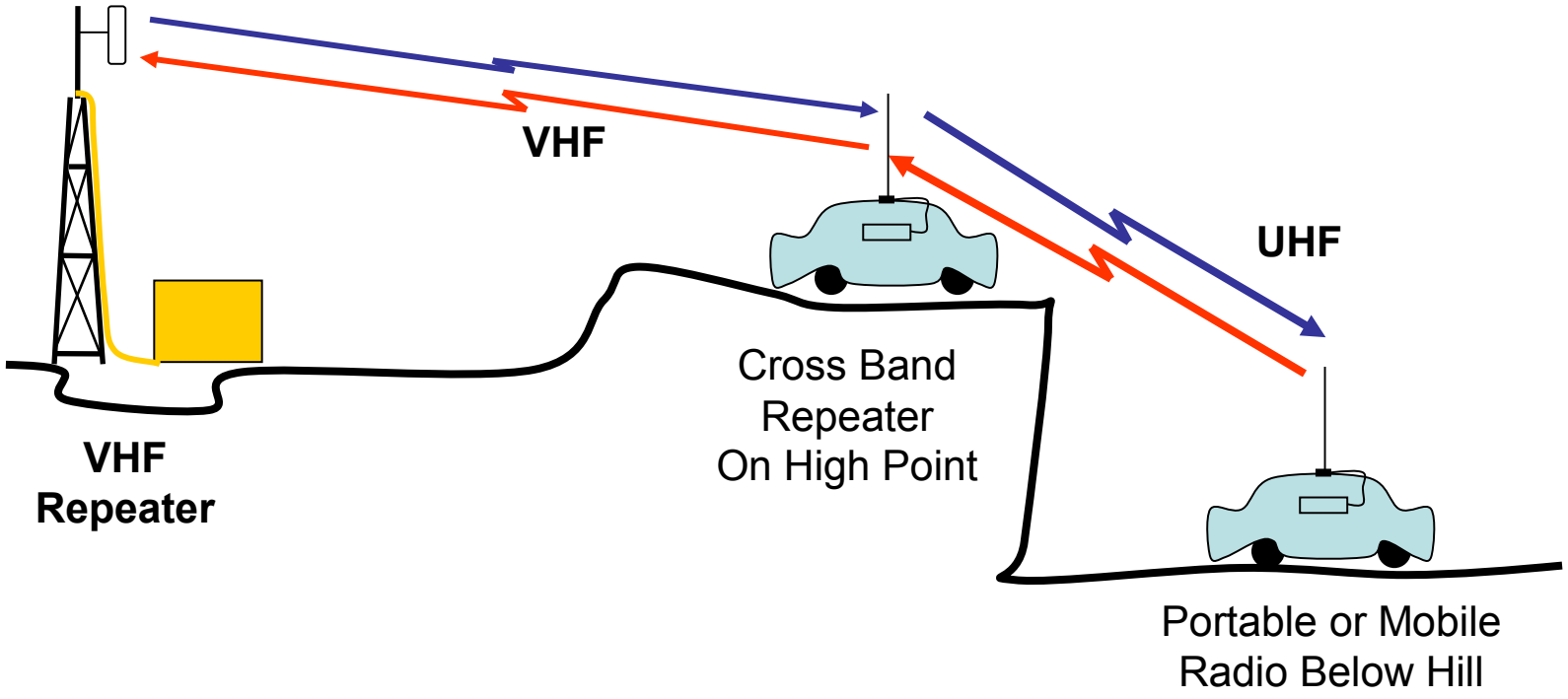
Problem:

- While many Amateur radios have a cross band repeat functionality, not all implement it well. Set up your radio and test it with someone else, to confirm that the audio is clear and the repeater works as you expect.

In Building Example



Extended Coverage Example



CAUTION: Only One Direction At A Time

- Cross band repeaters can receive on VHF & UHF at the same time, so long as they are not transmitting.
- Once the cross band repeater selects an incoming signal on one band, the transmitter on the other band is activated.
- The repeater now only receives on one band and transmits on the other band. The cross band repeater will stay in this configuration until the incoming signal stops.

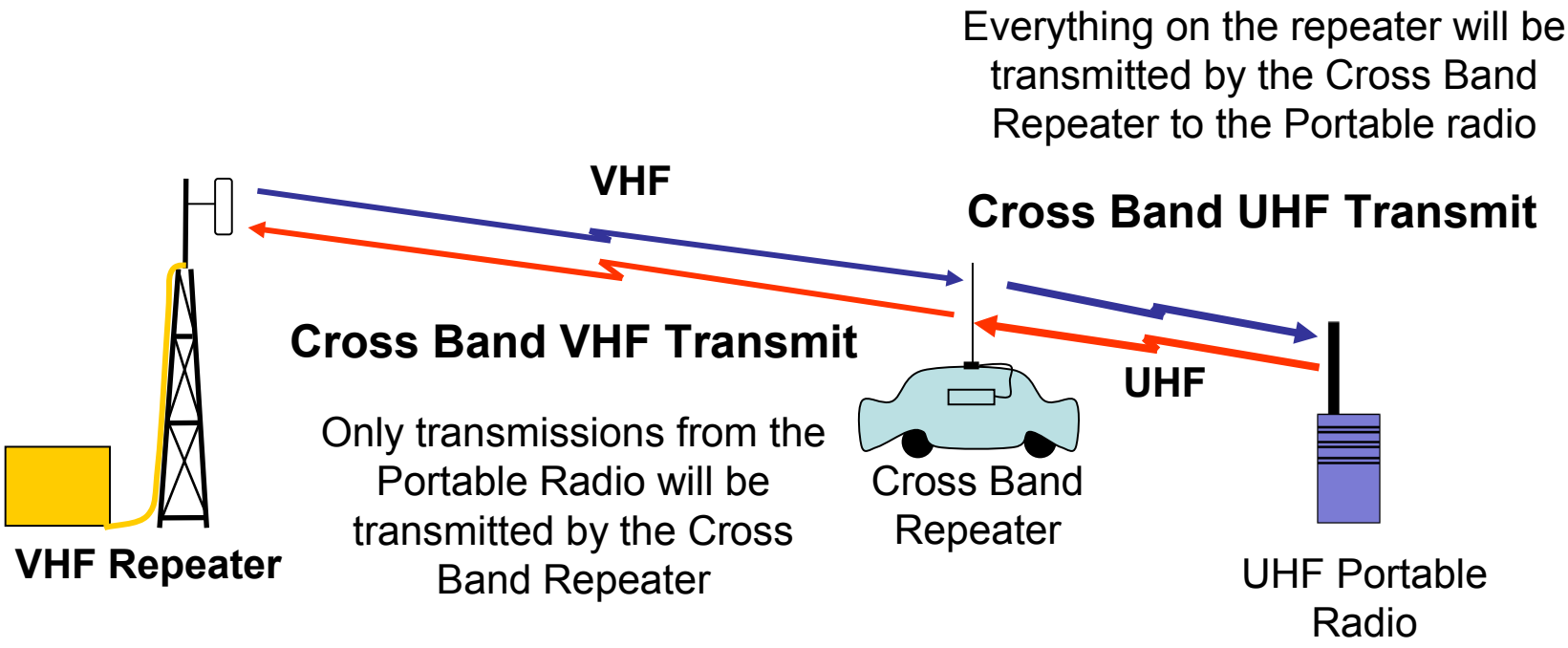
CAUTION: Radio Burn Out

- Mobile radios used for Cross Band repeaters, are not designed for long periods of transmitting. Set the power levels carefully!!
- If using cross banding into a busy VHF repeater, the UHF transmitter in the cross band repeater will be active any time the VHF repeater is active. Set the UHF transmit power as low as possible.
- Add a fan if possible
- Use better antennas, so less power is required.

CAUTION: Repeater Tail

- Repeater tail is the time a repeater continues to transmit, after the incoming signal stopped.
- EMRG tries to set tail as short as possible.
- If the cross band repeater is receiving from the main repeater and transmitting to the portable, the cross band repeater will continue to transmit to the portable until the incoming repeater stops transmitting (tail drops).
- All radio operators should leave open space after a message to let the repeater tail drop, so people using cross band can get in.

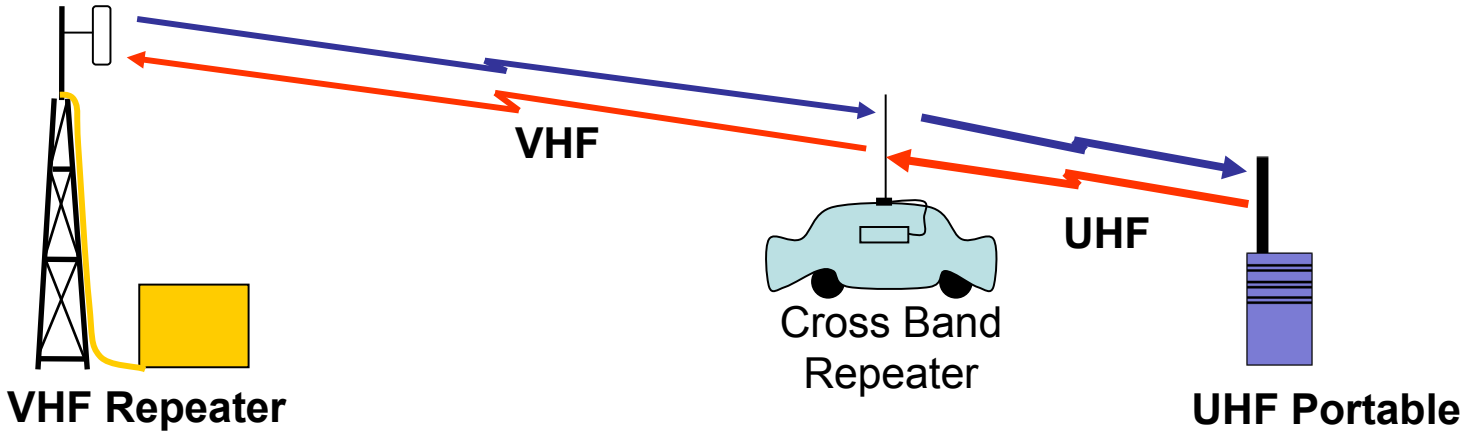
Cross Band Traffic Pattern



USE CTCSS

- Cross Band repeaters repeat everything, including the selected repeater and intermod.
- Most repeaters transmit a CTCSS tone. Set your cross band repeater to receive only when that tone is present to keep from cross banding VHF intermod to your UHF portable.
- It is possible that you are not the only person using Cross Band Repeat on a specific UHF simplex frequency. CTCSS tones can help reduce interference

CTCSS Cross Band Example



VHF Repeater Encode & Decode

Transmit: 146.880MHz
- CTCSS: 136.5Hz

Receive: 146.280MHz
- CTCSS: 136.5

Cross Band Repeater Encode & Decode

Receive: 146.880MHz
- CTCSS: 136.5Hz

Transmit: 146.280MHz
- CTCSS: 136.5

Transmit: 446.200MHz
- CTCSS: 136.5

Receive: 446.200MHz
- CTCSS: 136.5Hz

UHF Portable Radio Encode & Decode

Receive: 446.200MHz
- CTCSS: 136.5

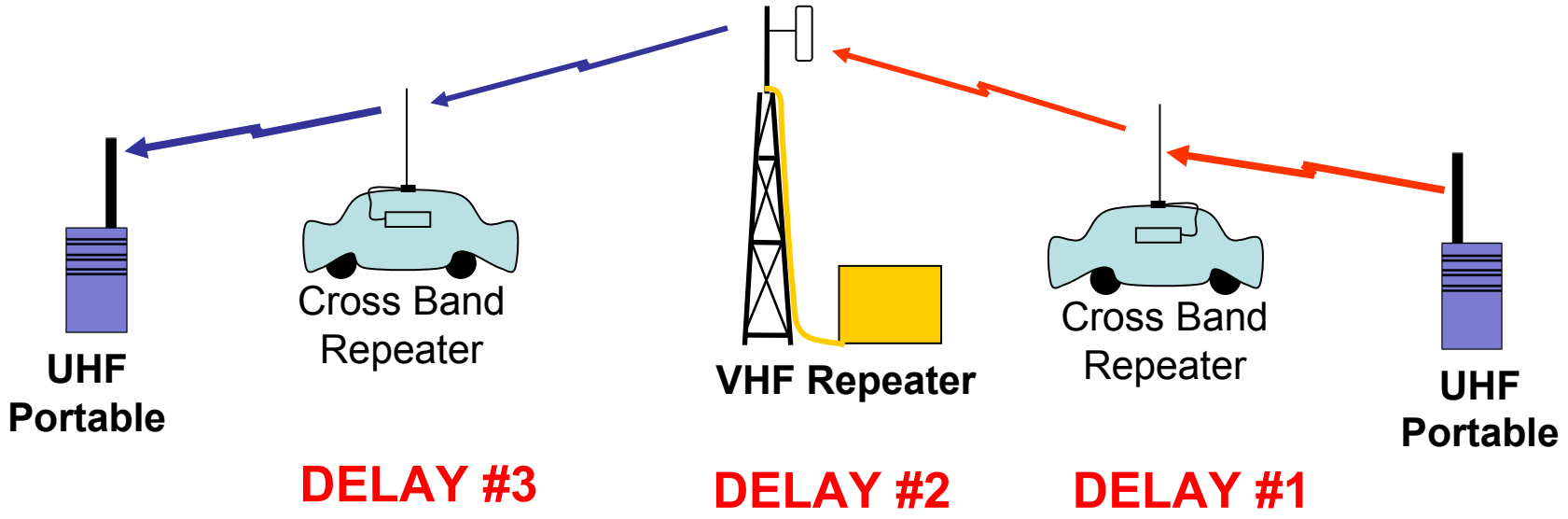
Transmit: 446.200MHz
- CTCSS: 136.5Hz

Push PTT & Wait 2 Seconds

- There is a delay when using cross band repeaters because the repeater needs to receive the incoming signal and activate the transmit in the opposite direction.
- Push and wait 2 seconds applies to all users on the repeater, whether they are using cross band or not.
- An example of what happens when people do not wait, is they cut off the callsign of the person being called, so all that is heard is the callsign of the person calling.
- A more serious example is if the reply is NO FIRE, and the radio operator pushes the PTT and talks right away, the other end will get the message FIRE.

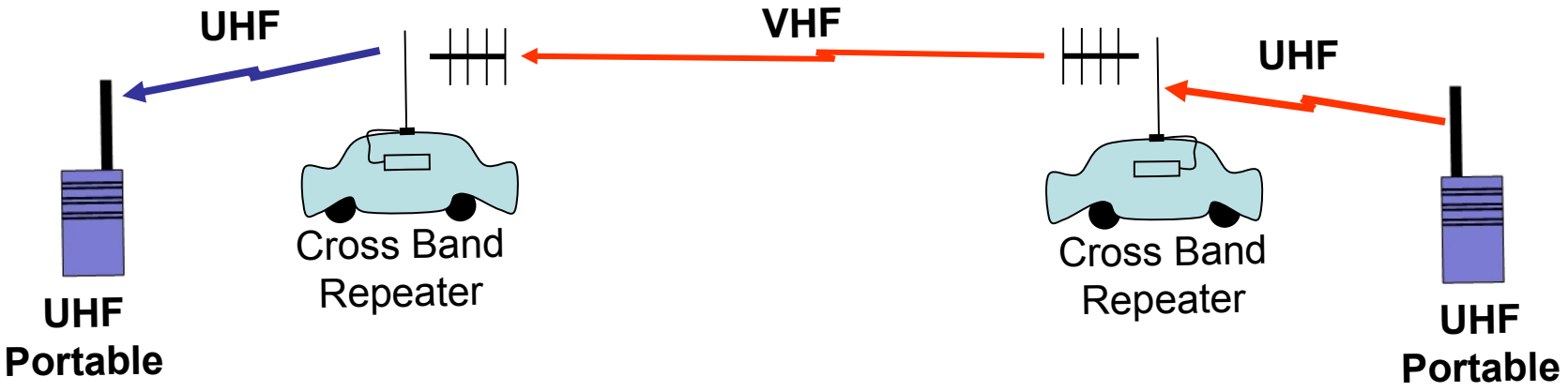
Two Cross Bands

- If two stations are using cross band repeaters and they are talking through a repeater, the delay can be significant, so **ALL** operators need to wait before they speak.



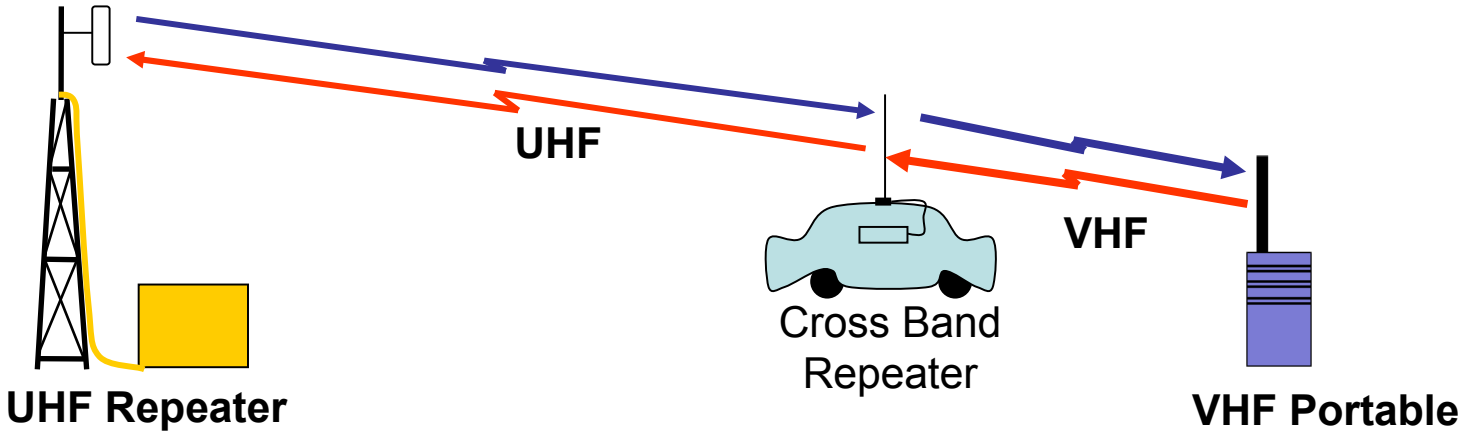
Extend Simplex Range

- Cross Band repeaters can be used back to back to extend the range of simplex communications.
- Using separate transmit and receive antennas on the cross band repeaters would allow a VHF beam to extend distance



It Works Both Ways

- The cross band repeater does not care which band is a portable radio and which is a repeater.
- A VHF portable can be used with a cross band repeater to extend the range of a UHF repeater.



PRACTICE USING CROSSBAND!

- In EMRG deployments and exercises, it became very clear that using a cross band repeater is not as simple as it appears. There can and will be issues!
- Write out the steps required for your radio to configure a simplex channel with CTCSS and how to activate the cross band repeater.
- There is no substitute for regular practice. Set up your cross band when checking into the weekly net. This helps you understand your radio and it helps others remember to push the PTT and wait before they speak.

Self Test

1. If you want to have a VHF and UHF radio share a single antenna, do you need a Duplexer, or a Diplexer?
2. List one value of using a Cross Band Repeater?
3. Should you use CTCSS on a cross band repeater? Why?
4. What causes cross band repeaters to burn out?
5. If some stations are using cross band repeaters, and you are not, should you transmit before the repeater tail drops (before the repeater stops transmitting)? Why?
6. Why do you need to wait after you press the PTT, before you talk?
7. Can you use a cross band repeater with a VHF portable radio, extending into a UHF repeater.
8. Can cross band repeaters be used back to back to extend simplex range?

Answers

1. If you want to have a VHF and UHF radio share a single antenna, do you need a Duplexer, or a Diplexer?
   - Answer: Diplexer
2. List one value of using a Cross Band Repeater?
   - Possible Answers: Interoperability, Extends portable radio coverage, Compact compared to an in band repeater
3. Should you use CTCSS on a cross band repeater? Why?
   - Answer: Yes you should use CTCSS to keep from cross banding intermoc
4. What causes cross band repeaters to burn out?
   - Answer: Setting the transmit power too high to the portable radio, when cross banding into a busy repeater.
5. If some stations are using cross band repeaters, and you are not, should you transmit before the repeater tail drops (before the repeater stops transmitting)? Why?
   - Answer: Any operators using a cross band repeater cannot transmit from the portable to the repeater until after the repeater tail drops. If other radio operators do not let the tail drop before they transmit, then cross band repeater operators may be locked out of the repeater.

Answers continued

1. Why do you need to wait after you press the PTT, before you talk?
   - Answer: It takes time for the cross band repeater to detect the incoming signal on one band and activate the transmitter in the other band.
2. Can you use a cross band repeater with a VHF portable radio, extending into a UHF repeater.
   - Answer: Yes
3. Can cross band repeaters be used back to back to extend simplex range?
   - Answer: Yes

www.emrg.ca

The EMRG web site provides information related to Amateur radio emergency communications, specifically as it relates to the City of Ottawa.

- Project Information
- Newsletters
- Upcoming Events
- Documentation
- Links to related information

Information: **training @ emrg . ca**