



Cross-band Repeating

Santa Clara County ARES®/RACES
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Learning Objectives

- What is cross band repeating
- How to do it
- Scenarios for cross band repeat use
- Legal considerations
- Operational considerations
- Frequencies

What is a repeater?

- Something that re-transmits radio signals
- Purposes
 - Extend range of signal
 - Overcome terrain obstacles

Types of Repeaters (1)

- Simplex Relay - Re-Transmit Signal, same frequency, time delay
 - Digipeater/nodes (automatic, used in packet radio)
 - Simplex relay (you relay what you heard)
- In-Band Repeater
 - Xmit at same time on same band as received, but different frequency
- Cross Band Repeater
 - Xmit at same time on different band than received

Types of Repeaters (2)

- In-Band Repeater
 - Xmit at same time on same band (different frequency) as received
 - Most common type of voice repeater – like N6ICW, K6IS, etc.
 - Requires bulky/expensive filtering to allow repeater to “hear” incoming signal vs. transmitted signal
 - Radios using repeater must be set up with proper shift and (in most cases) tone

Types of Repeaters (3)

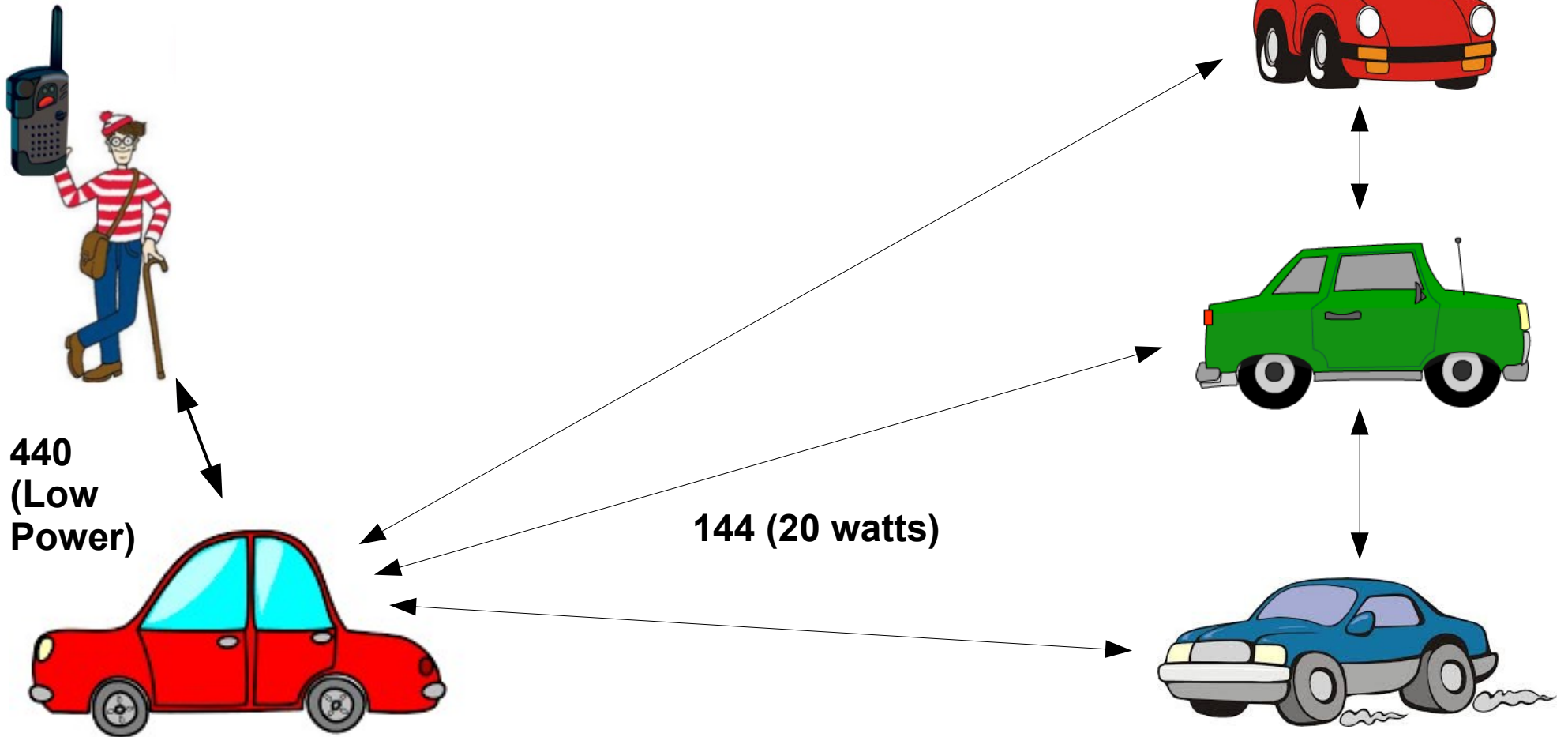
- Cross Band Repeater
 - Xmit at same time on ***different*** band (usually 2m/440)
 - Much cheaper and simpler to set up than an in-band repeater
 - Generally uses simplex frequencies
 - Those using a cross band repeater normally do not need to shift frequencies when transmitting/receiving
 - Generally can be set up anywhere – mobile
 - MANY radios, especially mobile radios, are capable of cross band repeat

Typical Cross Band Setup



- Set up one frequency (eg. 2 meter) on one side
- Set up 440 frequency on other side
- Set power and tones as needed
- Put radio in cross band mode

Scenario One – Simplex Full Cross Band Mobility/Stealth + Range



Scenario One – Simplex Full Cross Band



Operator on Cross Band		Cross Band Radio						All Other Operators	
		Side A		Side B					
RCV Freq	440	440	RCV Freq	144	RCV Freq	144	RCV Freq	2 Meter	
XMT Freq	440	440	XMT Freq	144	XMT Freq	144	XMT Freq	2 Meter	
SQL Type	Tone	Tone SQL	SQL Type		SQL Type	None	SQL Type	None	
Tone Freq	100	100	Tone Freq		Tone Freq	None	Tone Freq	None	
		Open	Man SQL		Man SQL	Open			

Interference Issues (1)

- Never want repeater picking up interference or other “junk” signals and re-transmitting those, especially picking up junk and re-transmitting it on the “common” frequency.
- Always use Tone Squelch (CTCSS) or digital coded squelch (DCS) on the “HT side” of a cross band repeater. Set the repeater to require the tone or DCS code to open squelch; set your HT to transmit the proper tone or DCS code.

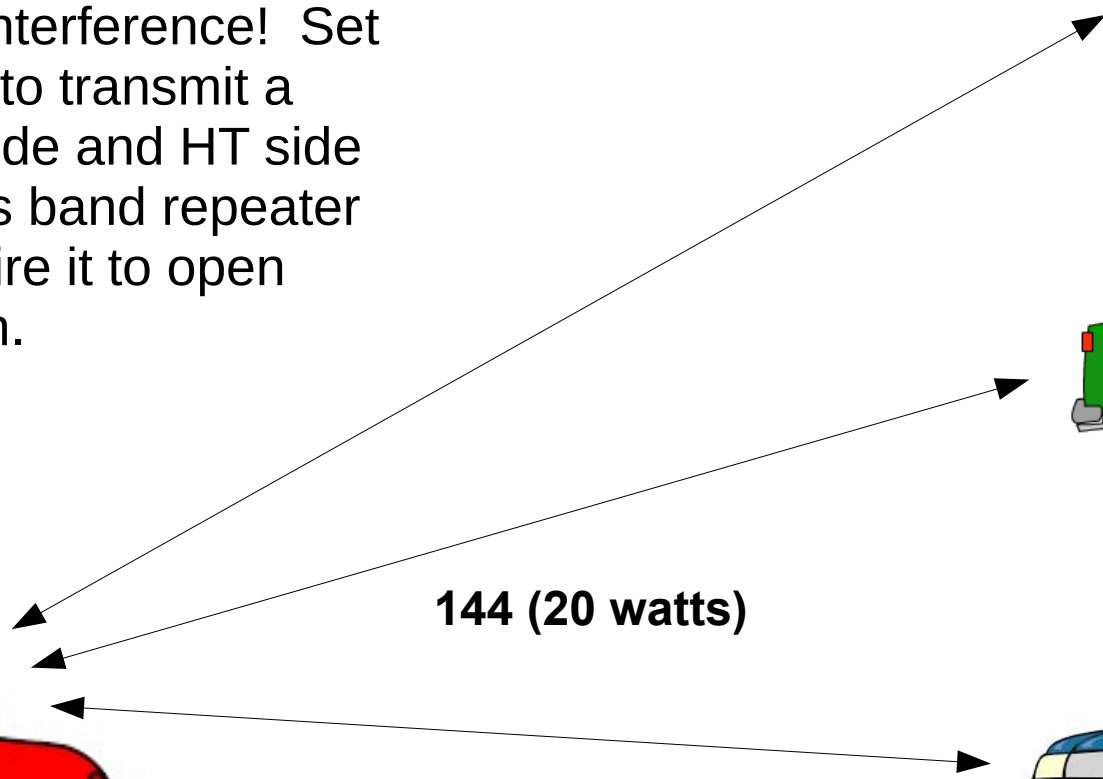
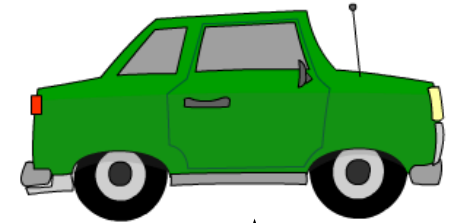
Scenario One – Simplex Full Cross Band Mobility/Stealth + Range



Avoid interference! Set the HT to transmit a tone/code and HT side of cross band repeater to require it to open squelch.

**440
(Low
Power)**

144 (20 watts)



Scenario One – Simplex Full Cross Band

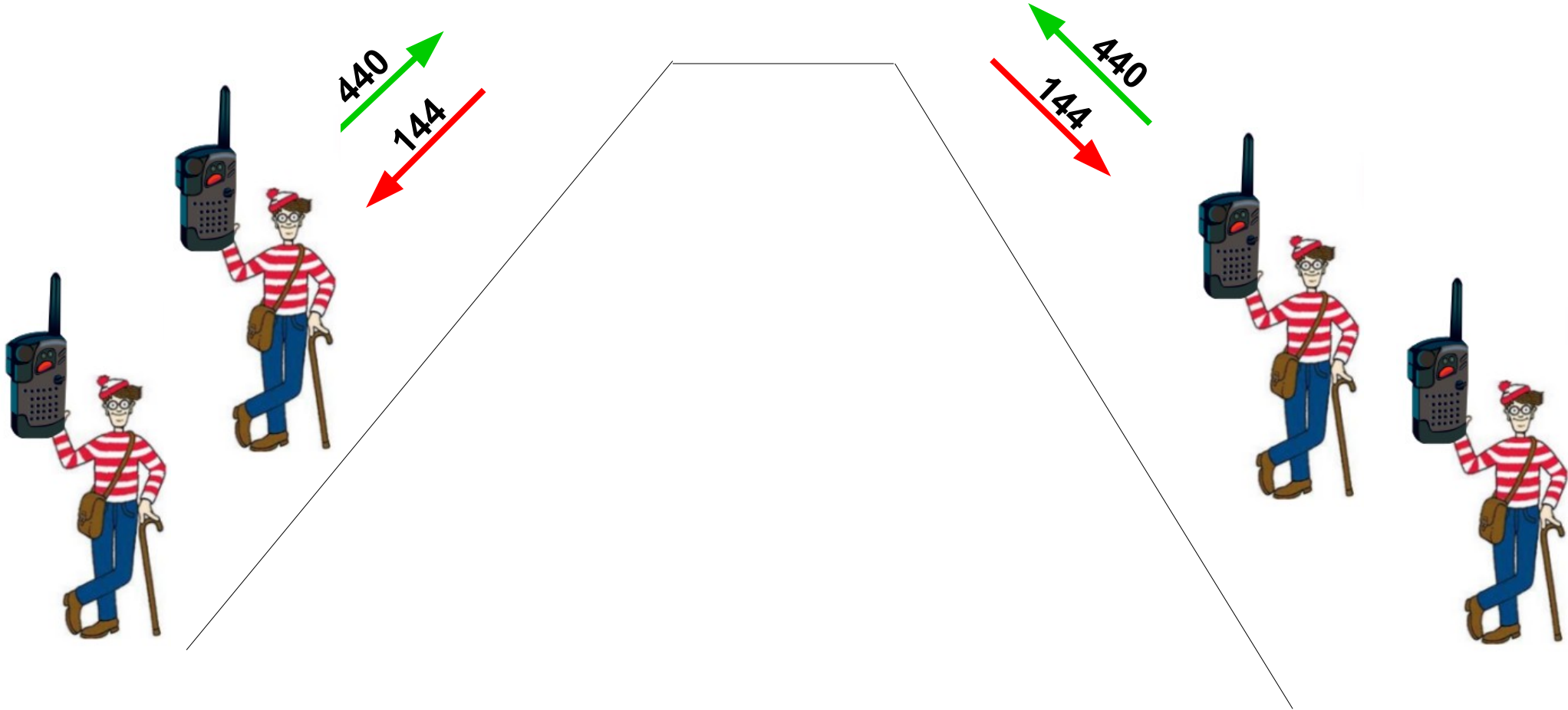
- Additional benefits: Longer battery life
 - If you're near the repeater with your HT, you can use low power, such as .5 watt power, on HT which greatly lengthens battery life and duty cycle.
 - Set cross band repeating radio with low power on HT (your) side, power as needed on other side. Example: 5 watts (minimum power) on HT side, 20 watts for more range on other side
- Why bi-directional repeat?
 - Car radio “listens” better than rubber duckie

Scenario Two

Terrain Blocks Signal



One-Way Cross
Band Repeater
(Locked Band)



Interference Issues (2)

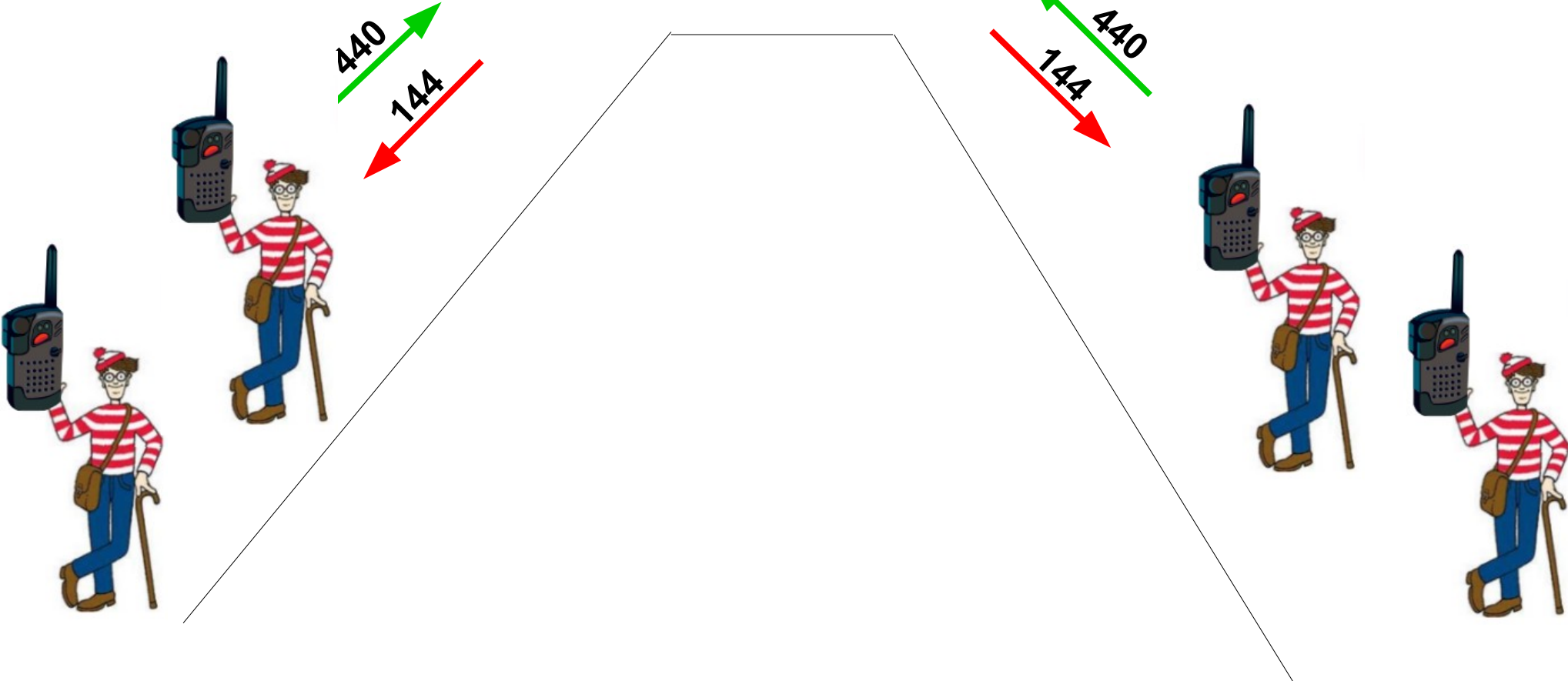
- Cross band repeaters are **bi**-directional by nature. Often, a one-way cross band is adequate. If that is the case, some Kenwood radios offer a “locked band” (one way) option. If you don't have that, you can suppress the other direction by putting an “oddball” tone or DCS code on that input frequency. You can also turn the squelch all the way up on that side, too. (Note: if the station you are trying to stop from cross banding is an in band repeater, additional steps are necessary.)
- Example: In scenario two, the repeater was receiving 440 and transmitting on 2 meters. None of our people would be transmitting on 2 meters, and we could put an “oddball” tone or DCS on the 2 meter side (and can also turn the squelch all the way up) to stop it from receiving and transmitting any 2 meter signals on 440.
- A one-way cross band repeater is sometimes called a “**Locked Band Repeater.**”

Scenario Two

Terrain Blocks Signal

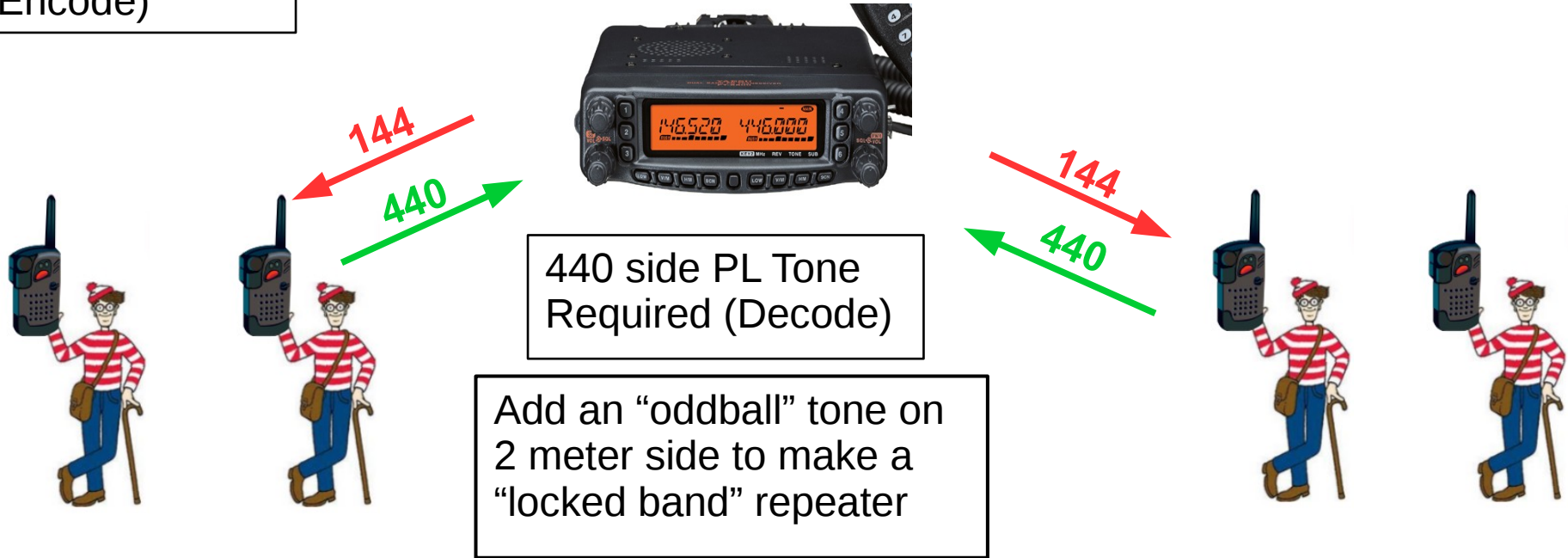


One-Way Cross
Band Repeater
(Locked Band)



One Way Cross Band (aka "locked band")

440 side Xmit
PL Tone
(Encode)



440 side PL Tone
Required (Decode)

Add an "oddball" tone on
2 meter side to make a
"locked band" repeater

		Locked Band Radio Repeater						
Transmitting Operator		Side A		Side B		All Other Operators		
RCV Freq	144	440	RCV Freq	RCV Freq	144	RCV Freq	144	
XMT Freq	440	440	XMT Freq	XMT Freq	144	XMT Freq	440	
SQL Type	Tone	Tone SQL	SQL Type	SQL Type	Tone SQL	SQL Type	Tone	
Tone Freq	100	100	Tone Freq	Tone Freq	????	Tone Freq	100	
		Open	Man SQL		Man SQL	Closed		

Scenario Three

Can't reach or hear
repeater

Two-Way Cross
Band Repeater



147.195
147.795

147.195
147.795

440
440

Note 1: having a
cross band
repeater *repeat*
another repeater
is generally
illegal!
Avoid doing this
except in a true
emergency.

Note 2: A repeater repeating another
repeater won't switch from TX to RX
until the first repeater drops. Long
squench tails can cause problems.



N6ICW
Repeater

Output:
147.195

Input:
147.795

Tone: 123.0



Scenario Three – Repeating a Repeater

N6ICW Repeater



Cross Band Radio Repeater

Transmitting Operator		Cross Band Radio Repeater				N6ICW Repeater	
		Side A		Side B			
RCV Freq	440	440	RCV Freq	RCV Freq	147.195	RCV Freq	147.795
XMT Freq	440	440	XMT Freq	XMT Freq	147.795	XMT Freq	147.195
SQL Type	Tone	Tone SQL	SQL Type	SQL Type	Tone	SQL Type	Tone SQL
Tone Freq	100	100	Tone Freq	Tone Freq	123.0	Tone Freq	123.0
		Open	Man SQL	Man SQL	Open		

Scenario Four

Can't reach but can hear repeater



Locked Band
(one-way)
Repeater

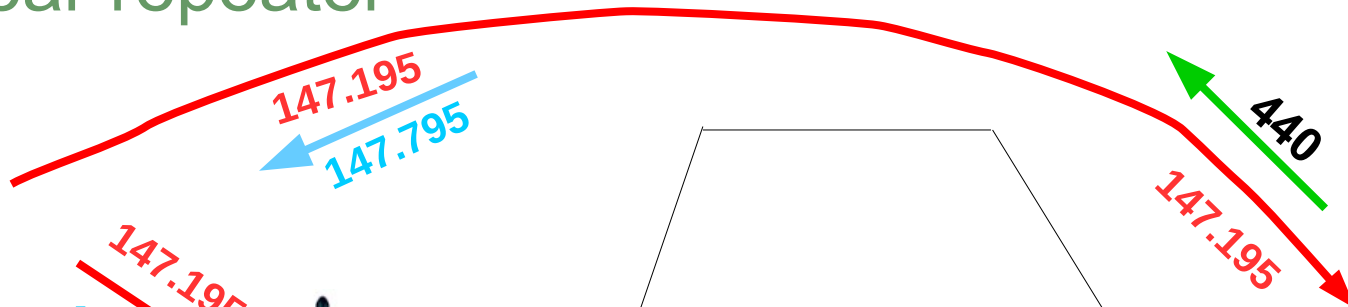


N6ICW
Repeater

Output:
147.195

Input:
147.795

Tone: 123.0



Note 1: Turn off
repeater shift
and use repeater
input frequency
in simplex mode
with correct PL
tone.

Note 2: This is much
preferred because
we are not re-
transmitting a
repeater's output

Scenario Four – NOT Repeating a Repeater

N6ICW Repeater



147.795

440

147.195

Turn OFF Repeater Shift. Set repeater side for simplex mode.



LOCKED Band Radio Repeater

Transmitting Operator		LOCKED Band Radio Repeater				N6ICW Repeater	
		Side A		Side B			
RCV Freq	147.195	440	RCV Freq	147.795	RCV Freq	147.795	
XMT Freq	440	440	XMT Freq	147.795	XMT Freq	147.195	
SQL Type	Tone	Tone SQL	SQL Type	Tone	SQL Type	Tone SQL	
Tone Freq	100	100	Tone Freq	123.0	Tone Freq	123.0	
		Open	Man SQL	Closed			

Legal Considerations (1)

- Control point rule. Radios are supposed to have an operator “at the control point.”
 - Why? Avoid interference and control your radio.
 - Letter of the law vs. spirit of the law
 - Very close by and constantly monitoring both bands, able to reach car radio and stop any interference very quickly

Legal Considerations (2)

- Technical ID issues
 - Repeater itself is a station and should be ID'd
 - Is cross band a full repeater or auxiliary station? Some say one, some other. Most say auxiliary station.
 - Therefore, ID cross band station such as “W6ABC” (caller) “via NM3S” (repeater control operator).
 - Technically, cross band station should also ID. This can be a problem using cross band radio. Maybe use an HT through the cross band radio.

Legal Considerations (3)

- Repeater Coordination
 - Do not cross band repeat an in band repeater as this violates coordination requirements (e.g. N6ICW suddenly appears on 440 simplex – WTF?) unless it is truly necessary and the situation is an actual emergency.
 - Use a locked band (one way) repeater ***whenever possible***. Keep two-way cross band repeating limited to simplex and, preferably, short range.

Operating Considerations

- When operating in cross-band mode, cross-band repeater will have very high duty-cycle. All traffic on both UHF and VHF causes cross-band repeater to transmit
 - Be careful of battery usage on cross-band repeater, especially if you're using your car's battery.
 - Best to use dedicated battery so you don't get stranded with a dead battery.
 - Be careful of over-heating. Many mobiles are not designed for high duty-cycle, high-power operations.
- Some radios open the microphone when cross-banding, so consider unplugging microphone in this case

Frequency Choice

- ARRL band-plan:
 - 445.00-447.00 Shared by auxiliary and control links, repeaters and simplex (local option)
 - Several states' band-plans advise 445.975 and 446.025 for cross-band
- NARCC shows all of 445-447 as allocated to repeater inputs.
 - NARCC database shows only 446.000, 446.500 and 441.00 as simplex
 - Will need to disable auto repeater offset
 - Or program simplex frequency into memory
 - Avoid harmonics (e.g., 147.5 and 442.5)

Does your mobile do cross band repeat?

- Must be dual band, dual receive.
- Check the manual. It may have instructions on how to put your radio into cross band repeat mode. Remember, not all manuals mention cross band repeat, even if the radio can do it.
- If your manual is silent on the subject, Google your radio model and “cross band repeat.” The Internet is often your best source of information on this feature.

Does your mobile do cross band repeat?



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Knowledge Base Article A8EH111956

Issue

IC-2820 - Cross Band Repeat - How do I enable my IC-2820 for cross-band repeater operation?

Resolution

1. Press and hold both left and right MAIN dials then the F/LOCK key together. After 2 beeps the lock key will flash on the upper right of the display

When in crossband, the VHF is on the left, UHF on the right.

2. Repeat step 1 to return for simplex operation.

Category

Amateur/DStar : 4. Miscellaneous / FAQ's : Mobile/Base : IC-2820

Partial list of Cross-band Capable Radios

- Yaesu- FT 8800, FT8900, FTM350, FTM400 (not in manual)
- Kenwood- TM D710, TM D700, TM V71A, TS 2000
- ICOM- IC 2730, W32a (not in manual)
- ADI- AT-600
- Alinco- DR635

- Not a complete list and may not all be current

Demo

- Turn your radio on and monitor 146.505.
- I will activate the cross band repeat feature on my radio and transmit from an HT on the 440 band. The 440 side has a tone on it so no other 440 transmissions should trigger the repeater, even if they are on the right frequency.
- You should hear me on 146.505.
- The cross band repeater will also work the other way for now. I could stop that by putting a “secret” tone on the 2 meter side which to create a “locked band” repeater.

THE END