Cross-band Repeating

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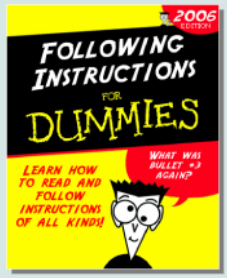
Housekeeping

- Pen/pencil & paper
- Cell phones & pagers
- Side conversations
- Questions
- Breaks
- Restrooms
- In case of emergency



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Learning Objectives

- What is cross band repeating
- How it can be deployed
- The factors necessary to doing it legally
- The advantages of doing cross-band repeating
- How the FCC addresses cross-band repeating
- Operational considerations
- Frequency choices

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What is Cross Band Repeating?

Cross band repeating is a feature included in some dual band radios, in real time, retransmit on one band what they receive on another.

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Cross-band operation

- TX on one band
- RX on another

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Cross-band modes

- “Cross-band operation”
- “Locked-band repeater”
- “Cross-band repeater”

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Cross-band operation

- Somewhat deceptive – not what most people think of
- Not very useful on its own
- Can be useful when used with locked-band repeater

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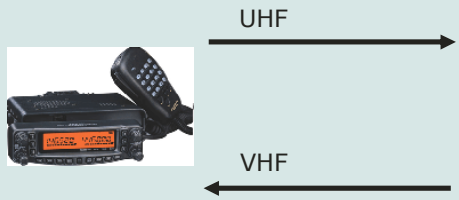
Cross-band operation

- TX on one band
- RX on another



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Locked-band Repeating

- Re-transmit from UHF -> VHF but NOT vice-versa
- "Half-duplex", "One-way cross-band"

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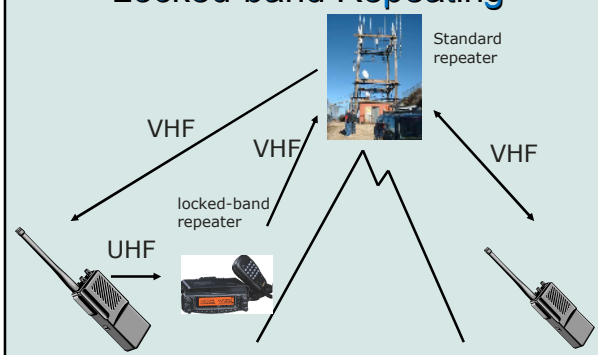
Locked-band Repeating



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Locked-band Repeating

Requires HT that can TX on one band and RX on another (Duplex)

Full dual-band operation or

'cross-band operation'

Requires HT be within RX range of transmitter (e.g., the standard repeater)

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Cross-band Repeating

- Re-transmit from UHF -> VHF and vice-versa
- "Full-duplex"

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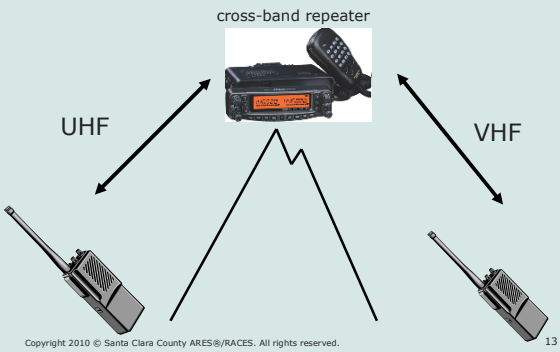
Cross-band Repeating



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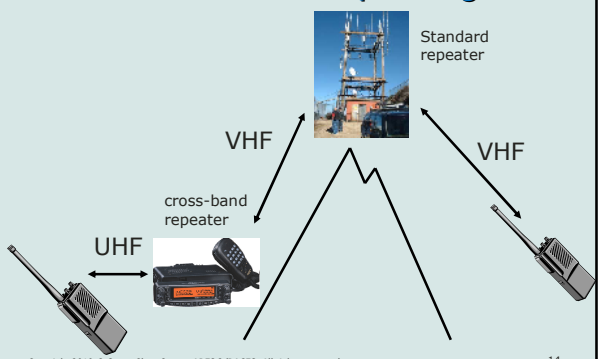
Cross-band Repeating



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Why Cross Band Repeating

- A cross band repeater is far less expensive than a conventional repeater. (no expensive filters or duplexers)
- One Antenna (dual band)
- Quick and easy to set up
- No coordination issues
- Easily relocated (can be mobile)

Advantages of X-band

- Mobility, Mobility, Mobility
- Increased coverage
- Relieve pressure on HT batteries

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Mobility

- Typical scenario:
  - Mobile/portable x-band repeater set up in parking lot with high-gain antenna and medium/high power operation
  - HT on ultra-low power, communicating through x-band repeater to EOC or Net Control station
- Allows operator to be highly mobile, interacting with served agencies when an HT can not reach the assigned frequencies

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Mobility

- Operating short-handed in EOC
- EOC base station set for cross-band repeat
- Net control on HT communicating through EOC base station
- Continued net control while delivering messages, running errands, getting lunch, etc.

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Increased Coverage

- Park mobile/portable on high ground and set for x-band repeat
- Multiple HT's/mobiles communicating through x-band repeater

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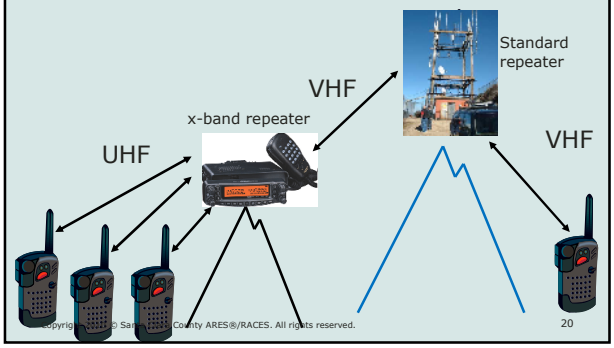
Increased Coverage (Range extender)



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Increased Battery Life

- At 5W, HT's might go through 2–4 battery packs in a shift.
- Recharging 2-4 packs over-night can be difficult, especially if battery is charged in the HT
- Operating at 0.05W, can handle a full shift on 1 battery.

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Basic Cross-band Setup simplex to simplex

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How to Set it Up

- Cross-band repeater:
  - Set channel 1 to 145.510Mhz Simplex
  - Set channel 2 to 446.500Mhz Simplex w/ PL
  - Enable cross-band repeater mode
- HT1: Set to a 440 freq Simplex w/ PL
- HT2: Set to 145.510Mhz Simplex

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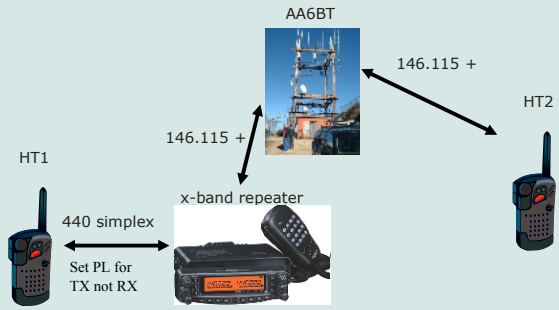
Cross-band to AA6BT



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Cross-band to AA6BT

- Cross-band repeater:
  - Set channel 1 to 146.115Mhz + offset, 100Hz PL
  - Set channel 2 to a(440 Freq) Simplex w/ PL
  - Enable cross-band repeater mode
- HT1: Set to the (440 Freq) Simplex w/ PL
- HT2: Set to 146.115Mhz + offset, 100Hz PL

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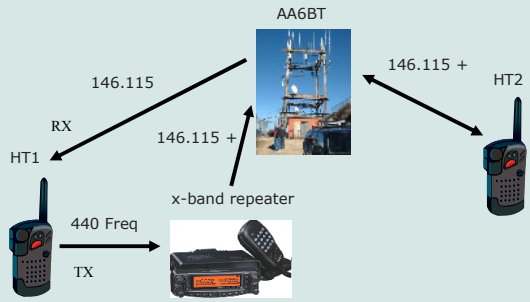
Locked-band to AA6BT



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Locked-band Repeater

- Locked-band repeater:
  - Set channel 1 to 146.115Mhz + offset, 100Mhz PL
  - Set channel 2 to a(440 Freq) Simplex w/ PL
  - Enable locked-band repeater mode
- HT1:
  - Set channel 1 to the (440 Freq) Simplex w/ PL
  - Set channel 2 to 146.115Mhz
- HT2: Set to 146.115Mhz + offset, 100Hz PL

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WHAT DOES THE FCC SAY?

§ 97.119 Station identification.
(a) Each amateur station….,must transmit its assigned call sign on its transmitting channel at the end of each communication, and at least every 10 minutes during a communication, for the purpose of clearly making the source of the transmissions from the station known to those receiving the transmissions. No station may transmit unidentified communications or signals, or transmit as the station call sign, any call sign not authorized to the station…..

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WHAT DOES THE FCC SAY?

Sec. 97.201 Auxiliary station (a) Any amateur station licensed to a holder of a Technician, General, Advanced or Amateur Extra Class operator license may be an auxiliary station. A holder of a Technician, General, Advanced or Amateur Extra Class operator license may be the control operator of an auxiliary station, subject to the privileges of the class of operator license held. (b) An auxiliary station may transmit only on the 2 m and shorter wavelength bands, except the 144.0–144.5 MHz, 145.8–146.0 MHz, 219–220 MHz, 222.00–222.15 MHz, 431–433 MHz, and 435–438 MHz segments.
(c) Where an auxiliary station causes harmful interference to another auxiliary station, the licensees are equally and fully responsible for resolving the interference unless one station's operation is recommended by a frequency coordinator and the other station's is not. In that case, the licensee of the non-coordinated auxiliary station has primary responsibility to resolve the interference.
(d) An auxiliary station may be automatically controlled.
(e) An auxiliary station may transmit one-way communications.
[54 FR 25857, June 20, 1989, as amended at 56 FR 56171, Nov. 1, 1991; 60 FR 15687, Mar. 27, 1995; 63 FR 68980, Dec. 14, 1998; 71 FR 66462, Nov. 15, 2006; 75 FR 78171, Dec. 15, 2010]
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Keeping it Legal

- CAVEAT: I'm not a lawyer, nor an expert on FCC rules. This is based on my interpretations, as well as guidelines from ARRL representatives.
- Technically Cross band repeater is not a 'repeater' – it's officially considered a remote base station, so follows Auxiliary Station rules
- Input is considered control and voice uplink, therefore must be comply with 97.201
- Operator must be able to control the station.
- If operator is remote, a 3 min timer must be employed.

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Keeping it Legal

- Must ID on ***all*** frequencies, every 10min and at the end of transmissions.
  - UHF uplink and VHF are handled by operator ID'ing themselves
  - If another station uses the x-band repeater, they must ID themselves and the x-band repeater.
    - E.g., KC6SKM sets up a x-band repeater. If KF6GAC uses KC6SKM's repeater, he should ID as 'KF6GAC/KC6SKM'.
  - The difficulty comes in ID'ing on the UHF downlink.
    - If your x-band repeater does not have automatic ID'ing capabilities, you will need to add a control module or have an operator ID on the downlink.
    - Try to avoid automatic ID on VHF link (crowds the net frequency with unnecessary IDs)
    - This is why locked-band repeating is easier, since there is no downlink.

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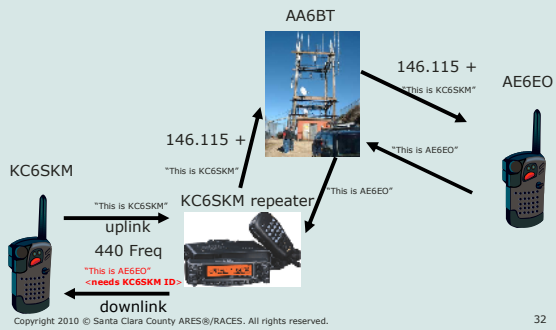
ID'ing on all frequencies



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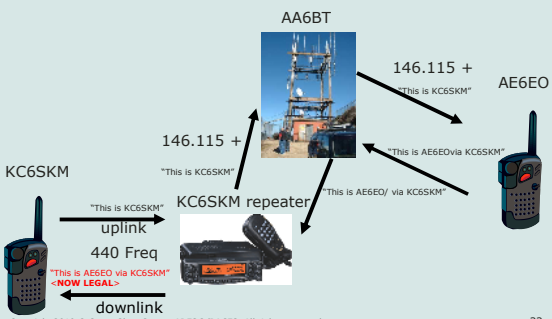
ID'ing on all frequencies



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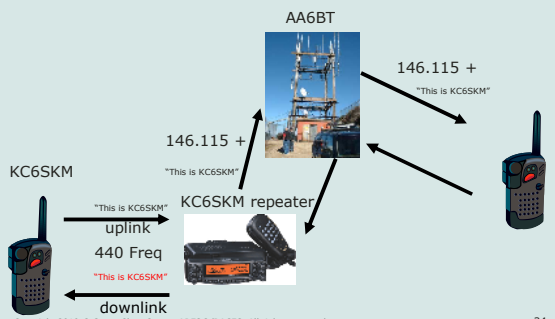
ID'ing on all frequencies

If I just transmit my ID every 10 min am I legal ?



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Operating Considerations

- When operating through standard repeater, squelch tail must be very short. X-band repeater will not switch from TX to RX until repeater drops
- Use a PL on the control link to avoid interference on the VHF Link
- When operating in cross-band mode, x-band repeater will have very high duty-cycle. All traffic on both UHF and VHF causes x-band repeater to transmit
  - Be careful of battery usage on x-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.

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Operating Considerations

- When possible, use locked-band mode
  - Uses less battery power – only transmits when traffic is on UHF
  - Reduces squelch-tail problems – monitoring VHF directly, so no need to wait for x-band repeater to switch from TX->RX
  - Easier to stay legal – no need to ID on the 'downlink' (more on this later)
- Strongly consider using CTCSS on x-band repeater's input to avoid accidental triggers
  - Only use tone, not CTCSS on the HT so you can hear if the frequency is in use by others

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Operating Considerations

- Some radios, especially 'acoustically coupled' open the microphone when x-banding, so consider unplugging microphone in this case
- Wireless remote-control can be very helpful, but consider which band to use as control band
  - it will get re-broadcast to everyone on the net
  - How to ID on both sides of the link-

    does 97.119a say the transmitter must ID or does the operator have to ID*? Some Radios (Kenwood) have auto ID features via CW*
  - Audio Quality / Time delays ??

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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 does show allocations for 445.975 or 446.025 as parts of repeater pairs
- Avoid harmonics (e.g., 147.5 and 442.5)

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Partial list of Cross Band Capable Radios

Yeasu- FT 8800, FT8900,FT5200,F847, FTM-350

Kenwood- TM D700, 710, TMV7A,TH79, TM742A,TM642A, TS2000

ICOM- IC 2720, W32a (not in manual)

ADI- AT-600

Alinco- DR605

Not a complete list and may not all be current

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Cross Band for D700

- Page 82
- Activating Cross-Band:
- Set PTT on Band A (left side).
- Select MENU 1-7-6 (Radio, Repeater, Repeater).
- Dial, Up Arrow, or Down Arrow to CROSS-BAND.
- Press OK, then ESC.

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TM-D710

Instructions in PDF on Disk
Cross Band (K Type)-E.PDF
Menu Mode 403 for Cross Band
Menu Mode 404 for TX HOLD
Menu Mode 406 for TX ID
Menu Mode 405 for entering Repeater ID
In Cross band mode 3 min TX timer is locked on.
Turning off does not cancel Cross Band
Must turn off and press [Tone] + Power on to reset

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Cross Band for Yeasu FT 8800

- Page 56
- First set VHF* on left and UHF* on Right
- Press set
- Rotate main dial to menu 45 (X-RPT)
- Press main dial knob will show X-start
- Press main dial again to activate
- To exit press set

* Either band may be on either side

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The ICOM IC-2720H

- The ICOM IC-2720H supports crossband repeat and this feature may be activated by simple key strokes as follows:
- To invoke this function:
  Set the frequencies
  Press **LOW** and **DUP**, then press **SET** for two seconds
  Two flashing **L**s will appear on the display
- To exit this function:
  Press **LOW** and **DUP**, then press **SET** for two seconds

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QUESTIONS?

Let's practice

If you brought you own radios lets try to set up a cross band operation including a PL on the input simplex link on Transmit only

Do NOT forget the Evaluations