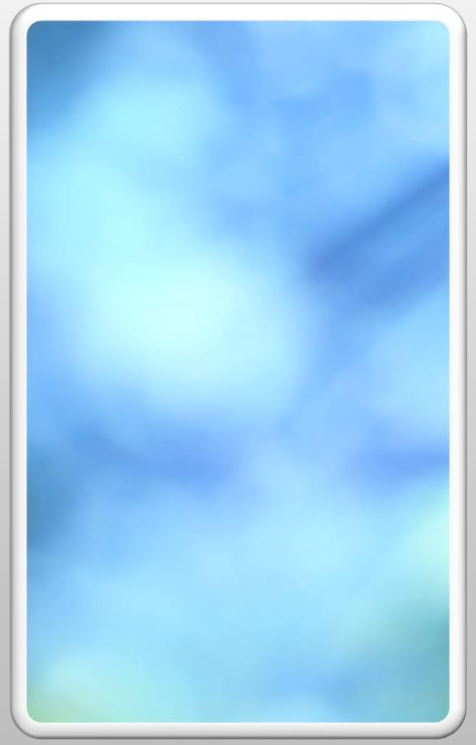
USING CROSSBAND REPEAT ON MOBILE AND HT RADIOS: BASIC & ADVANCED MODES

by

Ray Sommer

W2AUS



UNDERSTANDING MODES

ANALOG CROSSBAND – FULL DUPLEX

ANALOG CROSSBAND – HALF DUPLEX

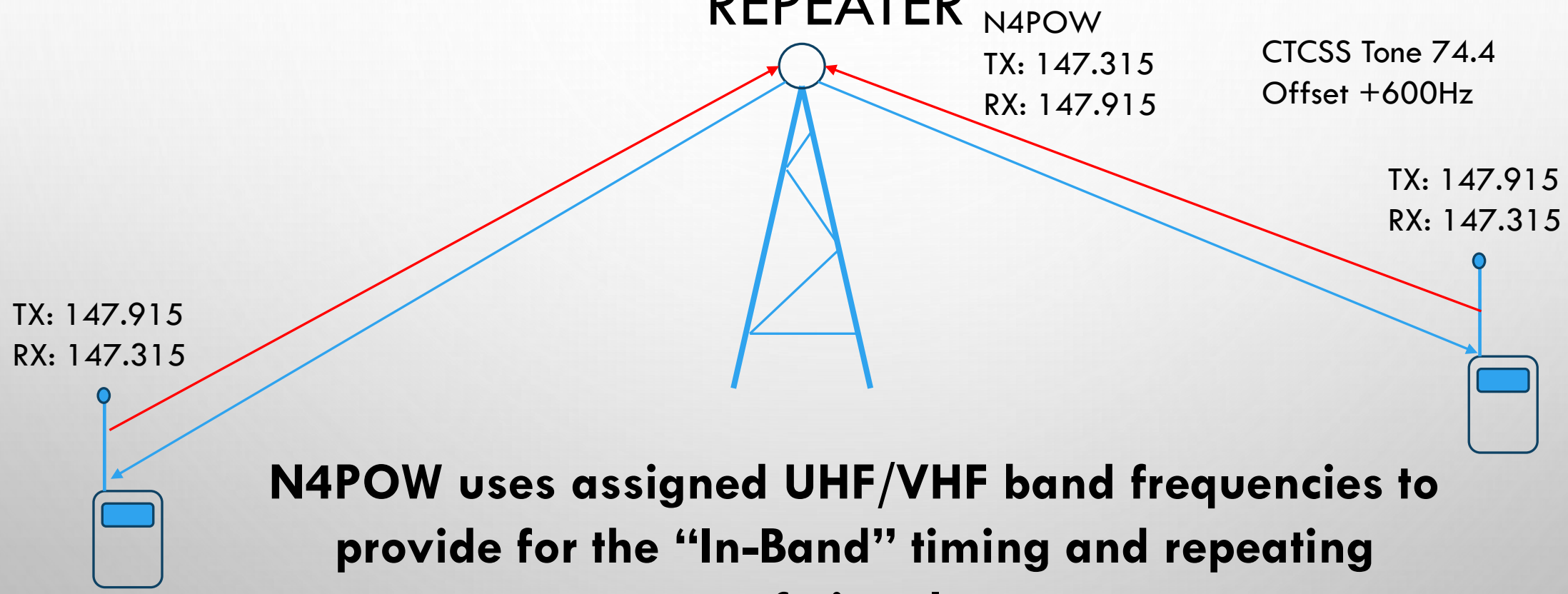
ANALOG/DIGITAL CROSS-MODE – FULL DUPLEX

CROSSBAND REPEAT: WHAT IS IT, AND WHY DO WE WANT IT?

Crossband Repeat (CBR) is a technique where a dual-band radio receives a signal on one frequency band (e.g., UHF) and retransmits it on another frequency band (e.g., VHF). This allows communication between radios that would otherwise not be able to connect directly due to distance or obstacles.

- CROSSBAND REPEAT HAS USUALLY BEEN EXECUTED USING TRADITIONAL ANALOG UHF/VHF RADIOS THAT CAN CBR ANALOG TO ANALOG COMMUNICATION.
- HOWEVER, RADIO TECHNOLOGY HAS PROGRESSED TO SUPPORT CBR WITH CROSS-MODE CAPABILITY FOR ANALOG TO DIGITAL, DIGITAL TO ANALOG, AND DIGITAL TO DIGITAL COMMUNICATION.

CROSS-BAND REPEAT (CBR) IS NOT THE SAME CONCEPT AS IMPLEMENTED IN OUR REGIONAL REPEATER



N4POW uses assigned UHF/VHF band frequencies to provide for the "In-Band" timing and repeating of signals

SELECT THE PROPER RADIO

Not all Dual Band radios are CBR capable. CBR is only available on certain models within a specific manufacturer's product line.

e.g., My Yaesu FT-5DR (HT) and FT-991A radios are not CBR capable; while the Yaesu FTM-400DR and FT- 500DR mobile radios are CBR capable.

My Radioddity GD-88 (HT) and TYT TH-7800 (mobile) radios are CBR capable; while the Radioddity DB-25 DMR mobile radio is not CBR capable

CROSSBAND REPEAT: WHY DO WE WANT IT?

- THE MOST TRADITIONAL USE OF A CROSSBAND REPEATER IS TO EXTEND THE RANGE OF LOW-POWER COMMUNICATION EQUIPMENT (I.E., HT RADIOS)
- THE USE CASE HAS BEEN SUCCESSFULLY PROVEN IN ….
  - EMERGENCIES: WHERE COMMUNICATION INFRASTRUCTURE IS NOT PRESENT OR HAS BEEN COMPROMISED.
  - PUBLIC/PRIVATE FUNCTIONS: WHERE THE ORGANIZERS WISH TO ESTABLISH A QUICK AD-HOC NET ORIENTED COMMUNICATION INFRASTRUCTURE.
  - HOMESTEADS: WHERE INDIVIDUALS ROAM THEIR PROPERTY AND/OR LOCALITY AND WISH TO USE THEIR HT RADIOS TO COMMUNICATE OVER LONGER DISTANCES THROUGH A FAR-OFF REPEATER OR DIRECTLY TO OTHER INDIVIDUALS IN THEIR VICINITY.

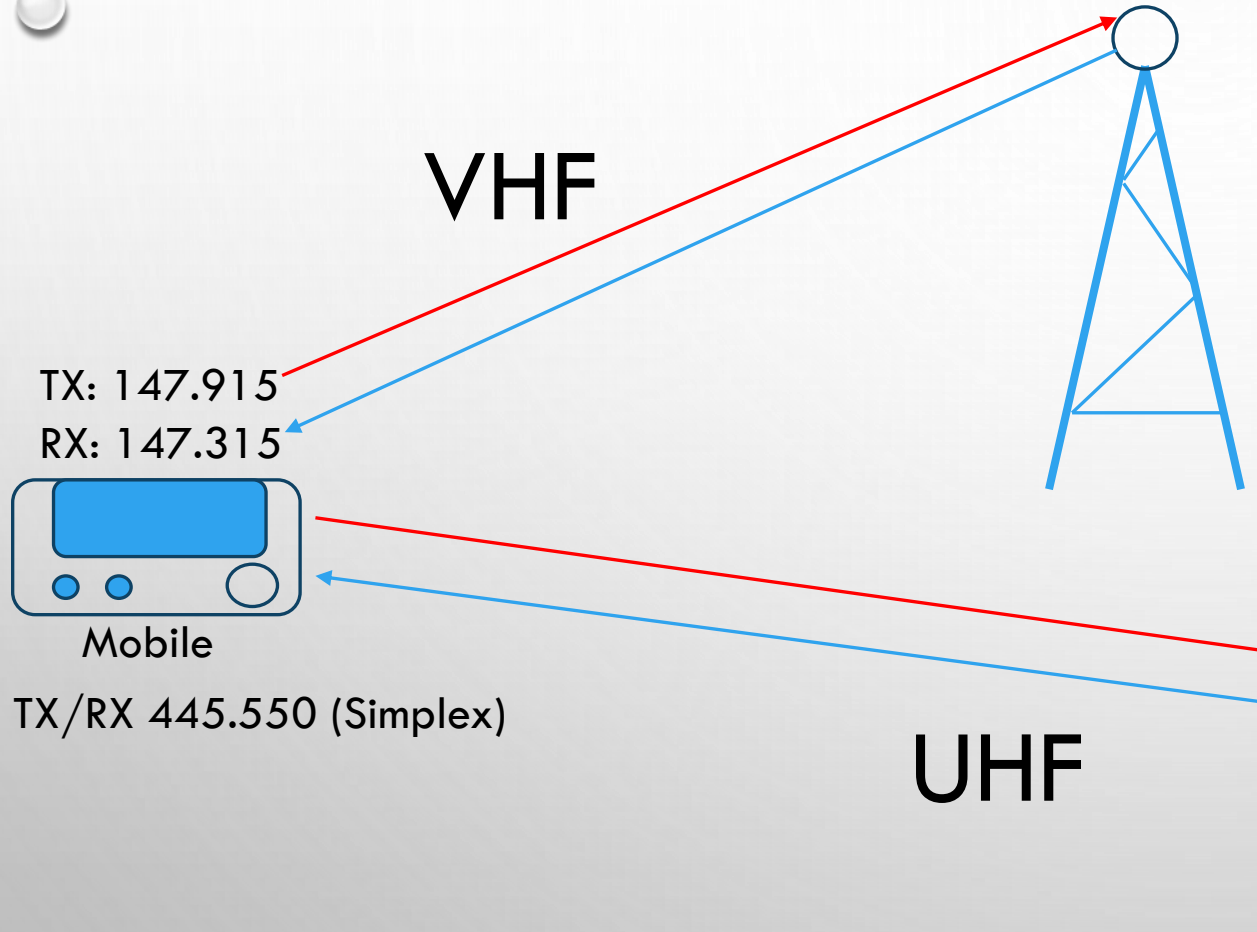
THE TWO MOST POPULAR MODES

- ANALOG FULL DUPLEX
  - USES A VHF AND UHF FREQUENCY TO REPEAT BOTH TX AND RX COMMUNICATION THROUGH THE CROSSBAND RADIO
- ANALOG HALF-DUPLEX
  - USES A VHF AND UHF FREQUENCY TO REPEAT ONLY TX COMMUNICATION THROUGH THE CROSSBAND RADIO

- MOST RADIOS IN THIS CATEGORY ARE HIGHER POWER (E.G., 50W) MOBILE RADIOS, OR MORE RECENTLY HIGHER END/HIGHER POWER HT RADIOS*

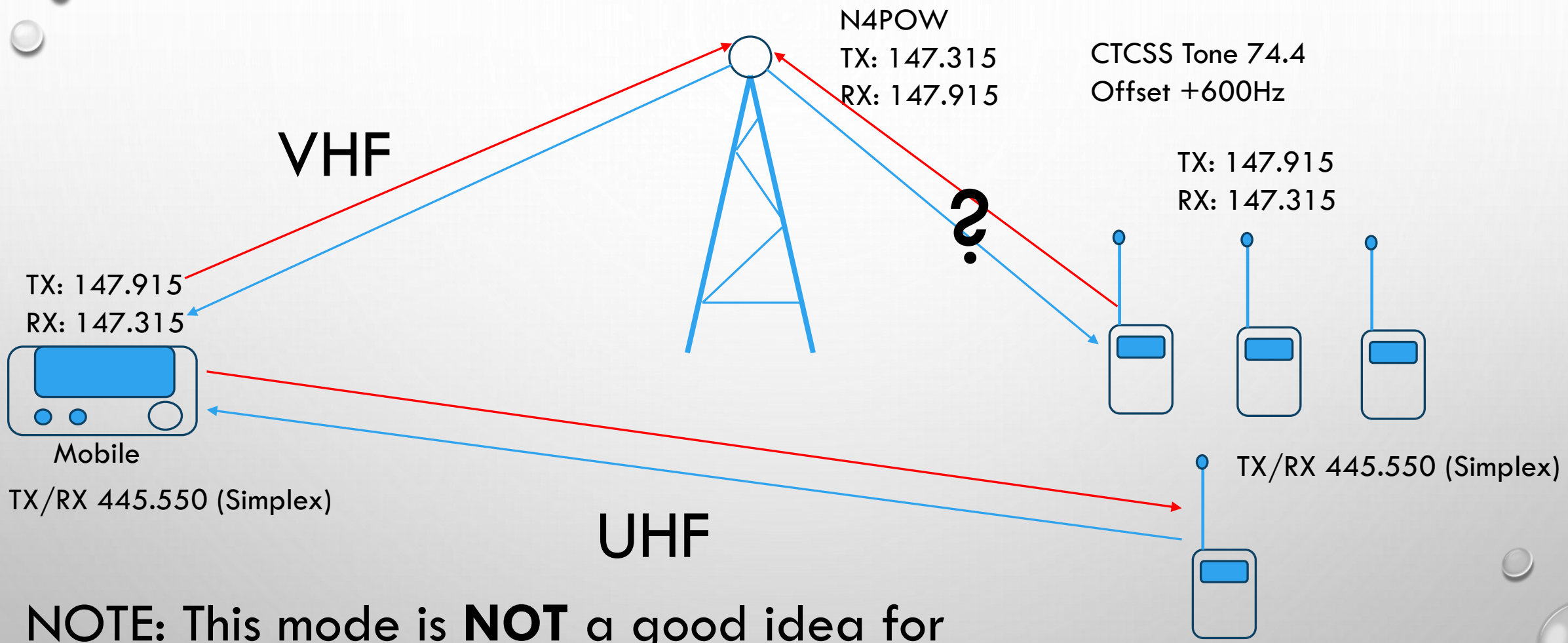
  *NOTE: NOT ALL DUAL BAND RADIOS ARE CAPABLE OF CROSSBAND REPEAT FUNCTIONS

ANALOG CBR – FULL DUPLEX THROUGH REPEATER



Operationally very simple to understand and deploy….BUT!

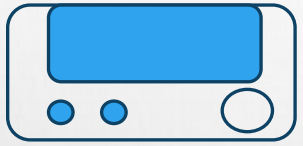
ANALOG CBR – FULL DUPLEX THROUGH REPEATER



NOTE: This mode is **NOT** a good idea for piggybacking on a repeater – Why?

MAJOR PROBLEM WITH FULL DUPLEX CBR TO A REPEATER

TX: 147.915
RX: 147.315



Mobile
445.550 (Simplex)

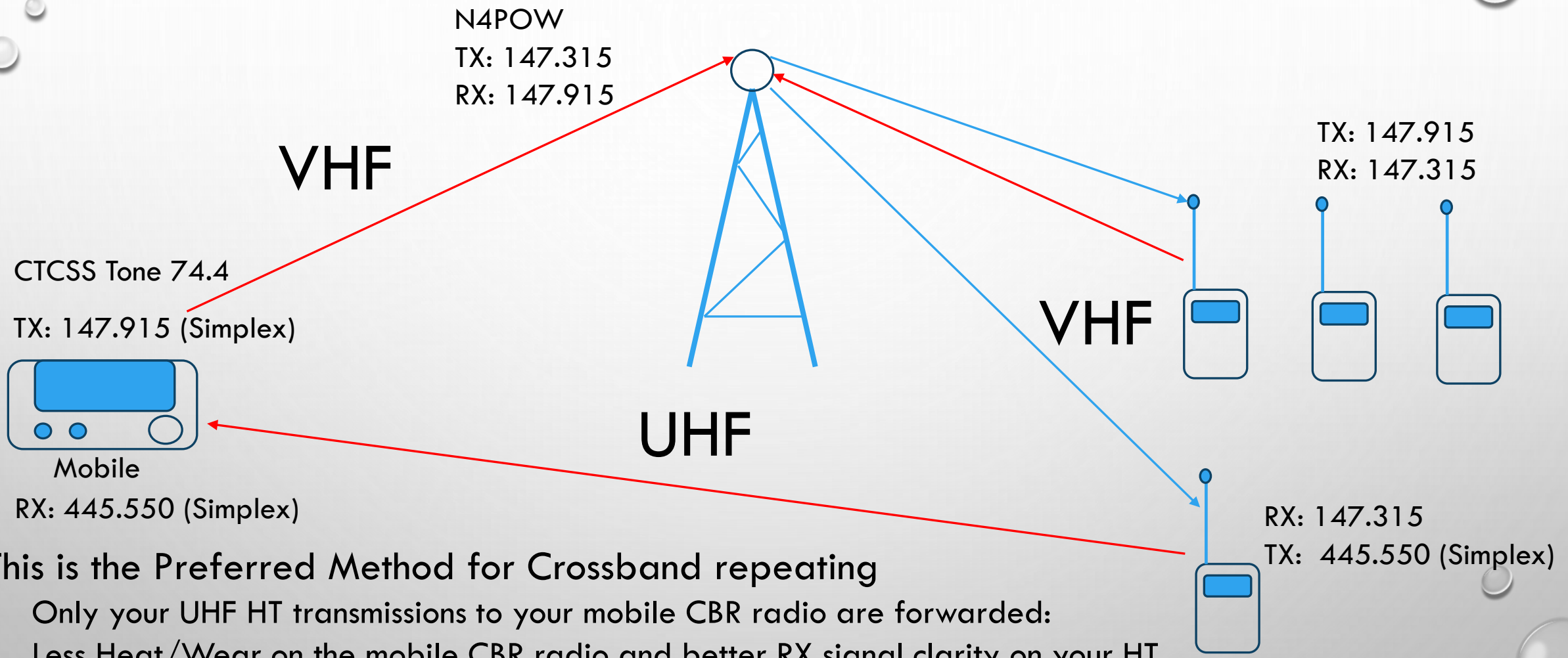
HEAT + Delay*

*Depending on radio and conditions

1. **Every** transmission picked up by the repeater will automatically get forwarded through your mobile CBR Radio to your HT
2. If there is a lot of traffic on the repeater (i.e., during an emergency), your CBR radio will quickly overheat and shutdown (or in some cases, damage the finals)

- If you MUST go this route, **never** set your radio on full power!
- Use the least amount of power to accomplish the task at hand

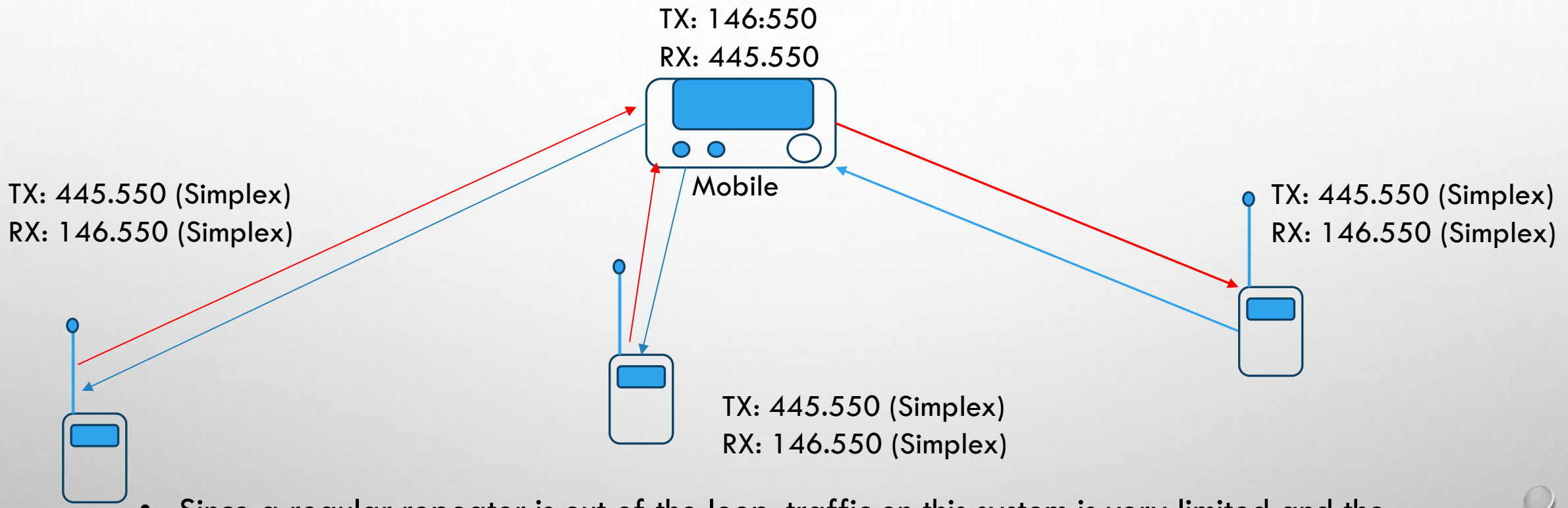
ANALOG CBR – HALF DUPLEX THROUGH REPEATER



This is the Preferred Method for Crossband repeating

- Only your UHF HT transmissions to your mobile CBR radio are forwarded:
- Less Heat/Wear on the mobile CBR radio and better RX signal clarity on your HT
- HT Radio **MUST** be "dual" watch/standby/reception capable --- e.g., Baofeng UV5 Menu #7 "TRD = on"

ANALOG CBR – FULL DUPLEX (NO REPEATER)

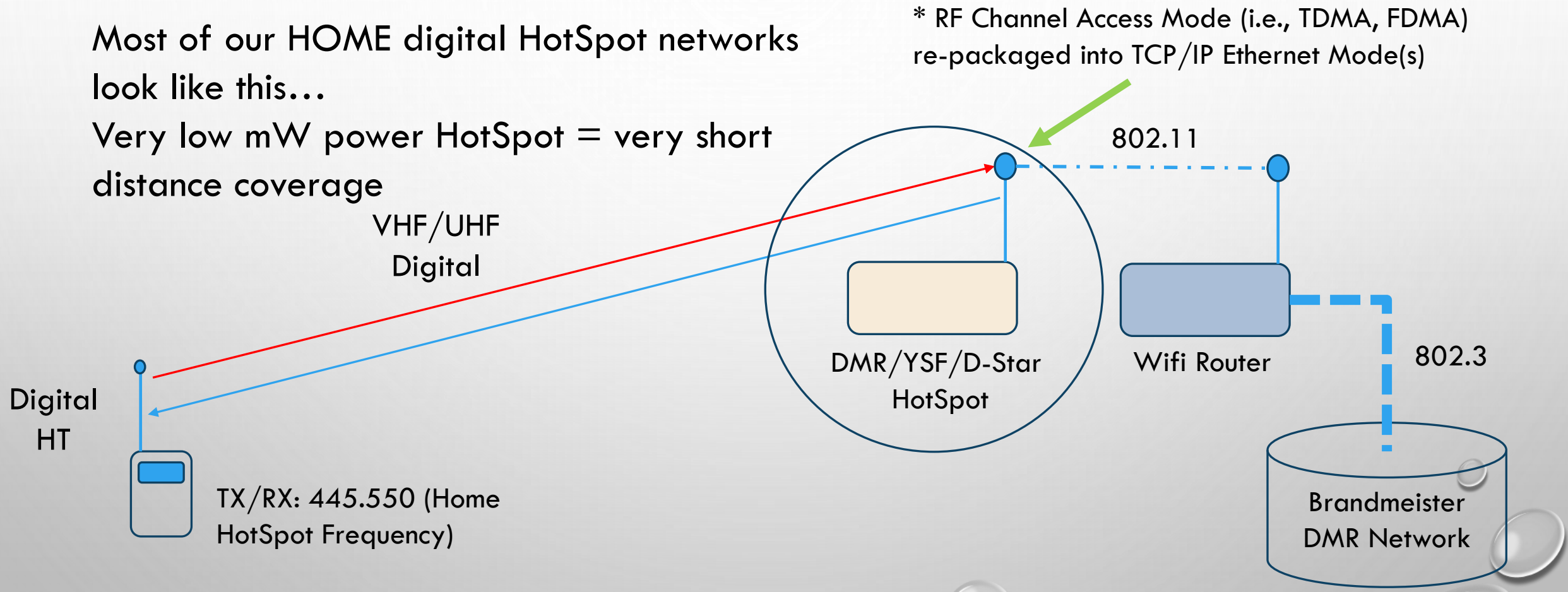


- Since a regular repeater is out of the loop, traffic on this system is very limited and the crossband radio won't likely overheat
- This mode is used on many large homesteads, farms, and by security companies
- HT Radio MUST be "dual" watch/standby/reception capable ---
  e.g., Baofeng UV5 Menu #7 "TRD = on"

CROSS-MODE/CBR OPERATION*

Most of our HOME digital HotSpot networks look like this…

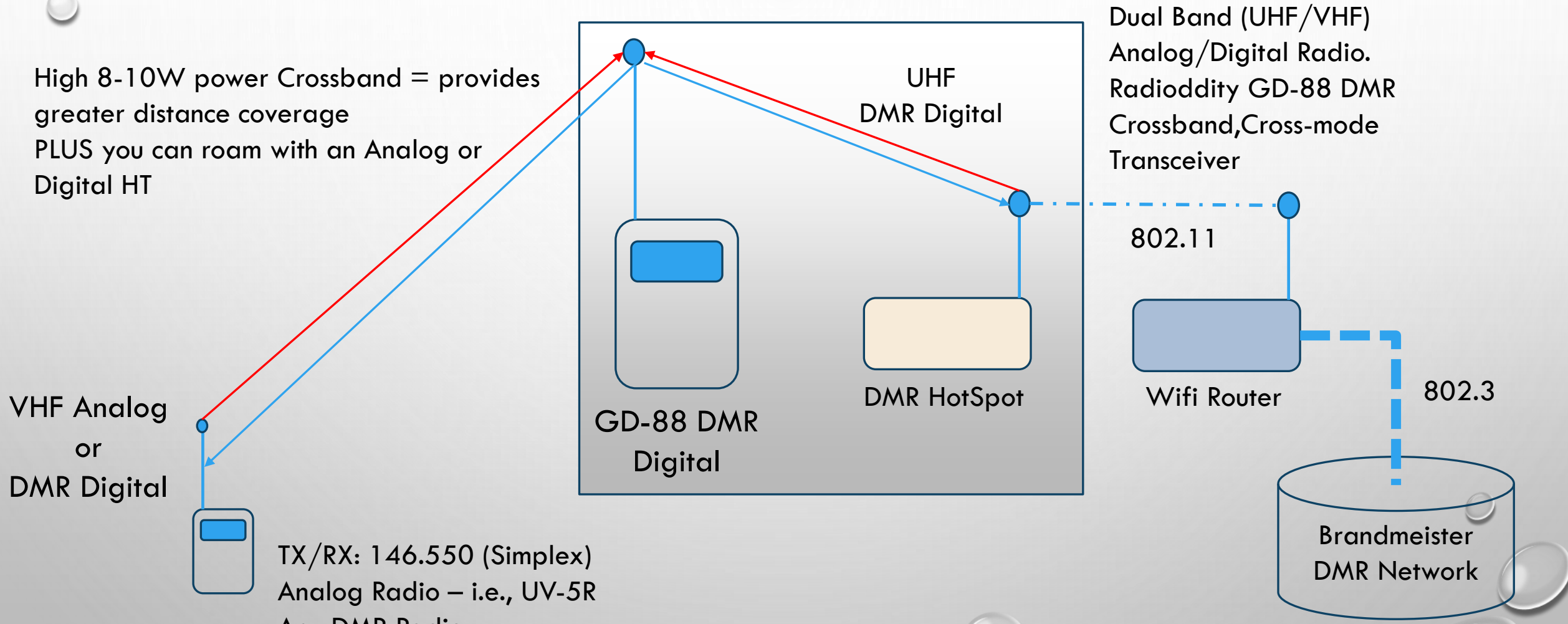
Very low mW power HotSpot = very short distance coverage



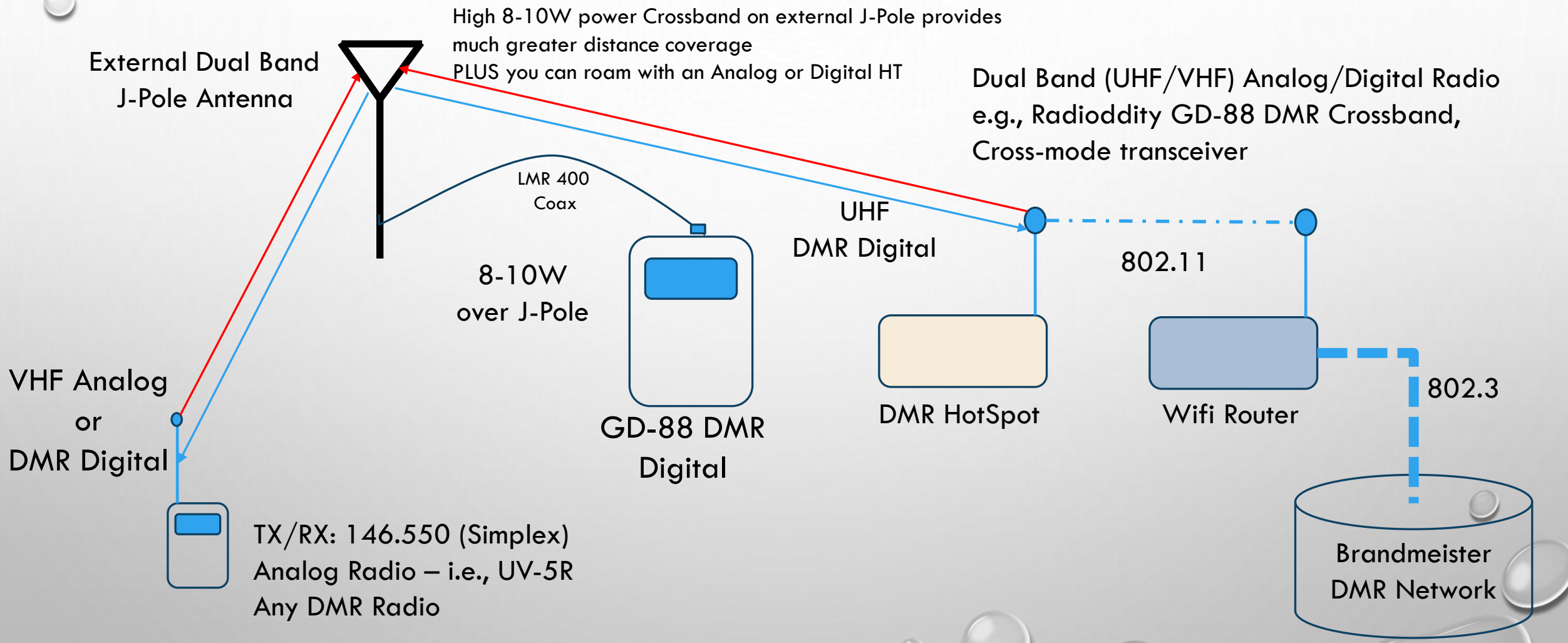
UNDERSTAND THE THREE LOWER ISO-OSI LAYERS

Device/Standard	Physical Layer	Data Link Layer	Network Layer
DMR Radios Channel Access TDMA	4FSK (4-level Frequency Shift Keying)	DMR Data Protocol (ETSI TS 102 361-3)	IP (Internet Protocol)
Yaesu C4FM Radios Channel Access FDMA	4FSK (4-level Frequency Shift Keying)	HDLC (High-Level Data Link Control)	Varies (often IP-based)
D-STAR Radios Channel Access FDMA	GMSK (Gaussian Minimum Shift Keying)	HDLC (High-Level Data Link Control)	IP (Internet Protocol)
IEEE 802.3 Ethernet	Various physical media and encoding (e.g., Cat5e, Fiber)	IEEE 802.3 (MAC addressing, CSMA/CD)	IP (Internet Protocol)
IEEE 802.11 Wi-Fi	FHSS = Spread Spectrum Various physical media and encoding (2.4 GHz, 5 GHz)	IEEE 802.11 (MAC addressing, CSMA/CA)	IP (Internet Protocol)

MULTI-CROSS-MODE/DMR CBR OPERATION



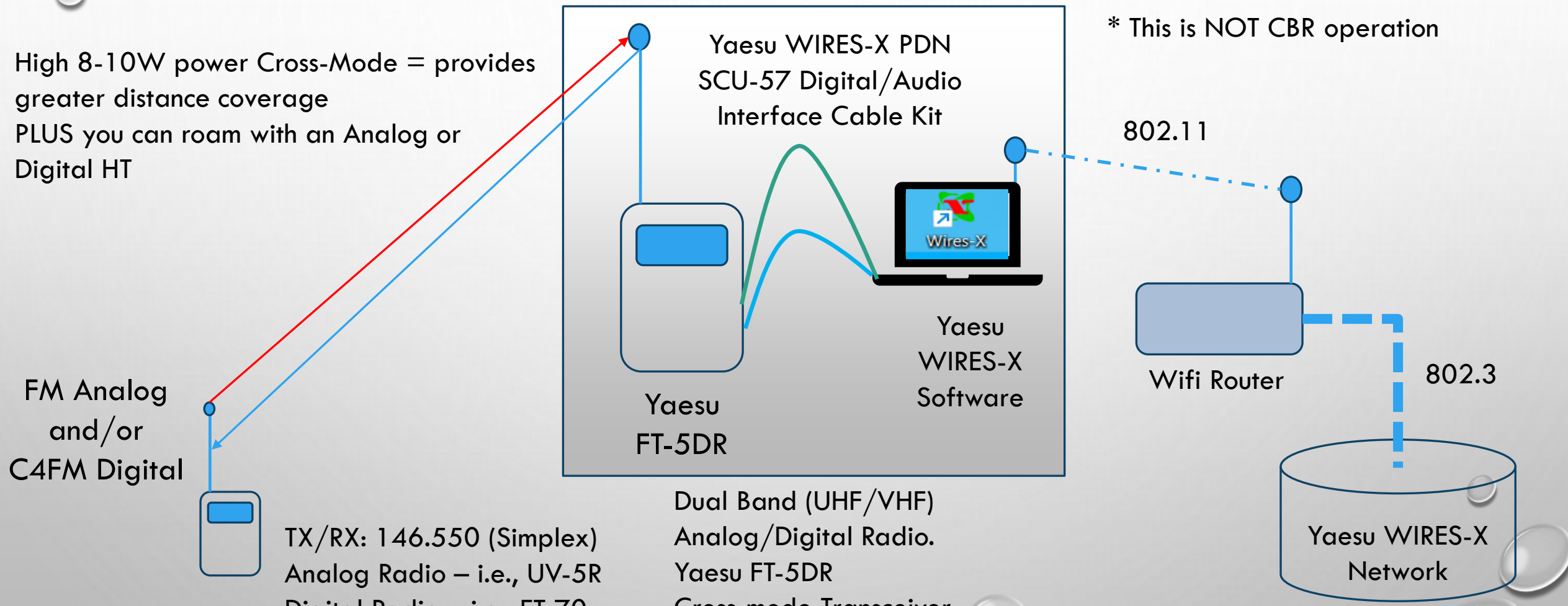
LONG RANGE, MULTI-CROSS-MODE/CBR OPERATION



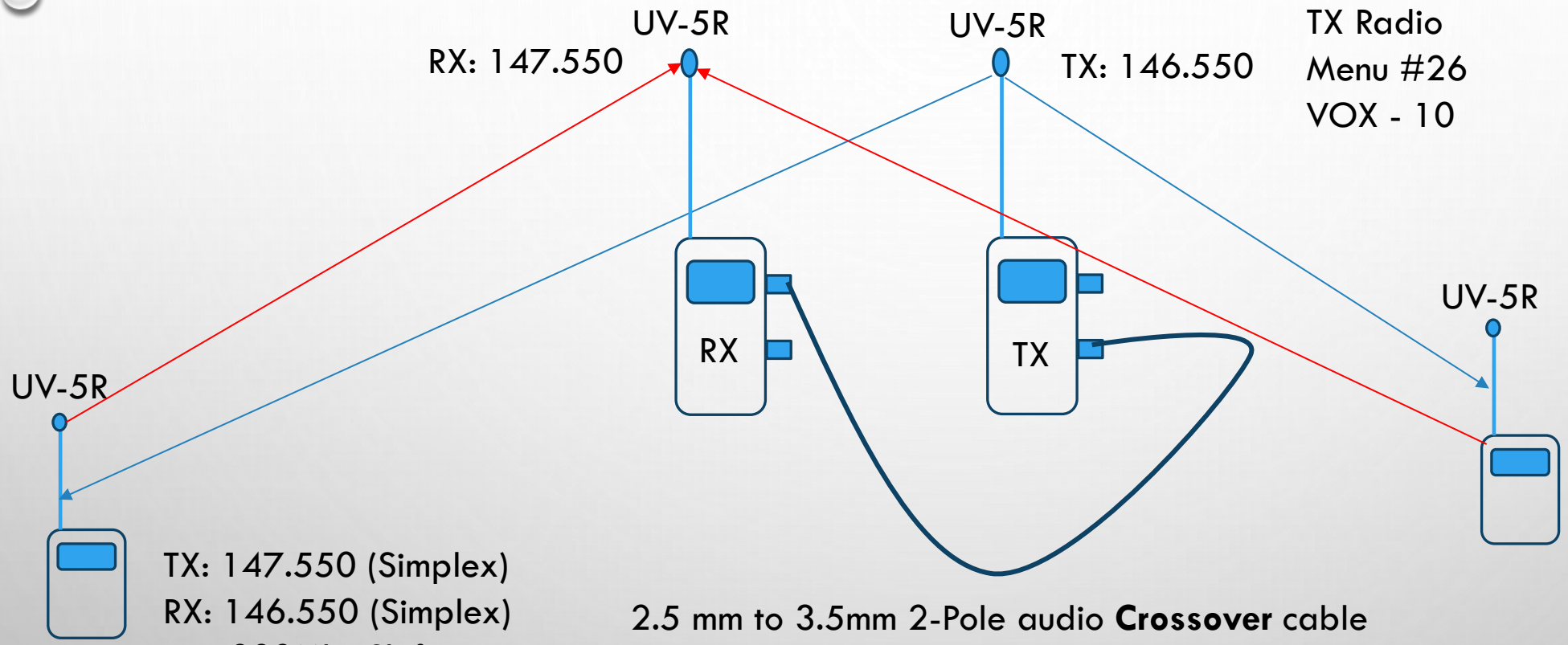
MULTI-CROSS-MODE/WIRES-X PDN (PERSONAL DIGITAL NODE) OPERATION*

High 8-10W power Cross-Mode = provides greater distance coverage
PLUS you can roam with an Analog or Digital HT

* This is NOT CBR operation



INEXPENSIVE "DIY FUN" UV-5R REPEATER



2.5 mm to 3.5mm 2-Pole audio **Crossover** cable
…..about $10 home brew, or purchase
a Baofeng Repeater Box ~$20

CONCLUSION

- SEVERAL CROSSBAND AND CROSS-MODE REPEAT SCENARIOS TO CHOOSE FROM
- TECHNOLOGY IS GETTING MUCH BETTER AND MUCH MORE ROBUST, WHICH ALLOWS FOR VERY ELEGANT AND USEFUL "REPEATER" FUNCTIONS
- BEST WAY TO UNDERSTAND THE USEFULNESS OF THE TECHNOLOGY IS TO EXPERIMENT

THAT'S IT!

ANY QUESTIONS?

JOIN US AT THE POWHATAN PUBLIC LIBRARY THIS SATURDAY AT 9:00 AM (LARGE CONFERENCE ROOM) FOR A WORKSHOP ON IMPLEMENTING SOME OF THESE MODES

RAY'S TYT TH-7800 DUAL BAND VHF/UHF RADIO ~$200.00

TYT

DTMF/2 Tone/5 Tone

A + B Dual Band Operation

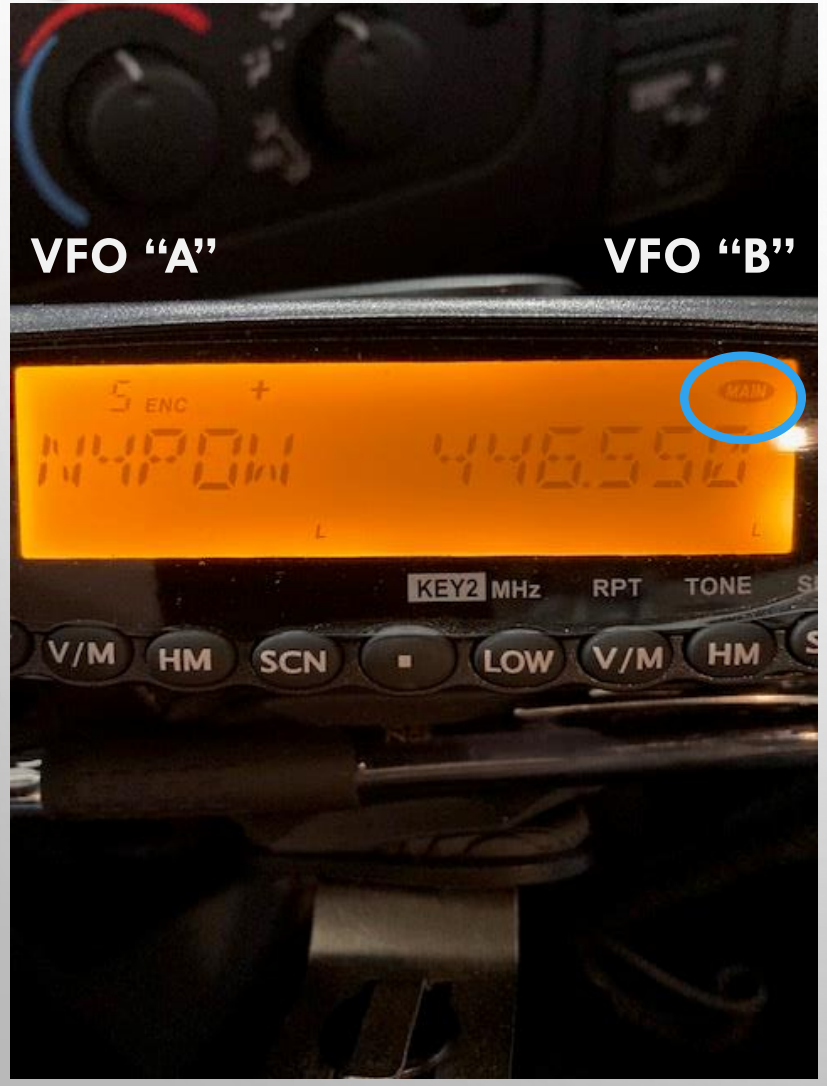
VHF and UHF Dual Band Mobile Transceiver

TH-7800

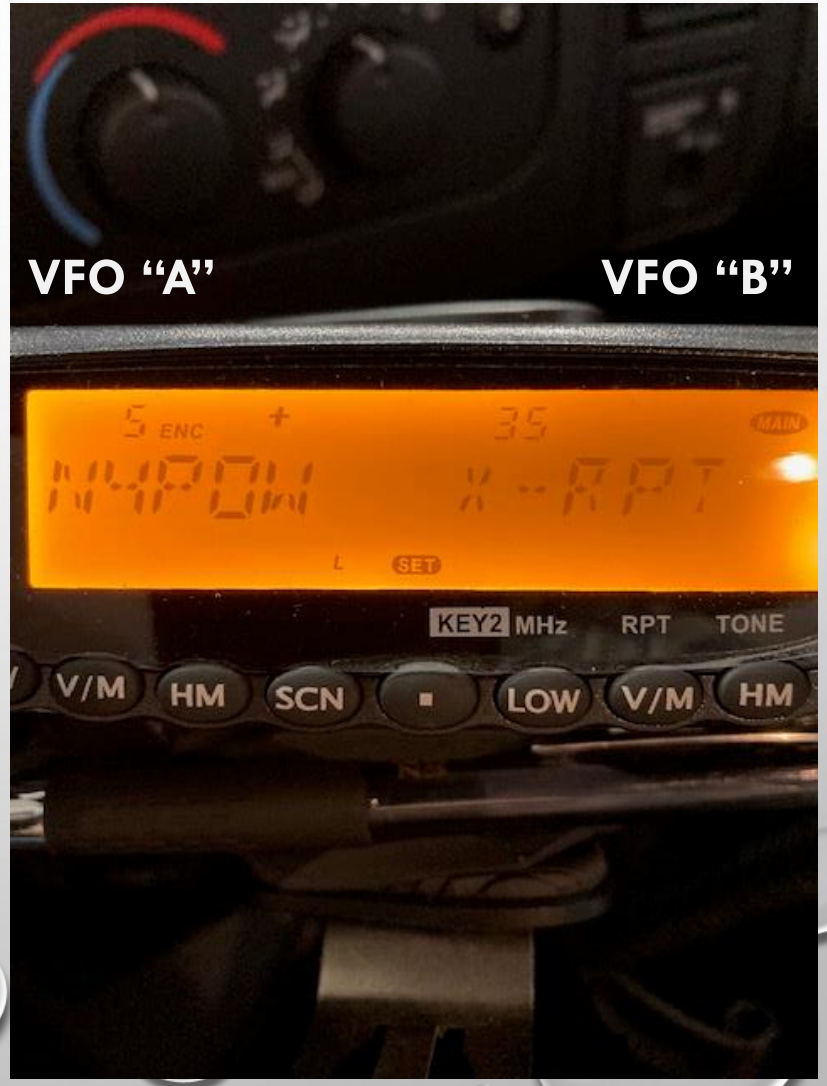
50W output power for 144MHz and 35W for 430MHz

V+U Full Duplex Operation / Cross-band Repeater Function / Ultra-size LCD Screen Dual Display
More than 800 Memory Channels / A + B Dual Band Operation / Detachable Front Panel
50 CTCSS tones/1024 DCS codes / 8 groups of Voice Scrambler option
Dual band: TX: 134-174MHz and 400-480MHz
AM/FM RX: 108-180MHZ, 134-174MHz and 350-520MHz

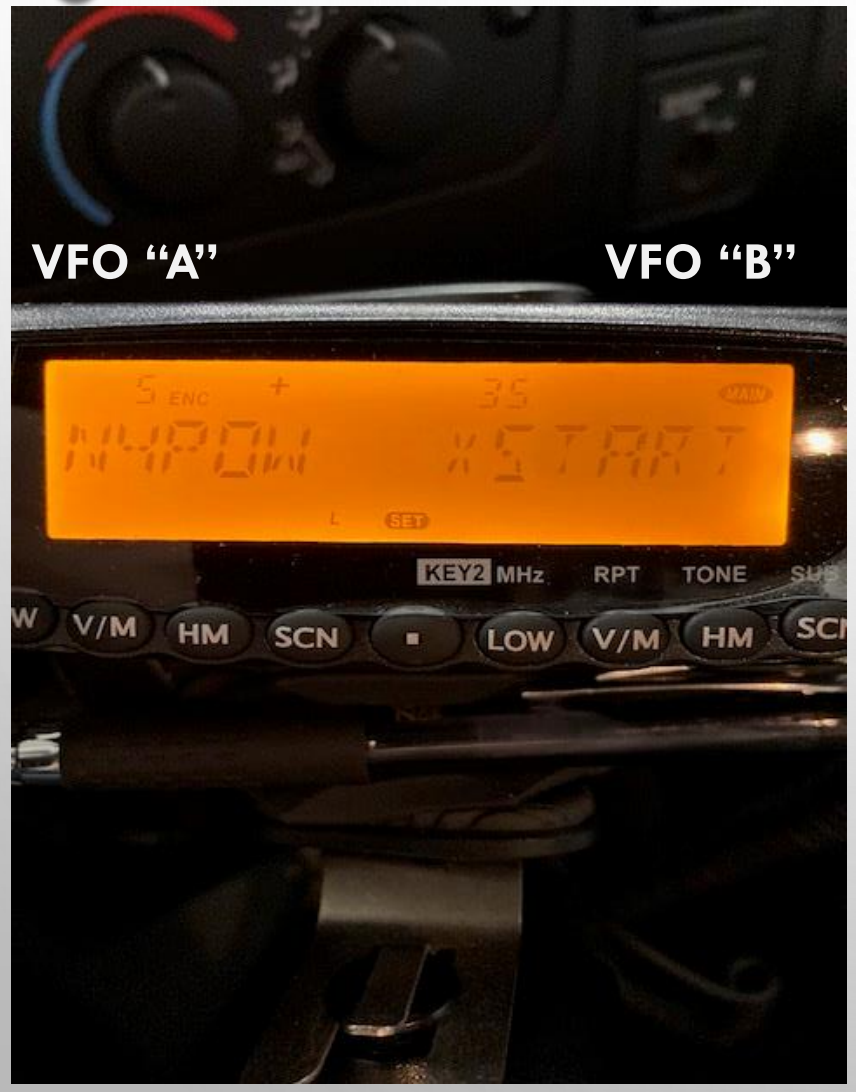
FULL DUPLEX CBR
RAY'S TH-7800 EXAMPLE



Right Side VFO
Press "SET" button
and rotate dial
to MENU 35
"X-RPT"



FULL DUPLEX CBR
RAY'S TH-7800 EXAMPLE

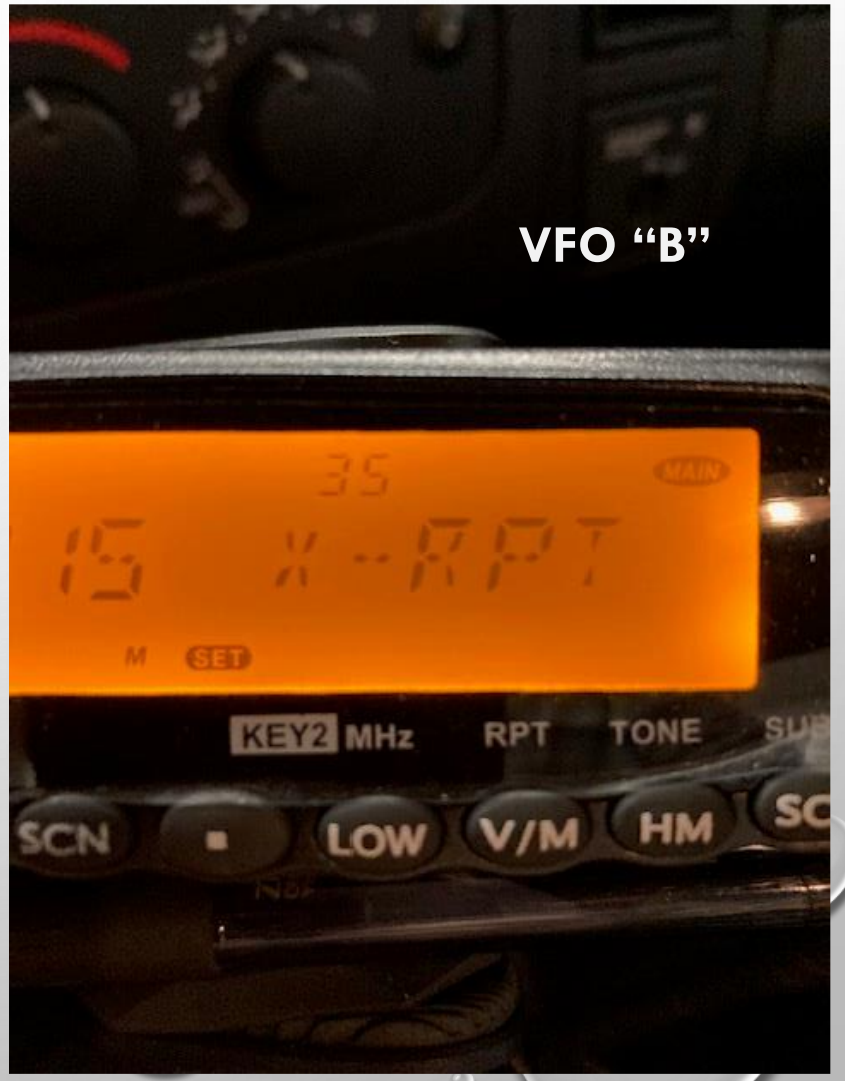


Press dial
on MENU 35
"X-RPT" to show
"XSTART"
Press dial again
To begin CBR

To End – Press
"SET" button

HALF DUPLEX CBR
RAY'S TH-7800 EXAMPLE

Right Side VFO
Press "SET" button
and rotate dial
to MENU 35
"X-RPT"



HALF DUPLEX CBR
RAY'S TH-7800 EXAMPLE

Press dial
on MENU 35
"X-RPT" to show
"XSTART"
Press dial again
To begin CBR

To End – Press
"SET" button