

Milford Amateur Radio Club

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What is Yaesu System Fusion II?



- Latest generation of Yaesu's analog and digital C4FM protocol
- Operating analog and C4FM is the Fusion of modes on same repeater

Basic Overview of C4FM

Three ways to modulate a sine wave radio carrier:
Modify the amplitude, frequency, or phase. Combining
two or more variations improves spectral efficiency.

- Continuous Four Level Frequency Modulation (C4FM)
- Version of 4 Symbol FSK (Frequency Shift Keying)
- Phase 1 of the P25 project also uses four-symbol FSK (4FSK) modulation
- P25 is used by public service radios - not compatible with C4FM
- C4FM is a variant using four frequencies with 2-bits/Hz efficiency
- Frequency shifted +/-1.8KHz or +/-600 Hz achieving four symbols
- Achieves 9600bps data rate with a 12.5KHz narrow band channel
- DMR also uses 4FSK and a 12.5KHz channel, but with a 6.25KHz channel using two-slot time-division multiple access (TDMA)

C4FM Operating Modes

All a C4FM user needs to know is he or she can use one of the following:

- Voice/Digital (Digital Narrow)
- Voice/Wide (Voice Wide)
- High speed Data (Digital Wide)
- Analog FM

Digital Narrow (DN)



- Allows for simultaneous voice and digital transmissions (e.g., GPS, text messages, or voice plus the sending of a photo with the optional camera microphone)

Voice Wide (VW)

- Uses full bandwidth for the highest fidelity and clearest communications
- Provides for a fuller sounding voice
- 4400bps for voice and 2800bps for Forward Error Correction

Digital Wide (DW)

- Up to 9600bps of text or data (e.g., photos with optional camera microphone)
- Effective rate is 7200bps after framing without Forward Error Correction

Analog FM

- Compatibility with existing Analog FM
- Allows users to upgrade over time

Automatic Mode Select (AMS)

- **Auto** - Rx/Tx mode automatically matches received signal (DN, VW, DW or Analog FM)
- **Tx Manual** - Same as Auto / pressing PTT changes Tx between DN and Analog FM
- **Tx FM Fixed** - Rx Auto / Tx FM only
- **Tx DN Fixed** - Rx Auto / Tx DN only
- **Tx VW Fixed** - Rx Auto / Tx VW only

Yaesu DR-2X



- Fusion is the joining of both analog FM and C4FM digital on same repeater. A Fusion repeater can operate in one of the following modes:
 - Analog FM Only
 - Digital C4FM Only
 - Both Analog and Digital Signals

The K8DV/r is 5W input and 100W output:
Yaesu DR-2X and a Henry C100D02R 100W
Amplifier

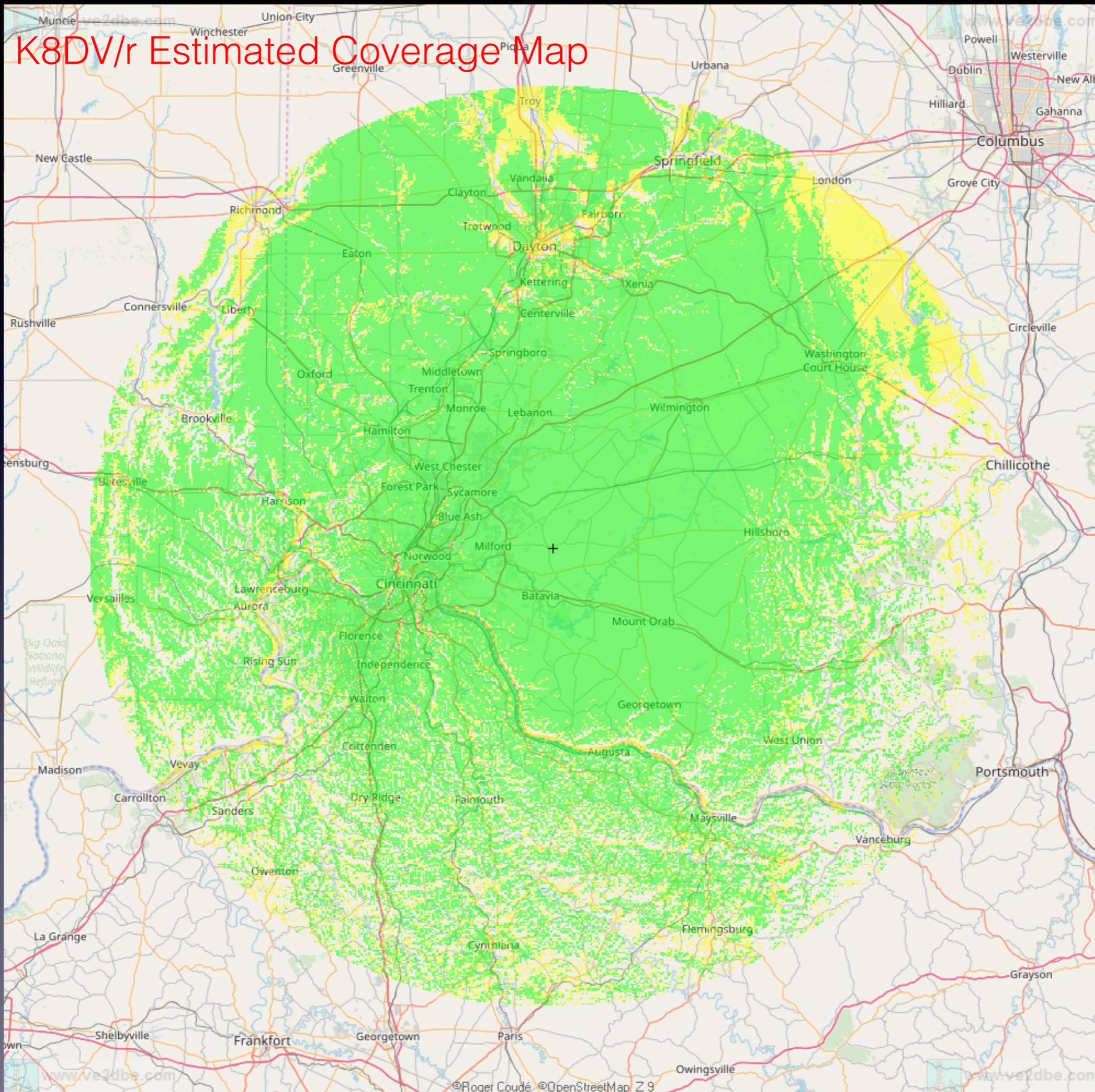


K8DV/r

UHF 443.450MHz (PL 123.0)
Operating in AMS Mode



K8DV/r Estimated Coverage Map



Benefits of C4FM

- Digital Signal Clarity
- Smart Navigation with distance and direction to other stations in real-time
- Backtrack function allows for navigation to starting point showing distance and direction on screen
- Group Monitor (GM) checks if users within a group are in range. (Shows distance and direction for up to 24 stations - great for EMCOMM)



Biggest Benefits

- No Code Plugs!
- Works out of the box
- Easier to hear and understand weaker signals



Club Raffle

- C4FM Dual Band Transceiver with APRS and GPS
- 100 Tickets - \$5 each

*A Digital Mobile Transceiver for a New Age,
with a Wide Variety of Mobile Operations
Made Possible Through Advanced C4FM Technology*



C4FM Clear and Crisp Voice Technology
AMS Automatic Mode Select
WIRES-X

C4FM/FM 144/430 MHz
DUAL BAND 50 W DIGITAL TRANSCEIVER

FTM-100DR

American, Asian and Australian versions

FTM-100DE

European version

(DTMF Microphone MH-48A6JA, Mounting Bracket, Bracket for Front panel, Control Cable 10 ft, PC connection Cable SCU-20, Stereo Monaural Plug and DC Power Cable included)

References

<http://systemfusion.yaesu.com/what-is-system-fusion/>

<http://www.trinityos.com/HAM/Yaesu-System-Fusion/Yaesu-fusion-and-c4fm-v7.pdf>

<https://www.electronicdesign.com/technologies/communications/article/21798737/understanding-modern-digital-modulation-techniques>