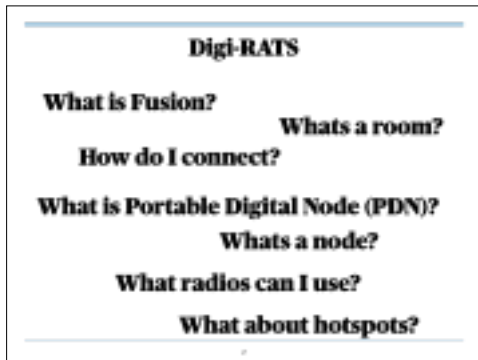
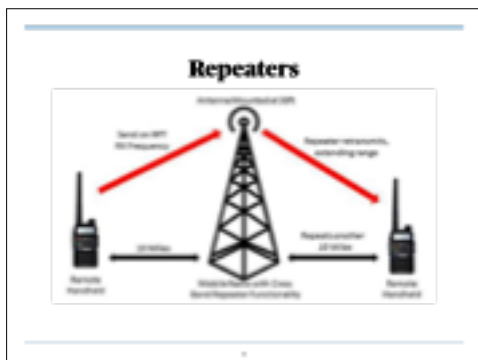


1 Thank you for this opportunity to help clear things up about C4FM & Wires-X. Some of us have more wide ranging understanding of VHF / UHF than others so we're going to try to bring everyone along for the ride.



2 "Digi-RATS" is a nickname for the Desert RATS members who use the C4FM. ... We're going to give you the information you need to connect to Wires-X either through our repeater or directly from home on your own and even listen to some of the nets on Wires-X without a

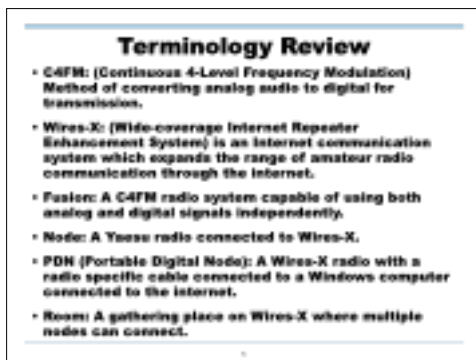


3 Repeaters play a crucial role in regional communication by extending the reach of radio signals, allowing people to connect over greater distances. With the advent of digital technology, this capability has expanded significantly. Now, the internet enables repeaters from across the country to connect through various networks, facilitating global communication. This means that with a radio costing as little as \$200, you can connect to a local repeater and communicate clearly with someone in locations as diverse as Colorado, Kansas, New York, or even London. The Desert RATS have invested in C4FM, a digital voice mode renowned for its exceptional sound quality, reliability, and ease of use. This investment underscores our commitment to leveraging the best available technology for seamless easy to use communication.



4

Our Clubs repeaters are Yaesu DR-2X. These repeaters are very agile and can transmit on 2m VHF 144MHz band as well as 70cm UHF 440MHz band and can operate in typical analog mode as our 146.940 MHz primary repeater does. Our digital C4FM repeater on our 449.240 MHz frequency is strictly digital. The barrels you see here are the duplexers that permit the repeater to use the same antenna for both transmit and receive. The antenna is a 3 to 6 db gain, two bay Dipole Telewave antenna. The programming and installation of this equipment was performed by our own club members. From Left to Right: Nathan AG6AV, Earl KJ6DQR, Guy KS6F, Steve N7AQ, and myself, Rick N6PSP.



5

I don't want to spend a lot of time here but knowing the basic language is important to understanding how Wires-X works. C4FM is one of the digital voice codecs that converts sound into digital packets for transmission over the air and through the internet. Wires-X uses the internet to connect to distant rooms and nodes for communications. Fusion is a system that can retransmit in analog or digital at will. A node is an individual radio connected to Wires-X. Portable Digital Node is a compact means of creating a node. A room is capable of hosting several nodes for group conversations and nets.

Digital voice modes encode speech into a data stream before transmitting it.

- APCO P25 - Found in repurposed public safety equipment from multiple vendors. Uses AMBE or AMBE CODEC over FSK.
- D-Star - Open specification with proprietary vocoder system available from Icom, Kenwood, and Plethadio Systems. Uses AMBE over GMSK with V-P capabilities.
- DStar - Found in both commercial and public safety equipment from multiple vendors. Uses AMBE codec over a FSK modulation variant with TDMA.
- NEXEDGE - Used primarily in commercial 2-way (particularly railroad). Equipment is available from multiple manufacturers. NEXEDGE uses (GMSK) with bandwidths of 6.25 kHz channels.
- System Fusion - Open specification with proprietary vocoder system available from Yaesu. Uses AMBE voice codec with FSK modulation (C4FSK).
- FlexEV - Narrow bandwidth, open source digital voice mode. Uses Codec2 with differential or coherent FSK modulation.
- M17 - Another open source digital voice mode based on Codec 2. Uses (FSK) (C4FM). Utilizes punctured convolutional coding and quadratic permutation polynomials for error control and bit stream re-coding.

6

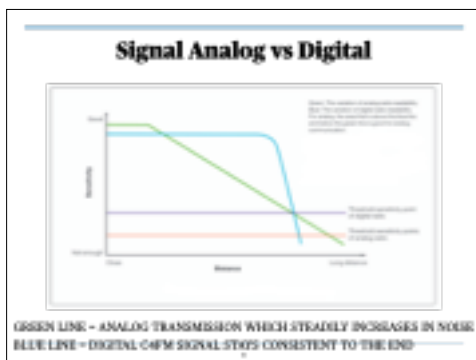
Digital voice modes convert analog sound into ones and zeros; the language of computers. There are several different ways of doing that as we can see here. A common codec used by four of the systems listed here use the AMBE chip to make the conversion from analog to digital so it can be transmitted then returned to analog by the receiving radio at the other end. Anyone listening to a digital transmission in analog mode will here noise like buzzing.

**Communications Mode**

Communications Mode	Acronym	Description of Modes
VOC Mode (Voice/Data simultaneous transmission mode)	DIG	This is the standard digital mode. Only one way opens to transmissions caused by detection and correction of the received digital voice signal.
Voice FM Mode (Voice Full Rate Mode)	WFM	High speed data communication using entire 12.5 kHz band (includes high-quality voice communication).
FM Mode	FM	Analog communication using FM mode.
AM Mode (voice only)	AM	This AM mode for voice only.

7

Our C4FM 70cm repeater uses only digital mode. The preferred communications mode is digital narrow. In this mode, both data including your callsign is transmitted as well as your voice. Voice Wide sounds the most natural of the communications modes but is more subject to interference. FM mode is what most VHF & UHF radios use and is analog in nature. AM signals typically used by aircraft.



8

The distance range of digital signal is not greater than a similar analog signal. However, analog will continue to degrade and become noisier over distance where digital sounds the same from up close all the way out to the edge of the signals end. On the chart, the

green line almost immediately begins to degrade where the blue line representing digital, sounds good for a longer distance and then falls off abruptly. Several of our club members have discovered that they can be clearly heard with even a handheld radio on digital where analog from the same place may not.



9

Here is how to connect to the clubs 70cm repeater over the air. Tune your C4FM radio to our clubs 70cm frequency 449.240 MHz. There is no “PL” tone as we are using digital signals not analog. Select “DN” by pressing the “Dx” button (second orange button on left). Press and hold the the DX button you’ll get the “Handshake Screen” If it doesn’t connect the first time, try again.



10

The interface provides several key features to help you manage node connections effectively:  
Below the Frequency Display is the first gray box displaying the ND (Node) you are currently connected to.  
The lower gray box indicates the room

to which the node is connected and the number of nodes linked to it. Search & Direct: This feature assists you in finding rooms to connect to. The orange section highlights the item that will be selected when the upper right knob is pressed. By turning the knob, you can navigate through different items. Pressing the knob selects the highlighted item. Here, we will focus on selecting "Search & Direct." Before moving the repeater to another room, ensure it is currently in the "Clubs" room. This information is displayed at the bottom, where it reads "DESERT-RATS." If it shows a different name, it indicates someone else has moved it before you. If there is no traffic for a couple of minutes, you can disconnect it from its current location and connect it back to the club room. Once connected, ask on the air if anyone is using the repeater and wait for a reply. If no response, proceed to connect to the room of your choice. Remember, this repeater is a shared resource, so it's important to be considerate of others who may be using it.



11

This is the screen after selecting Search & Direct. We'll cover each item here separately.



12 The 'All list' shows, in descending order, the online rooms and the number of nodes connected to them. The second room here is "America-KC-Wide" with 126 nodes connected and is a popular room with numerous nets every week. This list is 999 rooms long and can be displayed 20 at a time using the upper right channel knob to the bottom of the list. Press in on the knob to connect to the orange highlighted room.



13



14 The 'search & direct' brings you to a keyboard to type the name of a room your looking for.



15 Select each letter using the upper right channel knob, press the same knob to select the letter you want and repeat the process to create a search. Press and hold the same knob to initiate a search based on the letters you selected.



- 16 A list of rooms that match your criteria, in this case “D-E” appears. Using the knob, highlight the room you want to connect to and press the knob to connect to it.



- 17 The C1 thru C5 provides a place to store favorite nodes and rooms you frequent.



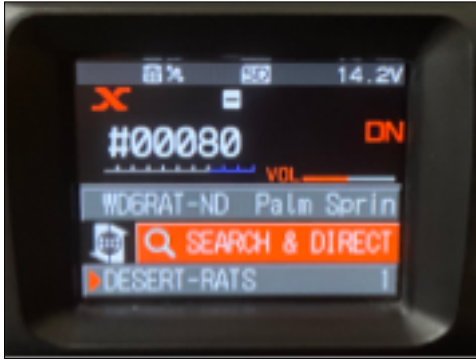
- 18 Each group can be re-named. Each group can hold up to 5 rooms. The number of nodes connected to the rooms in these lists will be shown here as well. This saves time when going to favorite rooms instead of searching for it on the active rooms list. The list we see here are rooms that host nets each week that we connect to.



- 19 From the “handshake screen”...



20 ...press and hold the # key on the handheld microphone to enable you to enter the unique 5 digit code every node or room is assigned.



21 Pressing the # key again sends you to that room.



22 So, we can connect to rooms by scrolling through a list of all of the rooms on Wires-X now, or put in search criteria to find items matching that criteria or you can select off of a short list you have previously compiled or you can type in the 5 digit code assigned to each room. Any of these will connect you to the rooms of your choosing. This can only be done with a C4FM Yaesu radio. So that's how to connect to rooms. To disconnect, press and hold the \* key on the microphone between transmissions. Or, select another room including the clubs room 00080 and select that room as we've seen before, again between transmissions. The repeater will give you 60 minutes in any room you've selected before it will remove you from that room and send the repeater back to the Clubs room.





23 Q & A...



24 Once connected, this screen pops-up. For the most part, these are seldom used features. Just select the “BACK” button on the radio face to continue. Feel free to explore these items on your own.



25 Not all Yaesu radios are capable of C4FM. The FTM-500D is the newest in a line of C4FM radios. The nick name for this one is “Big Head” because of the larger display and the large VFO dial. Each of the radios from Yaesu, have varying features that should be considered before selecting one. Any of the mobiles can be used as either a mobile in a car, pair it with a battery for portable operation or in place of a battery, an AC to DC power supply to be used in a home or apartment. All will require some kind of antenna.



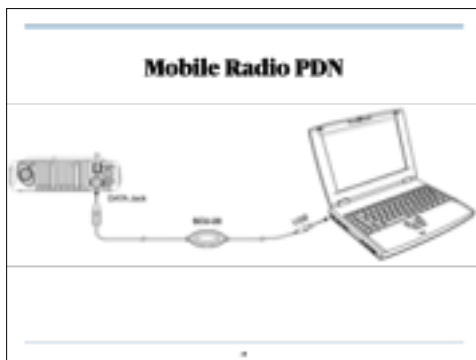
26 The FTM-200 was the most affordable of the mobiles. Like the 500, 200 and the 300, these radios are capable of transmitting at up to 50 watts in both 2m and 70cm. As of November 13, 2024, the FTM-200 is no longer available new due to inability to source parts required

for this model radio. Yaesu has announce 3 new Analog radios at the same time. These have a new technology that makes marginal analog signals more readable however they are NOT C4FM or Wires-X capable.



27

The FTM-300 has been in production since 2020 and is a popular model. All three mobiles have a remote head allowing the radio to be mounted somewhere else while the control head is placed in an easily visible location. All mobiles are capable of operating in Portable Digital Node and are available through authorized Yaesu dealers. The frequency set for Europe radios will not work in the US. If your going to operate in the US, be sure to buy one designed to do so.



28

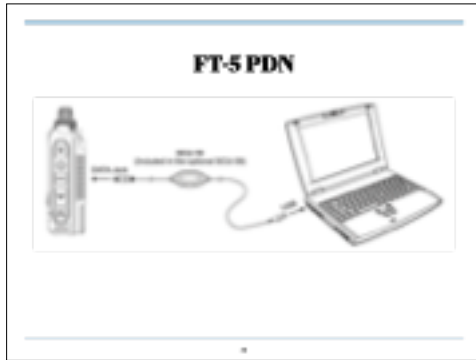
Another way to get to Wires-X is by connecting any of these mobiles to a computer connected to the internet with a separately purchased cable. Using a Portable Digital Node, you can access rooms and nodes from around the world any time you like, for as long as you like.



29

The premier handheld is the FT-5D it is the only handheld that has the ability to do PDN mode and is a 5 watt radio with many of the same features as the previously mentioned mobiles. Simple button presses on power-up allows this radio to move from being a regular FM

and C4FM handheld for over the air radio use, to using the PDN mode with a internet connected Windows computer. Wires-X does NOT support Apple computers, any tablet or any smart phones.



30 Purchasing a different cable than what is used on a mobile, club members have checked into our weekly C4FM “Digi-RATS” nets from around the country. Most recently a board member checked into our weekly net from St. Martin.



31 FT-70D is a good starter radio capable of FM and C4FM transmissions as are all the radios we’ve talked about. Access to Wires-X through a repeater is possible but FT-70D can NOT do PDN. This too, is a 5 watt small form handheld radio that’s been out in since 2017. Several of our club members have this radio and use it to checkin to our C4FM nets and participate in the national technical nets on our club repeater. This could be a good second radio to use around the house to speak through another Wires-X capable radio in access point mode giving you freedom of movement while still using Wires-X.



32 We connect the repeater to these national weekly nets so our club members can learn and participate in these nets weekly. Each of these rooms are available by listening to the repeater or using a Portable Digital Node (PDN) at home or even on

vacation. There is valuable information dispensed every week on these nets by people who are knowledgeable on the given topics.



33

Some of these nets and many others with server connected systems are available to listen to on the web without a radio at all. You can't talk on this system but you can hear up to two days worth of transmissions from this site. These larger systems have multi-modes in the same room so you could hear C4FM then DMR or D-Star in the same room. Therefore, the sound quality will vary depending on which mode is being used.

Sun	Mon	Tue	Wed	Thu	Fri	Sat
GM 7:15pm						
Voice 7:20pm						
GM 7:15pm						
Voice 7:20pm						
GM 7:15pm						

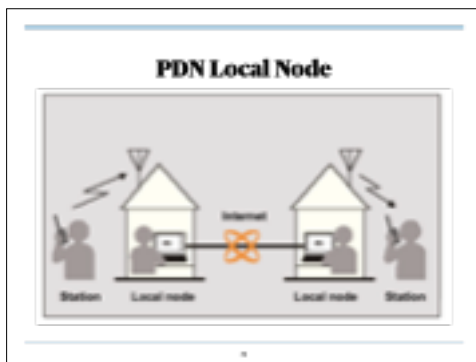
34

Each week we conduct our own nets. On the First, third & fifth weeks of each month we do a Group Monitor Mode check in net. On the second, fourth we conduct a voice checkins. Group Monitor is a feature on C4FM that beacons your call-sign and position information to anyone else in the GM mode on that frequency. It is more commonly used in a simplex environment say.. on a road trip with others or camping. We conduct a test on the repeater each month to familiarize members with how to use it.



35

When we do GM checkins, each members callsign displays on each participants radio. After the net controller acknowledges the members by announcing their callsign, they turn GM back off. We do this process to allow members a window of time to checkin so they can prepare for the ARES net that follows the clubs analog net that same night. Using GM is a coordinating tool and should NOT be used on simplex or especially on a repeater when not coordinated.



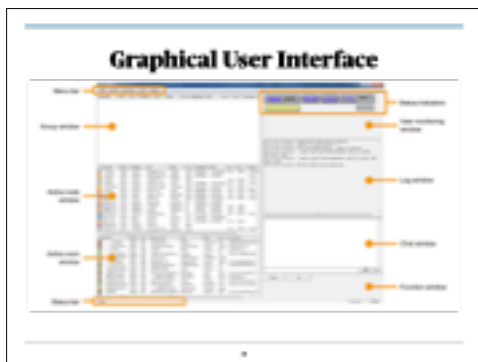
36

That was repeater operation. Another way to get to Wires-X is Portable Digital Node (PDN) which lets an individual ham operator have access around the world like we do on the Club's 70 cm repeater. All that's required is a Windows computer with internet access, a Yaesu PDN capable radio and a radio specific Portable Digital Node (PDN) cable to connect the two. PDN is like having your own repeater at home. Here, both hams are using PDN in access point mode. Someone has a handheld radio transmitting to the Local Node in their home where another radio is connected to a computer with access to the internet to reach Wires-X. In access point mode, it's possible to move around your home or even down the street a short distance to stay connected to the home radio and Wires-X. If using only one radio connected to Wires-X the node can be set to Direct Access mode so a second radio is unnecessary.



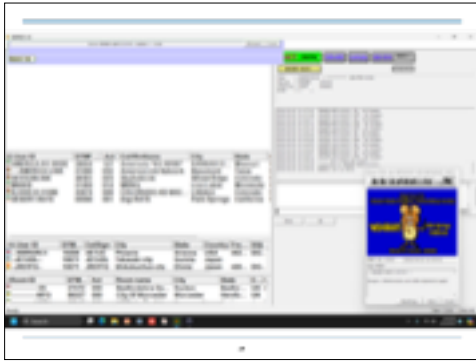
37

There are two ways to get on Wires-X. One requires Port Forwarding on an router and the purchase of a \$120, HRI-200 device. This enables a user to host their own room, but most individuals don't need that. Our club has this so multiple members can connect remotely at the same time for nets and other group QSOs. The upper section shows how our club repeater access Wires-X. On the bottom, access is accomplished by an individual connecting through a Windows computer as a PDN. Although we are showing a FTM-500, other radios can be used in these rolls. This expands the home PDN by adding a handheld creating the ability to move around your home while still be connected to Wires-X.



38

For those who choose Portable Digital Node, the computer interface gives you lots of information. It includes lists of all the online nodes and Wires-X rooms and other ways of connecting to them. The group window shows a list of your favorite nodes and rooms. You can bookmark these for quick access in the group window. The status indicator tells you how you are connected to Wires-X, which radio you are using, and which room or node you are connected to, if any. There's a lot more to this interface, we will only be covering some of it tonight.



39

PDN is a way to by-pass the repeater and connect directly to any room or node you want, any time you want for as long as you want via a computer and the internet. This is what the clubs node page looks like from a PDN. In the narrow blue box in the top left show who is connected to the 00080 room. Note WD6RAT-ND or node is in the room. The clubs node is the access to Wires-X and can only connect to one room or node at any one time. A room may have numerous nodes connected to it at any given time but nodes can be connected to only one thing at a time, either a node or a room. The lists are the bookmarked favorites you have put in the bookmarks list. The next group is nodes available to connect to. The last is the list of rooms available to connect to. The green box shows us we are in digital mode. The “Local” box changes to internet when a transmission is originated from this node using the “HRI-200” the club uses. QSL artwork appears in this box with other text from the room administrator entered for the connected room or node.



40

Here we see all the 127 nodes (ND) connected to Kansas City Wide room. This is a typical list for this room. Notice the QSL artwork in the lower right corner for Kansas City Wide is unique to their room with other data included.



41

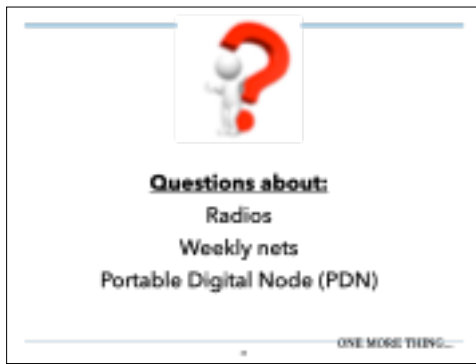
Now we are connected to Skyhub Link System. On the right side we see the green “NET” box that shows we are in digital mode. When someone transmits, the “ON AIR” would light up red. When someone transmits through the RF side of the repeater, the “LOCAL” turns red and changes to “INTERNET” . The connection to the internet is made through the “HRI-200” as indicated by the last box on that row. Right below that box is a timer. When someone transmits, the timer starts. The time out timer will take you off the air when you exceed 3 consecutive minutes. The larger box below is a node activity log. The next white box down is a text window where messages from others in the same room can be seen. The smaller narrow window with the cursor in it is where you can type a message to others. The “News and GM” buttons are advanced features you can tryout on your own.



42

A common question is ‘can I use a “hotspot” to connect to Wires-X rooms and nodes?’ The simple answer is NO. Although hotspots can access other digital modes like DMR & D-Star, Wires-X is owned by Yaesu and does not directly connect to other modes. Some of the most popular Wires-X rooms use servers that have developed ways of cross-modeing to multiple modes like DMR & D-Star. In my personal opinion the SharkRF OpenSpot 4 Pro is currently the most agile and easiest of the hotspots to use.





43

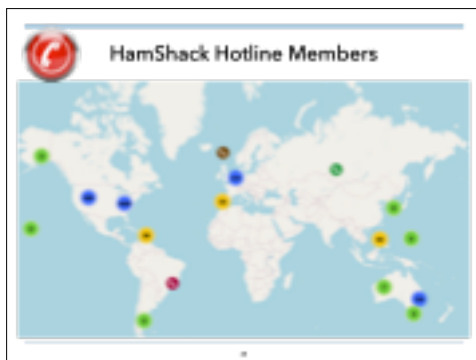
Q & A...

In last months newsletter, I introduced you to HamShack Hotline.



44

HamShack Hotline is a free service only for amateur radio operators using Voice over Internet Protocol over the internet using an authorized telephone device in your and/or an app on a smartphone, both allowing private communications around the world and is not subject to the same compromises that cellphones can experience. So far, there are four club members using HamShack Hotline.



45

HamShack Hotline continues to grow every week. This represents approximately how many hams are on this service. It's also being embraced by Emergency Communications as an alternative means of communications that's more reliable than cell phones or even satellite phones which all can be saturated and become overwhelmed. Are there any questions about this or anything we've covered?

Demystifying and Clarifying C4FM / Wires-X



**DIGIRATS**

Clear and Crisp Voice Technology

**Presented by Rick Lee - N6PSP**