## Yaesu System Fusion and WiresX OVERVIEW:

This presentation attempts to explain various items in a plain language manner. It therefore may not be 100% technically correct in all aspects. But, it should serve to make new users more familiar and comfortable with Yaesu digital radio.

There are other Digital modes out there including DMR, D-Star, and IRLP. However, Yaesu's System Fusion is my favorite for several reasons

First of all, IRLP connects one repeater to another over the internet. It is easy to learn and use, and it has been around the longest. It's not nearly as popular nowadays as the newer digital voice technologies.

DMR is the least expensive of the new digital voice technologies, but for me it has several drawbacks. The main one of these is the need to pre-program your radio before you can visit any "Talk-Group". They call the radio programing file a "Plug" and it is required.

Likewise, D-Star requires you to program your radio.

System Fusion does not have this entry level hurdle. It's collective spaces (or Reflectors, if you will) for folks to gather and talk are called "Rooms" versus "Talk-Groups". And, you can search for and find a Room from your radio with no pre-programming required.

### Let's define it a bit:

System Fusion is Yaesu's implementation of Digital Amateur Radio, utilizing C4FM 4-level FSK (Frequency Shift Keying) Technology to transmit digital voice and data over the Amateur radio bands. It was named "Fusion" because it "Fuses" Digital and Analog voice technology. Fusion itself is not Proprietary. Yaesu has published all of the details. This is why the Dongle makers such as Open-Spot and Pi-Star can include a crossband mode for YSF or "Yaesu System Fusion". The method of encoding the voice into a digital signal is not proprietary.

However, Wires X, which stands for Wide-Coverage Internet Repeater Enhancement System is a comprehensive and easy-to-use system for linking repeaters and/or home stations together and it is a Proprietary "closed' system. This was done to ensure that this **"network"** is used exclusively for Amateur radio and is not "degraded" by others trying to utilize it differently.

So, if you use a dongle that includes a YSF cross-mode from DMR (and most of them do) you can talk to SOME Wires X Rooms, **but only the ones that have installed a bridge between Wires X and the DMR's YSF network.** Let me clarify that just a tiny bit more: When you are on your Pi-Start and using the YSF cross-mode, you are NOT actually on the Wires X network. Said another way, not all Wires X Rooms have a bridge to YSF. **In fact, many rooms do not!** So, there are many Wires X rooms on the network that you CANNOT reach via a digital voice dongle.

I like to think of it and explain it this way. When you connect to a room on Wires X, you are coming in the front door. If the owners of that room have installed a bridge to DMR, then you can use an open-spot or a raspberry pi-based digital voice dongle to come in the side door. But, remember, many Wires X rooms do not have this kind of side door! The only way to access all Wires X rooms is to use the Wires X network, which requires a Yaesu Fusion capable radio,

**C4FM:**
Continuous 4 Frequency Modulation:
This is a method of encoding the input signal into a digital signal.
This uses FDMA (Frequency Division Multiple Access) to divide the input signal into multiple smaller frequencies. There are other implementations of C4FM for other radio services, and they are not necessarily compatible with each other. In fact, they are probably NOT compatible with each other.

In Yaesu fusion the result is a 12.5 Khz wide signal that is used to send your voice, call sign, and location digitally. However, this 12.5 Khz signal is utilized in various ways. The most common of these is a scenario in which it ends up as **TWO** 6.25 Khz wide signals.

This is the "DN" or Digital Narrow mode that you will see on the display of your Fusion radio. One of these 6.25 Khz channels carries the digital voice signal, and the other is used for Forward Error Correction of the voice signal ***and*** data such as GPS location.

***This is the mode that you want to use when connecting to a Wires X Room.***

"VW" or Voice Wide mode utilizes the full 12.5Khz width for your voice, and it does not contain the same amount of Data Error correction. While in theory this gives a higher audio quality, it is more likely to have slightly worse characteristics of range and less quality under sub-optimal conditions, due to less forward error correction.

So, do NOT use this mode thinking that you are going to "Sound Better". ***It has been known to cause issues with some of the WiresX Rooms.*** It doesn't "break: the room, but at times a user in VW Mode cannot be heard by everyone else in the room***.***

There is also a "DW" or Digital Wide mode. This is NOT user selectable. It uses the entire 12.5 Khz signal for Data Only (no voice) and again this has a smaller forward error correction component. Your radio will automatically use this mode to send control signals to the repeater when you are in digital mode. So, you may be able to talk on the repeater in digital mode, but not be able to control it (ie. change rooms, etc.) if you are in a fringe area. *My experience has been that this results in a significant reduction in useable range.*

**Different ways to Use the system**:

You can simply control a system Fusion repeater (like this one) to select a room and start making contacts in a different city or country. And, while this will not harm the repeater, it does tie it up so that others cannot use it. If you are monitoring in FM only mode, you may hear a "White Noise" sounding hiss. And, this is likely a digital conversation going on.

Or, you can connect your fusion capable radio to a PC, and get out onto the Wires X network to a room, without tying up the repeater. There are several methods of doing this. One utilizes the HRI-200 box. With that you can have a WiresX "node" and a WiresX Room. However, there is really no need to have your own WiresX room, unless you plan to leave your radio and PC on at all times. Also, the HRI-200 method requires TWO radios. One to act as the WiresX gateway/repeater and the other to talk to the gateway radio.

**What is a Wires X Node?**:

WIRES-X uses local nodes (stations connected to the Internet via PCs) as access points to relay communications of amateur radio stations. For example, mobile stations using WIRES-X can communicate with amateur stations all over the world by using a local node access station operating within their area. If I fire up my node, a ham friend down the street can use it to connect to any room he likes. All he needs to know is the correct frequency for my node. *However, you have to REGISTER with Yaesu in order to set up your node*.

Without the HRI-200 box, you can still have a WiresX Node. This is the "Portable Digital Node" set up. It can be set up as an Access Point, or as a "Direct Connection". In "Direct" mode you use the PTT switch on the radio connected to the PC. It sends out no RF, but it sends your digital voice out on the WiresX network. In Access Point" operation, you can use the PTT on the radio connected to the PC, OR, you can use an HT to talk to your connected radio, and your connected radio sends the signal out onto the WiresX network.

***PLEASE NOTE:*** There are WiresX rooms that are set up to handle Analog signals. I don't know much about this, but I do know that there are very few of these. Also, there are instructions from Yaesu about setting up your node to handle analog signals as well. However, this requires additional cabling and the instructions and use of this is a bit convoluted. Your best bet is to stick with only the digital mode.

**Let's get down to it:**

All of the following instructions vary from radio to radio. **Download and consult the appropriate Supplemental Wires X manual from Yaesu America for your specific radio.**

*How to connect Digitally to the Hortonville(this) repeater.*
This varies from Radio to radio. But, it is normally a press of the Wires X button on your radio. On some radios it is a long press of the button, on others it is a short press. This will shift your radio into DN mode and change the display to show Wires X information, such as Room, Repeater Call Sign, etc. There should be a Down Arrow button on the display. This is the SEARCH button. Once you press this you will find one or more ways to search for a room. You can type in the beginning portion of the room name, (if you know it's exact name and spelling.)

Or, you can look up a room in advance on the internet.
Go to: **https://www.yaesu.com/jp/en/wires-x/**
Here, you can find both a name and a Wires X Room ID number. For example, on the FTM-400 you can press long press the Wires X button. Then, from Wires X mode screen you can hold down the # (hash, or pound) key on the mic. No PTT just the # key. An # will appear on the screen. You then enter the 5 digit DTMF code for the Room (MinWs is 24193) and then hit the # key again. The repeater will then connect to that room.

No matter what room the repeater may be connected to, you can go back to FM mode on your radio, without disconnecting the repeater from the room. But, if you are the one that connected the repeater to the room, then it would only be proper etiquette for you to disconnect from that room when you are done.

*How to DISCONNECT from a room.*
One Long press of the asterisk (*) key should do the trick. Do not use the PTT for this. Just press the star key on the mic until you hear a beep.

*How to go back to FM mode.*

Typically, another long press of the Wires X button will cause the display to switch back to the normal "repeater' type of display. However, you may still need to press the V/M key to get back into memory mode. And, you still need to use the MODE (key, button, etc.) to get back into FM mode.

NOTE: The repeater will auto-disconnect from the room after 20 minutes i*f nobody **locally** keys the repeater input with a digital signal*.

*Difference between a Node and a Room.*

A node is a connection to the Wires X network. One or more Nodes can be connected to a Room. A Room is analogous to a "Reflector". Multiple repeaters (which are basically nodes as well) and User Nodes can be connected to a given room.

**Now, let's talk about MinWis:** (I think they spell it **MinWs** on the internet.)
One of the BEST websites you can use for help with Yaesu digital is HamOperator.com
Here you can find the "WiresX Bible".
You can also find a Calendar of interesting Wires X nets, (Such as MinWis and MVARV (Magic Valley Amateur Radio Club) in Idaho), plus lots and lots of other interesting and USEFUL information. *And, they have a link to live stream of the Weekly MinWis net.*

The Primary place to go for answers to your questions is the MinWis net. Every Monday night at 8:30 PM Eastern time.
Do NOT check into this net unless you have a question about Fusion, or Wires X, or how to do something with your Wires X capable Yaesu radio, etc. *Feel free to connect to the MinWis room during the net, just remember to not "Check-In" unless you have a specific question to ask later.* These guys have the answers. And, if they cannot answer your question on the net, they will take it under advisement and try to answer it during a future net! Chris, K9EQ is the driving force behind this net and he is the GENIUS with most of the answers.

You can also find podcasts of previous MinWis nets on HamOperator.com. Listen to a few of these and you will learn a LOT about Fusion/WiresX. These are nice to have because your local WiresX repeater (Hortonville) will time out after 20 minutes. So, if you use the repeater to listen, to MinWis, you will likely get disconnected from it after 20 minutes. So, find a moment between dialog and hit the transmit key for about a ¾ of a second.

This is one of the advantages of having your own node. Or, you can listen to the podcasts of previous MinWis nets..

Go to K9EOC.org (and you should be redirected to:) (https://sites.google.com/view/noblesville-repeater/home) and click on HamCoHam to request to join that Google group. This is where I will post the links that you can use for Fusion/Wires X information.

**WiresX Links**
https://www.yaesu.com/jp/en/wires-x/pdf/WIRES-X_PDN_Function_OM_ENG_2304-K.pdf

**New Member Registration:**
https://www.yaesu.com/jp/en/wires-x/regist/index.php

**Member Log In:**
https://www.yaesu.com/jp/en/wires-x/index.php

**Main Wires X Web site:**
https://www.yaesu.com/jp/en/wires-x/node/index.php#/

**Wires X Room List:**
https://www.yaesu.com/jp/en/wires-x/id/active_room.php

**Yaesu Protable Digital Node Instruction Manual:**
https://www.yaesu.com/jp/en/wires-x/pdf/WIRES-X_PDN_Function_OM_ENG_2304-J.pdf