

Yaesu System Fusion

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Drumlins Amateur Radio Club

Steve Verzulli
KA1CNF

System Fusion (YSF)

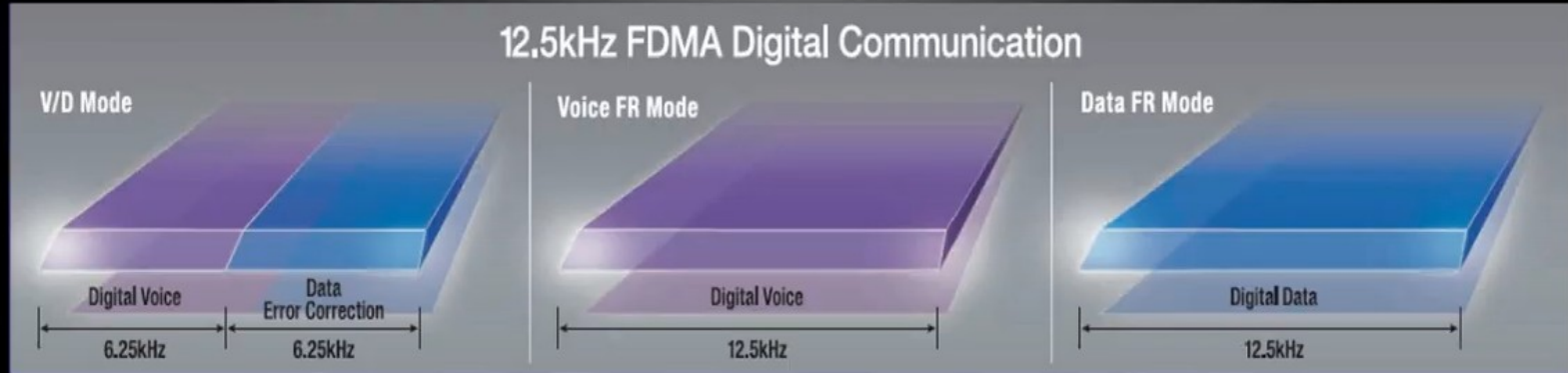
- Newest of the digital modes
- One of the 2 digital modes Designed by hams for ham radio - Amateur friendly
- Goals
 - High Quality digital voice
 - No static, picket-fencing, fading, bacon frying
 - Ease of use and operation
 - Versatile and flexible
- First introduced an HT (FT1) and mobile (FTM-400)

System Fusion (YSF) cont'd

- Repeaters DR1, DR2 came later
- Yaesu chose FDMA – more friendly than TDMA. You do not need a special amplifier
- “Fusing” of analog and digital – AMS (Automatic Mode Select)
- Only mode that is backward compatible to FM
- Modulation scheme used is C4FM
- Programming is either manually from front panel/keypad or software from Yaesu (ADMS) or RTSystems

Four Modes (FM not shown)

The modes of Fusion are...



DN Mode

VW Mode

DW Mode

Terms and definitions

- **Node**

Radio (repeater or simplex) connected to the Internet via a PC, which repeats communications of a conventional amateur radio as an access point.

- **Local Node**

This is a Node within the radio communication range of a conventional amateur radio station.

- **Analog Node**

A Node that is a transceiver or repeater using a conventional FM format and can only repeat DTMF codes and analog audio

- **Digital Node**

A Node which is a transceiver or repeater compatible with digital communications in C4FM format. With this type of Node you can not only relay voice communications but also text and image data.

- **Room**

This is a WIRES-X network community space to which multiple nodes can connect simultaneously, like a telephone party line. Capable of voice, and chat.

Terms and definitions

- **WIRES-X user ID (node)**

YAESU provides identification name with the WIRES-X node. Each node is assigned a DTMF ID (5-digit number, e.g. 11916) and user ID (alphanumeric e.g. WB7OEV) up to 10 digits in length provided. Knowing the ID of the node to connect to, you can transmit the DTMF ID code from the transceiver, specifying the node to connect to by searching by characters.

- **ID List**

Nodes and room which currently operating WIRES-X. The list is stored on a Yaesu server and is distributed to nodes over the WIRES-X network. They are listed and published on the Yaesu website. The website shows information such as IDs, the call sign and the operating frequency of the node.

- **WIRES-X Linked Repeater**

A repeater connected to the WIRES-X network. A can be direct, or via an RF Link.

- **Reflector**

A reflector is a computer based server which connects 2 or more "nodes" together via server to create kind of "conference room".

Fusion Product Line

C4FM/FM 144.430 MHz
Dual Band 5W
Digital Transceiver
FT-70DR
(700 mW Low and Clear audio,
Commercial Grade Specifications)

C4FM/FM 144.430 MHz
Dual Band 5W
Digital Transceiver
FT3DR
(Improved 66 ch GPS receiver included,
Built-in Bluetooth® Unit)

System Fusion
Pursuing Advanced Communications

C4FM Digital
Pursuing Advanced Communications

DR-2X
C4FM/FM 144.430 MHz
Dual Band Dual Receive Digital Repeater

FTM-100DR
C4FM/FM
144.430 MHz Dual Band 50 W
Digital Transceiver
(Improved 66 ch GPS receiver included)

FTM-400XDR
C4FM/FM
144.430 MHz Dual Band 50 W
Digital Transceiver
(Improved 66 ch GPS receiver included)

FTM-7250DR
C4FM/FM 144.430 MHz Dual Band 50 W
Digital Transceiver
(Heavy Duty 50 Watts High Power)

FTM-3200DR
C4FM/FM 144 MHz 65 W
Digital Transceiver
(Genuine 65 Watts High Power)

FTM-3207DR
C4FM/FM 430 MHz 55 W
Digital Transceiver
(Heavy Duty 55 Watts High Power)

FT-991A
CW/SSB/AM/FM/C4FM
117/50/44.430 MHz Wide-Coverage
100 W All Mode Transceiver (Heavy Duty 100 W)
(Real-Time Spectrum Scope Included)

<u>Radio</u>	<u>Type</u>	<u>PDN Mode?</u>	<u>Cost @ HRO</u>
FT70DR	HT	NO	175
FT2DR	HT	YES	360
FT3DR	HT	YES	350
<u>FTM-3200</u>	VHF Mobile	NO	170
<u>FTM-3207</u>	UHF Mobile	NO	170
<u>FTM-7250</u>	Dual Band Mobile	NO	210
<u>FTM-100</u>	Dual Band Mobile	YES	310
<u>FTM-300</u>	Dual Band Mobile	YES	470
<u>FTM-400</u>	Dual Band Mobile	YES	520

Ways to communicate with Fusion

- Simplex – promoting National Calling Frequency of 145.5625 MHz (FM users will hear digital “noise”)
- Repeaters – 11 within 50 miles of Rochester (video file)
- WiRES-X – like voip – communicate over internet
- PDN – Personal Digital Node
- Hotspots – YSF reflectors are NOT Yaesu and cannot connect directly to Wires-X

Repeaters

- Repeaters – From Repeaterbook within 50 mi. 14526
- DR1,DR1X, DR2X DR1X-FR (W2SO, 147.285, Batavia)

VOIP Legend: A=AllStar; E=EchoLink; I=IRLP; W=WIRES

DGTL Legend: A=ATV, D=DMR; P=P-25; S=D-Star; Y=Yaesu System Fusion

Frequency	Offset	Tone	Call	Location	ST/PR	Use	VOIP	DGTL	Mi	Dir	
444.9000	+5 MHz	110.9	N2BZX	Fairport	NY	OPEN		Y	7.81	SSE	+
444.7750	+5 MHz		KA1CNF	Macedon	NY	OPEN	W	Y	9.48	SE	+
444.8250	+5 MHz		W2XRX	North Chili	NY	OPEN	W	SY	17.60	W	+
146.7450	-0.6 MHz	71.9	WA2AAZ	Newark, Water Tower	NY	OPEN	EA	Y	19.62	SE	+
444.7500	+5 MHz	110.9	WA2EMO	South Sodus, Brantling Hill	NY	OPEN	A		19.64	ESE	+
444.7500	+5 MHz	110.9	WA2EMO	Arcadia, Brantling Ski	NY	OPEN	A	SY	19.75	SE	+
443.2500	+5 MHz	CC 110.9	N2MKT	Newark	NY	OPEN	EA	DSY	20.42	SE	+
145.2900	-0.6 MHz	110.9	W2XRX	Canadice, Bald Hill	NY	OPEN	W	Y	29.62	SSW	+
442.8750	+5 MHz	141.3	K2SRV	Albion	NY	OPEN	E	Y	38.14	WNW	+
147.2700	+0.6 MHz	71.9	K2RSY	Auburn	NY	OPEN		Y	47.47	SE	+

Repeater setups

Left is a UHF digital only repeater, DR2X, connected to an HRI-200 box and is running Wires-X connected to the Southern Tier Fusion Network.

To the right, a VHF repeater, DR1X, is the Drumlins ARC 146.745 setup with an Scom controller and Allstar using a Motorola PL board that tells the repeater to be in digital or analog mode.

Photo and description from Jeff, N2MKT, repeater chair/trustee



WiRES-X with HRI 200

- WiRES-X using HRI 200 box Yaesu controlled server
- Node -----Internet-----Node
- Wide-Coverage Internet Repeater Enhancement System
- Think of WiRES-X as an Internet linking system like other VOIP systems, Echolink, Allstar, D-Rats and hotspots
- It has enhancements that work directly with Fusion.
- Links repeaters and/or home stations together using Internet voice technology
- Windows computer connected to your HRI 200 with a radio or repeater
- Static IP required along with several open ports, port forwarding
- Must turn on radio or repeater in WiRES-X mode
- Second radio needed for communication


WiRES-X Software

WiRES-X

File(F) View(V) Connect(C) Tool(T) Help(H)

G.User ID	+DT...	Act	Call/Rm...	City	State	Cou...	Freq(MHz)
WN8Z-RPT	11199		WN8Z	Fulton	New York	USA	147.390M...
WAZEMO-ND	11777		WAZEMO	Lyons	New York	USA	444.750M...
---AMERICA-...	21080	164	America ...	Beau...	Texas	USA	
N9RIM-ROOM	21424	013	Souther...	Cam...	New York	USA	
MNWIS-FUSION	21497						
TEXAS-NEXUS	21637						
WNY-HUB	21707						
ALABAMA-LINK	28937						
N2EUS-ROOM	40967						

View QSL de KA1CNF (ID:KA1CNF-RPT)



DTMF ID: 21424 2020/05/10 07:41:02

Southern Tier-NY

< N9RIM-ROOM #21424 >
 Southern Tier NY
 Northern Tier PA
 Facebook: Southern Tier System Fusion

Room ID

SC-WIRES-X
 BOSWELL-W7JHQ/R

Room N9RIM-ROOM(21424) member 13 nodes Refresh Close

NET DIGITAL ON-AIR LOCAL HRI-200 RADIO 1

N9RIM-ROOM

User = KC2EQ-JOHN > ***** (DN:FT3D)
 Uplink = KC2EQ (18023)
 Downlink = KA1CNF (30128)
 Room = (21424)
 Position = N:42 04' 46" / W:076 47' 10"
 Distance: 128.4km (79.8mile) Direction: SSE

2020/05/10 13:45:06 KB2FAK-ND(54769) OUT. 14 Nodes.
 2020/05/10 13:54:33 N2CTK-BARY(52776) OUT. 13 Nodes.
 2020/05/10 14:08:23 AB2HS-ND(53766) OUT. 12 Nodes.
 2020/05/10 14:08:59 AB2HS-ND(53766) IN. 13 Nodes.
 2020/05/10 16:00:04 AB2HS-ND(53766) OUT. 12 Nodes.
 2020/05/10 16:06:37 AB2HS-ND(53766) IN. 13 Nodes.

2020/08/02 21:30:47 N1DJS-RPT > MNWIS-FUSION : mobile user list will show l
 2020/08/08 20:08:01 KI5EGH-ND > N9RIM-ROOM : got booted a minute ago. but
 2020/08/31 16:04:25 N9RIM-RPT > N9RIM-ROOM : Power Failure at N9RIM 4:00pm
 2020/04/05 20:23:40 AE5ME-ND > N9RIM-ROOM : Net control you have AE5ME (che
 2020/04/18 21:47:37 AC2YS-RP > N9RIM-ROOM : ac2ys
 2020/04/18 21:51:54 AC2YS-RP > N9RIM-ROOM : SAT APRIL 25 YAESU SIMPLEX 146.
 2020/04/28 23:05:37 KD2GDT-ND > N9RIM-ROOM : Thanks to N2EUS and AB2HS - I
 2020/04/28 23:11:30 KD2GDT-ND > N9RIM-ROOM : Again - thanks! I figured out
 2020/04/30 08:42:26 KC2EQ-RPT > N9RIM-ROOM : on going networks problems...

SEND CLR

N9RIM-RPT KC2EQ-RPT KA1CNF-RPT N2EUS-RPT KA3EQU-ND N2OJM-ND AC2YS-RP AC3ER-ND KB2CKK-ND2 W3JU-ND2
 KD2GDT-ND AB2HS-ND WA2QEL-ND2

Ready Ver-1.530 ONLINE

PDN – Personal Digital Node

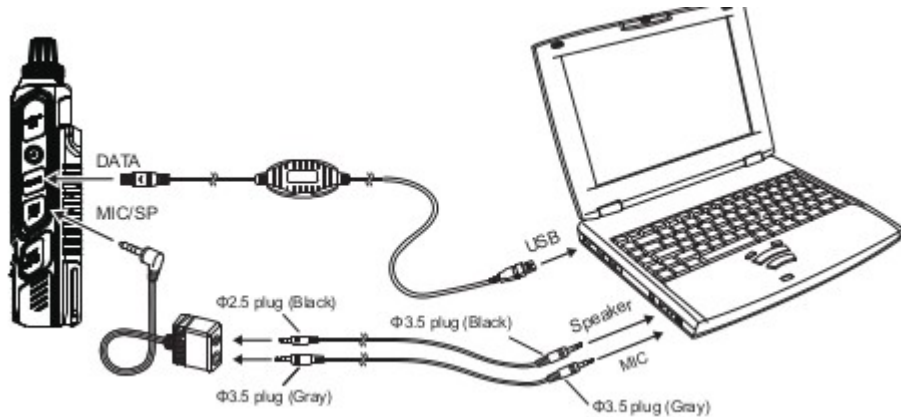


- Cannot host your own room
- Certain radios capable
- Also need audio cable for mixed mode
- WiRES-X software is Windows only
- Must turn on radio in PDN mode

PDN – Personal Digital Node

- No HRI Hardware needed
- Use your radio
- USB Cable, audio cables
- Windows pc or tablet
- No special Internet setup
- Cannot host your own room
- FT70, FTM3200, FTM3207, FTM7250 do not have this capability
- Also need audio cable for mixed mode
- Runs on Windows 7 and 10
- Use at home or travel

PDN – Portable HRI mode



- Digital and analog FM
- Note addition of audio cables
- Install USB cable driver first!
- Set radio to low power
- Use direct or hotspot mode

Getting started with PDN

1. Can use only with FT2, FT3, FTM100, FTM400 and FTM300 radios at this time.
2. Submit for WiRES-X registration at the following Yaesu website: <https://www.yaesu.com/jp/en/wires-x/regist/index.php> You need to register separately each radio you plan on using for PDN. Will need the radio ID. Instructions for how to read the ID are in the radio manual.
3. Order the USB and the audio cables if you plan on operating in mixed mode rooms with analog users.
4. Make sure your radio firmware is updated to the latest. There is main, sub and dsp firmware
5. Download and install the Wires-x software, ver. 1.53 or later on your windows pc. Note that there are minimum pc hardware and internet speed requirements
6. Help for setting up the pc here: https://wp.hamoperator.com/?page_id=41
7. N9RIM has put together a good document on the Southern Tier System Fusion Facebook page that goes into more detail on setting up a Wires-x HRI-200 and a Portable Digital Node.
8. The USB cable driver is a separate download and that must be installed for your particular radio BEFORE you plug it into your pc.
9. Set up communication port
10. Activate the Wires-x software.
11. Transceiver settings.
12. Download the additional manuals at the Yaesu website for the radio and the Wires-x software which is under the HRI-200 tab.

Hotspots

- Many choices
- Price ranges
- Basically tunnels
- Connection to YSF, FCS, XLX reflectors
- Pi-Star is popular software
- Can add custom displays and cases
- Will cross-mode
- Will NOT connect to Wires-X



Pi-Star web dashboard

Hostname: pi-star04
Pi-Star 4.1.0 / Dashboard: 20200309

Pi-Star Digital Voice Dashboard for KA1CNF

Dashboard | Admin | Live Logs | Power | Update | Configuration

Gateway Hardware Information

Hostname	Kernel	Platform	CPU Load	CPU Temp
pi-star04	4.19.75-v7l+	Pi 4 Model B (2GB) - Sony, UK	0.22 / 0.18 / 0.07	56°C / 132.8°F

Service Status

MMDVMHost	DMRGateway	YSFGateway	YSFParrot	P25Gateway	P25Parrot
DStarRepeater	ircDDBGateway	TimeServer	PiStar-Watchdog	PiStar-Remote	PiStar-Keeper

YSF Link Manager

Reflector	Link / Un-Link	Action
FCS00358 - Alabama-Link	<input checked="" type="radio"/> Link <input type="radio"/> UnLink	Request Change

Gateway Activity

Time (EDT)	Mode	Callsign	Target	Src	Dur(s)	Loss	BER
17:04:41	May 10th	YSF FCS	ALL at FCS003-58	Net	1.5	0%	1.3%
17:04:20	May 10th	YSF KA1CNF	ALL	RF	1.7	0%	0.8%
17:03:20	May 10th	YSF KD4L	*****ESTeO at KD4L	Net	2.3	0%	0.0%
17:03:16	May 10th	YSF WA60VP	ALL	Net	22.4	0%	0.0%
16:43:39	May 10th	YSF 2E0UKH	ALL at 2E0UKH	Net	24.0	0%	0.0%
16:42:13	May 10th	YSF KD9PHF	ALL	Net	9.9	0%	0.0%
16:41:21	May 10th	YSF AL-LINK	ALL	Net	0.7	0%	0.0%
16:39:45	May 10th	YSF KG4JJS	ALL	Net	25.4	0%	0.0%
16:37:09	May 10th	YSF G0RFD	ALL at M0JE0	Net	0.1	0%	0.0%
16:35:39	May 10th	YSF W65EEK	ALL at W65EEK	Net	30.0	0%	0.0%
16:33:53	May 10th	YSF M7SZY	*****E58qZ	Net	0.2	0%	0.0%
16:30:18	May 10th	YSF KF4INA	ALL	Net	0.9	0%	0.0%
16:21:29	May 10th	YSF K4MFC	*****E56Vn	Net	0.3	0%	0.0%
16:21:28	May 10th	YSF KC2FHT	ALL	Net	0.4	0%	0.0%
16:18:11	May 10th	YSF AA6TU	ALL	Net	0.9	0%	0.0%
16:17:03	May 10th	YSF KB5SAT	*****E5XEC	Net	0.2	0%	0.0%
16:16:27	May 10th	YSF KA9ZRZ	*****F0KH6	Net	34.3	0%	0.0%
16:12:20	May 10th	YSF KC2WLX	ALL	Net	0.3	0%	0.0%
16:08:16	May 10th	YSF W1MDS	ALL at W1MDS	Net	0.1	0%	0.0%
15:45:09	May 10th	YSF K04AIL	*****F0KH6	Net	0.3	0%	0.0%

Local RF Activity

Time (EDT)	Mode	Callsign	Target	Src	Dur(s)	BER	RSSI
17:04:20	May 10th	YSF KA1CNF	ALL	RF	1.7	0.8%	S9+3dB (-90 dBm)

Modes Enabled

D-Star	DMR
YSF	P25
	NXDN
DMR XMode	POCSAG

Network Status

D-Star Net	DMR Net
YSF Net	P25 Net
YSF2DMR	NXDN Net
YSF2NXDN	YSF2P25
DMR2NXDN	DMR2YSF

Radio Info

Trx	Listening
Tx	438.800000 MHz
Rx	438.800000 MHz
FW	HS Hat:v1.5.1b
TCX0	14.7456 MHz

YSF Network

Linked to: FCS00358

Pi-Star / Pi-Star Dashboard, © Andy Taylor (M0W0MW2) 2014-2020.
 ircDDBGateway Dashboard by Hans-J. Barthen (DL5DI),
 MMDVMDash developed by Kim Huebel (DG9VH).
 Need help? Click here for the Facebook Group
 or click here to join the Support Forum
 Get your copy of Pi-Star from here.

Hotspot tips

- Wifi on pi zero is “weaker” than regular pi so may need to operate near your router
- Set your radio on lowest power setting and don't operate right next to the hotspot
- Keep firmware and software up to date
- Reboot occasionally
- Use a class 10 SD card
- Shutdown properly especially on Pi, nothing special for openSpots.
- If bit rate, (BER) is over 3% may need to adjust frequency offset
- Monitor packet loss
- Don't use a metal case for wifi
- Choose frequency carefully. Stay away from repeater, local users and satellite frequencies
- Older pi's will work but will be slower to change reflectors and screens
- If more than one hotspot have them on different frequencies
- Watch out for clones and counterfeit hotspots
- You can use WiRES-X on pi-star and openspots 2,3 to change rooms. Exit WiRES-X before talking.
- Make sure you do not pass DTMF tones over the network.

Hotspots vs. WIRES-X

- They are completely separate networks (Wires-X, YSF, FCS, XLX) Cannot use one to access the other.
- Run more power out with WiRES-X vs. milliwatts with hotspots.
- WiRES-X can operate on 2 m or 70 cm with Yaesu radio
- WiRES-X cannot directly access YSF, FCS or XLX reflectors and vice versa. Folks have established bridges between the two systems, but bridging could degrade voice quality or the user experience. There are groups that do it right!
- Hotspots such as pi-star YSF<=>DMR<=>P25 can do cross-mode. openSpot3 can do cross mode with Dstar due to hardware included (AMBE 3000 chip in the circuit). Must use VW to cross mode YSF to P25
- WIRES-X Network is access controlled. Yaesu assigns IDs based on registering an HRI-200 box.
- Disconnect from Wires-x on a hotspot before transmitting. (known issue)
- Bridged systems are starting to change their YSF 5 digit ID numbers to match the Wires-X 5 digit ID numbers to avoid issues.
- Both are great for sitting in your family room with an HT and talking to hams any where in the world.

Radio Operating Etiquette

- Check your mic gain. Over modulating will cause distortion and dropouts over networks. Your special mic or bluetooth mic might be handy but some sound like crap on digital...
- Leave 2 second gap between transmissions
- Push PTT then wait a second before talking. When done talking wait another second before releasing the PTT
- Call signs show up on the radios. You do not need to give both call signs at the beginning and end of each transmission. Identify per FCC rules every 15 minutes as normal as some network connections may not pass your call sign
- Do NOT quick key like you do to connect and disconnect on DMR or DStar. It disrupts the network and interferes with existing QSO's. Use WiRES-X for control to find out if repeater is connected and what room it is connected to or to change rooms.

System Fusion Links...

Official Yaesu US Website: <https://www.yaesu.com/>

Official Yaesu Japan Website (English): <http://www.yaesu.com/jp/en/index.html>

Official Yaesu Facebook Page: <https://www.facebook.com/groups/yaesuusa/>

Official Yaesu Fusion Facebook Page:

<https://www.facebook.com/groups/YaesuSystemFusionOfficial/>

Good for maps and general (but not updated in a while): <http://c4fm.xyz/>

Hotspot history and what they are: <https://www.youtube.com/watch?v=TuEpFJbXNq4>

Finding Fusion rooms: fusion.ke5eo.com

More Links...

Difference between Yaesu WiRES-X and hotspots:

https://www.youtube.com/watch?v=RghsOLCv_mU

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

RTSystems Programming

https://www.youtube.com/watch?v=pT8FiVvDQNs&fbclid=IwAR19uRJJ8tXHFLQhi4Uk5JVZZ_zWne gWNTb_MFkkcUROK7hXkOb_6SYxNwM

Southern Tier System Fusion Network:<https://www.facebook.com/groups/174762320398275/>

145.5625 Fusion Simplex: <https://www.facebook.com/groups/1731516706988359/>

Yaesu's WIRES-X:<https://www.facebook.com/groups/wiresx.fusion/>

Excellent site with great info: <https://hamoperator.com>

Information on Fusion and MMDVM projects:<http://ve1cra.net/main/ysf.html>

And more links...

YouTube videos:

Yaesu FT-70DR Wires X Control https://www.youtube.com/watch?v=_JuhryJODP4&t=2s

Yaesu FT-70DR Wires X Operations https://www.youtube.com/watch?v=C_T43pSLgol

How to use Wires-X on the FT3D : <https://www.youtube.com/watch?v=NsZR9K4EhY0>

FTM-100 Wires-X Portable Digital Node + Firmware update : <https://www.youtube.com/watch?v=qpu1QjH0k00> (Laboenligne.ca)

Yaesu USA Soundcloud:<https://soundcloud.com/user-620300163>

YSF Reflectors: <https://register.ysfreflector.de/>

FCS Reflectors: <http://fcs001.xreflector.net/>

Yaesu Wires-X active node list : https://www.yaesu.com/jp/en/wires-x/id/active_node.php

Lots of info on digital modes and pi-star hotspots : <https://amateurradionotes.com>

Pi-Star main page : pistar.uk and youtube videos on pi-star setup by W1MSG: <https://www.youtube.com/channel/UCcjYjtognBaSAa-ZLk3EU2A/videos>

Bonus:

Try out digital modes for free

BlueDV-AMBE for Android and Windows 10.....with one catch...server is on my network

pa7lim.nl/garage/

The Garage

Update May 2020: Added Fusion RX and TX

Update October 2018: Updated a new version of the BlueDV AMBE for Android version. Better screen support and PTT support.

Update 24 Jun 2018: Some issues with adding OTG on some devices. I am investigating this issue.

Sometimes I work on projects that never reached a final but fun to test with.. They will end up in the garage page.

Try it... It's free but no support.

BlueDV-AMBE for Android (DSTAR, DMR and Fusion)

