Fun with Fusion Radio

With an introduction to Yaesu Fusion Radio

Presented by Bill "Bucky" Buckwalter WØSUN
Year 2020 During Covid

Fun with Fusion Radio

Link to YouTube Presentation
https://youtu.be/wmMvRUmxV_E?si=jq8CTGomaNCxPf5p

Fusion Confusion!

WiRES-X C4FM YSF FCS

HotSpot Jumbospot
openSPOT Pi-star Reflector Brandmeister

- Yaesu Digital World ←Part 1 →
- WiRES-X Node

← Part 2 →

- Hotspots
- YSF Reflectors
- FCS Reflectors
- PI-Star
- openSP0T Cross Mode
- DMR Brandmeister

Yaesu Digital World

Fusion Repeaters and Nodes Denver and Surrounding Areas

- **Links: Yaesu WiRES-X Active Nodes**
  http://www.yaesu.com/jp/en/wires-x/id/active_node.php
  https://www.hamoperator.com/rw/
  https://www.repeaterbook.com/repeaters/index.php?state_id=none
- **SKYHUBLINK REPEATERS** - https://skyhublink.com/repeaters/
  448.35 – Hub. Permanently linked to **DENVERSKYHUBLINK 46361**
  449.625 Denver to Loveland
  449.600 Littleton above Lockheed Martin
- **Parker Radio Association** https://www.parkerradio.org/on-the-air/
  447.225 Linked to **COLORADO-MEGA 40895**
- **Denver Radio Club**
  449.775 – No WiRES-X. Just Fusion
- **Simplex WiRES-X Nodes –** Experimental
  146.535 - KCØJIM-HRO Ham Radio Outlet Denver
  145.560 - WØSUN-GW Centennial, Lone Tree
  145.5625 – National Yaesu Fusion Simplex Frequency

KØPRA Fusion Repeater – 447.225

K0PRA-RPT - Node 30895 : Colorado Mega : WiRES-X 40895

YSF US ColoradoMega 23160 : DMR BM TG310759 : D-STAR XRF223-B

Yeasu DR-2X Repeater

- **Duplexer and HRI-200**

Yaesu Terminology

- **WiRES-X: This is one of Yaesu's current methods of Internet linking. It is used primarily for linking Yaesu amateur digital radios.**
- **IMRS: Internet-Linked Multi-Site Repeater System. This system also uses the Internet but primarily links Yaesu amateur digital repeaters. Either IMRS OR WiRES-X can link repeaters, but not both at the same time.**
- **System Fusion: Basically this refers to the ability of Yaesu's amateur digital radios to automatically switch between analog FM and digital FM use. You may select either, or automatic switching.**
- **System Fusion vs. System Fusion II: System Fusion II simply refers to upgraded capabilities that came with software and firmware updates. All System Fusion radios with the latest firmware are System Fusion II compatible.**
- **C4FM: C4FM refers to a type of modulation that is used by Yaesu in their amateur digital radios as well as by others. Yaesu has made their radios incompatible with other existing commercial digital platforms.**

Tech Spec Comparison

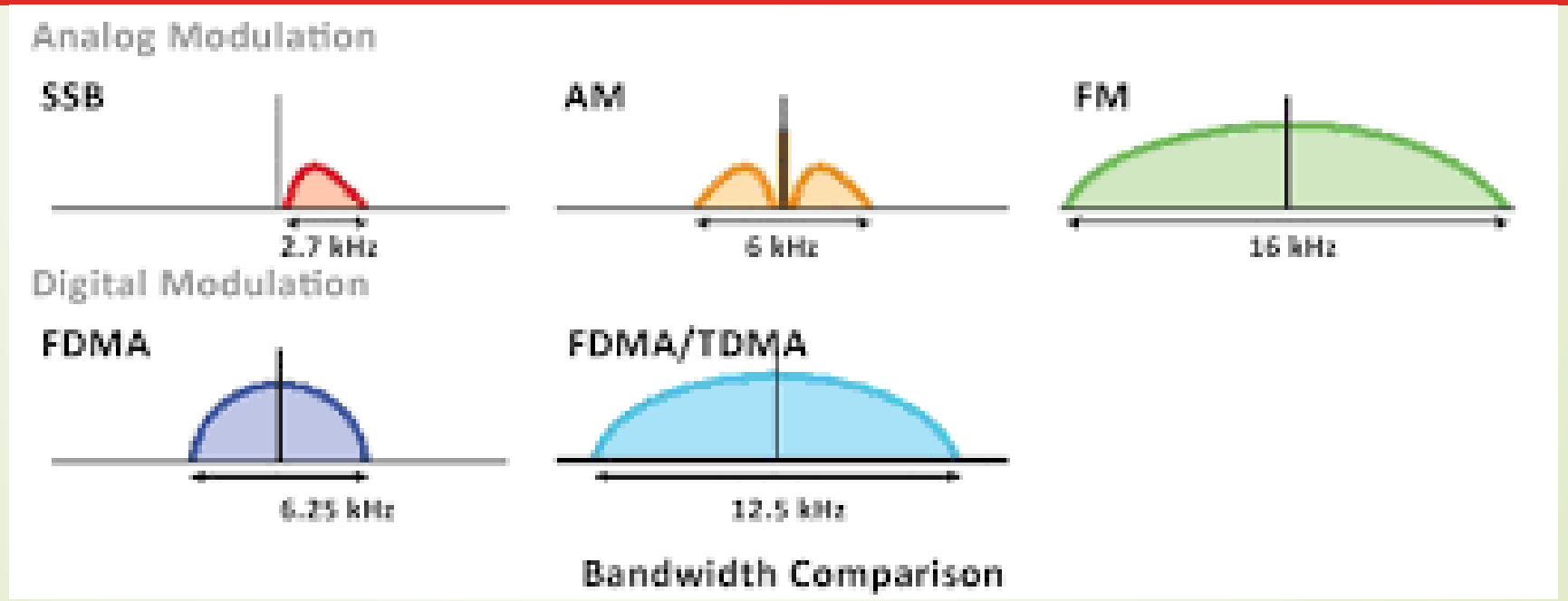
	D-STAR	DMR	Fusion
Vocoder (see note)	AMBE+	AMBE+2	AMBE+2
Forward Error Corr.	Voice Only	Voice Only	Voice Only
Modulation	GMSK	4FSK	C4FM
Multiplex Method	FDMA	TDMA	FDMA
Transmission Rate	4.8 kbps	4.8 kbps x 2	9.6 kbps
Bandwidth	6.25 kHz	12.5 kHz	12.5 kHz
Channels supported	1	2	1
Standard Developer	JARL	ETSI	Yaesu

GMSK = Gaussian Minimum Shift Keying
4FSK = 4-level Frequency Shift Keying
C4FM = Continuous 4-level Frequency Modulation
FDMA = Frequency Division Multiple Access
TDMA = Time Division Multiple Access

5YZD

Note: Newer radios implement the vocoder in the DSP chip

Digital Wide and Digital Narrow (DN)



WHAT MAKES IT FUSION

- System Fusion is different from D-star, DMR
- It's automatically backwards compatibility with analog FM
- AMS or Automatic Mode Select
- If a QSO input starts as FM, the repeater “repeats” FM
- If the QSO input starts as C4FM, it “repeats” C4FM
- Each endpoint (HT, mobile, etc.) auto-switches

** FTM-400XDR TIP

- WIRES-X digital C4FM only works on Band “A”. TOP
- APRS only works on band “B”. BOTTOM

WHAT IS C4FM AND FUSION?

- Easy to setup. Simply enter your call sign. No need to register with worldwide database.
- Excellent digital audio quality
- Send pictures over-the-air
- See the callsign, distance, and direction of received users
- All Fusion radios can perform both analog and digital communication
- Most Fusion radios (except the FT-991) have APRS with GPS built-in
- Via WiRES-X, Fusion radios can communicate world-wide, share photos & texts, leave voice messages, etc.

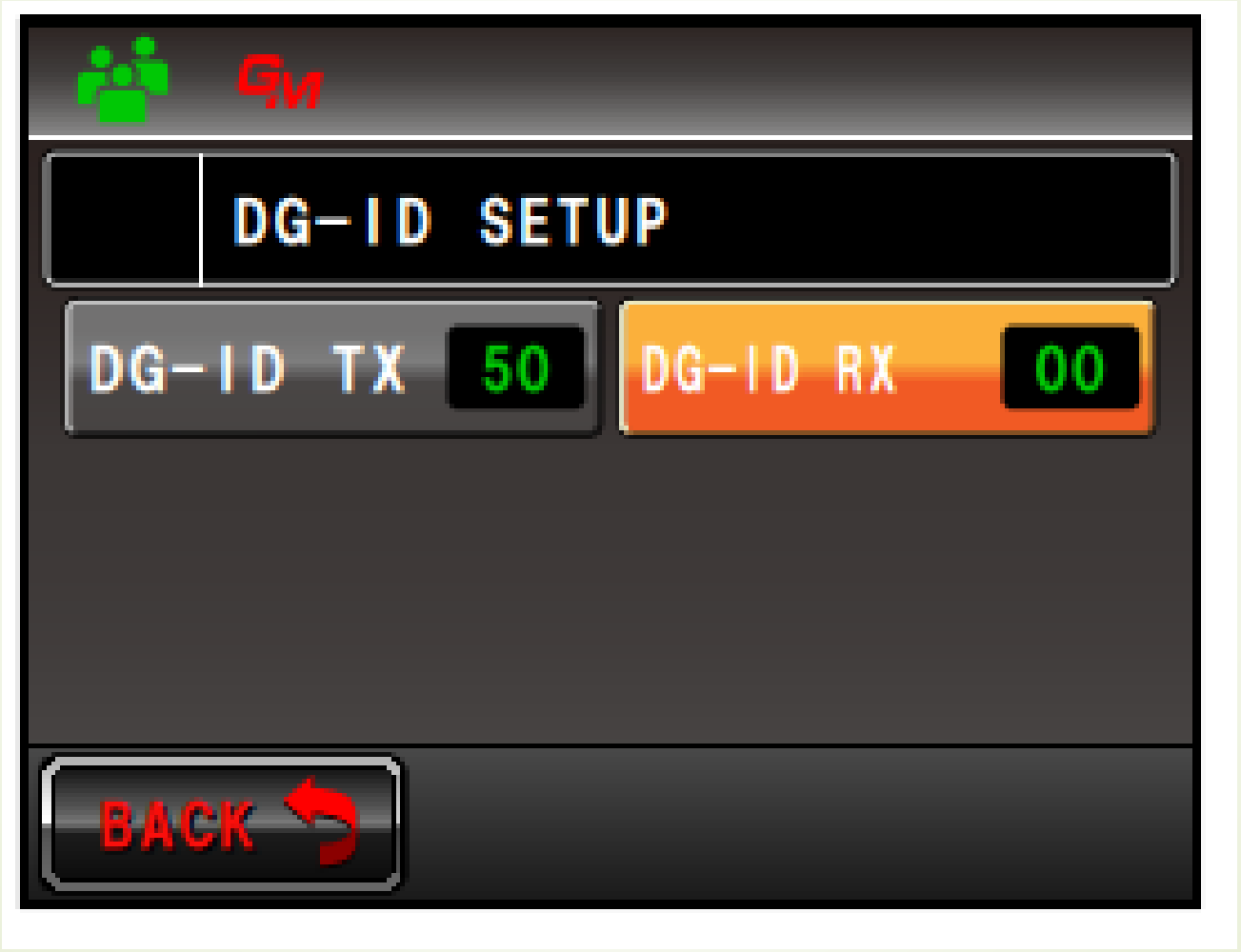
System Fusion

WiRES-X

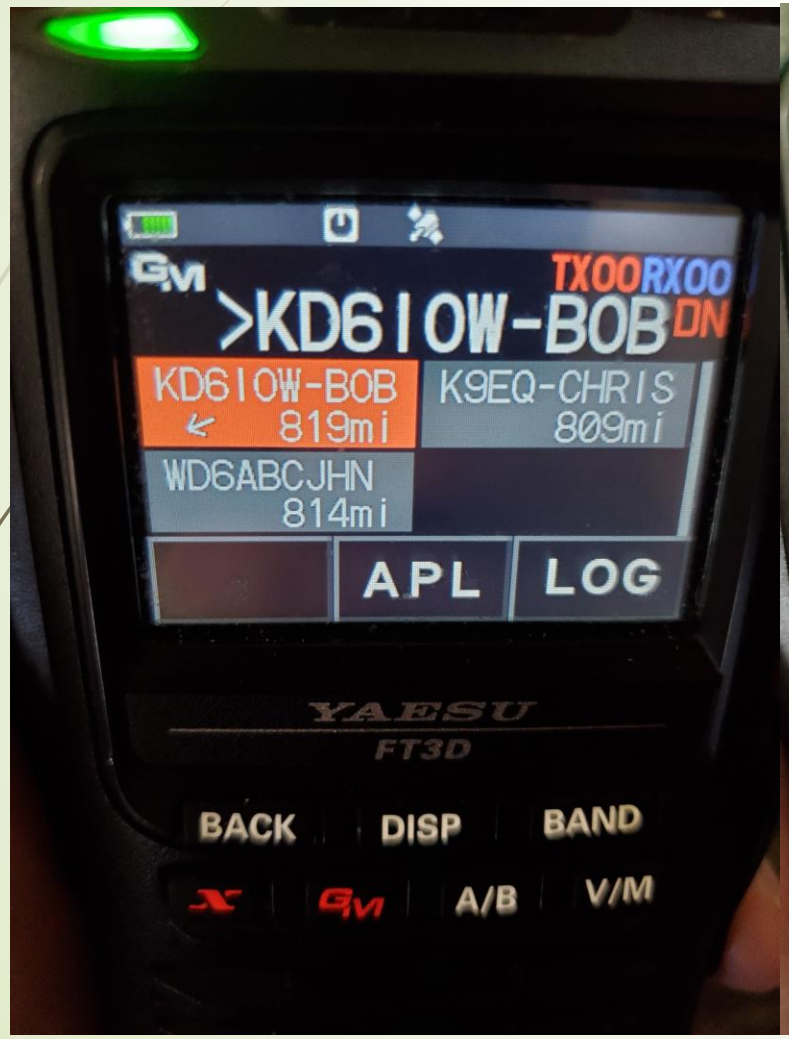
Wide-Coverage Internet Repeater Enhancement System

- **C4FM** is the Modulation Method used by Yeasu
- **FUSION** uses AMS to bring FM and C4FM together from NODE to NODE.
- **WiRES-X** is used by nodes to manipulate DATA and change rooms.

DG-ID → Similar to PL Tones in Analog

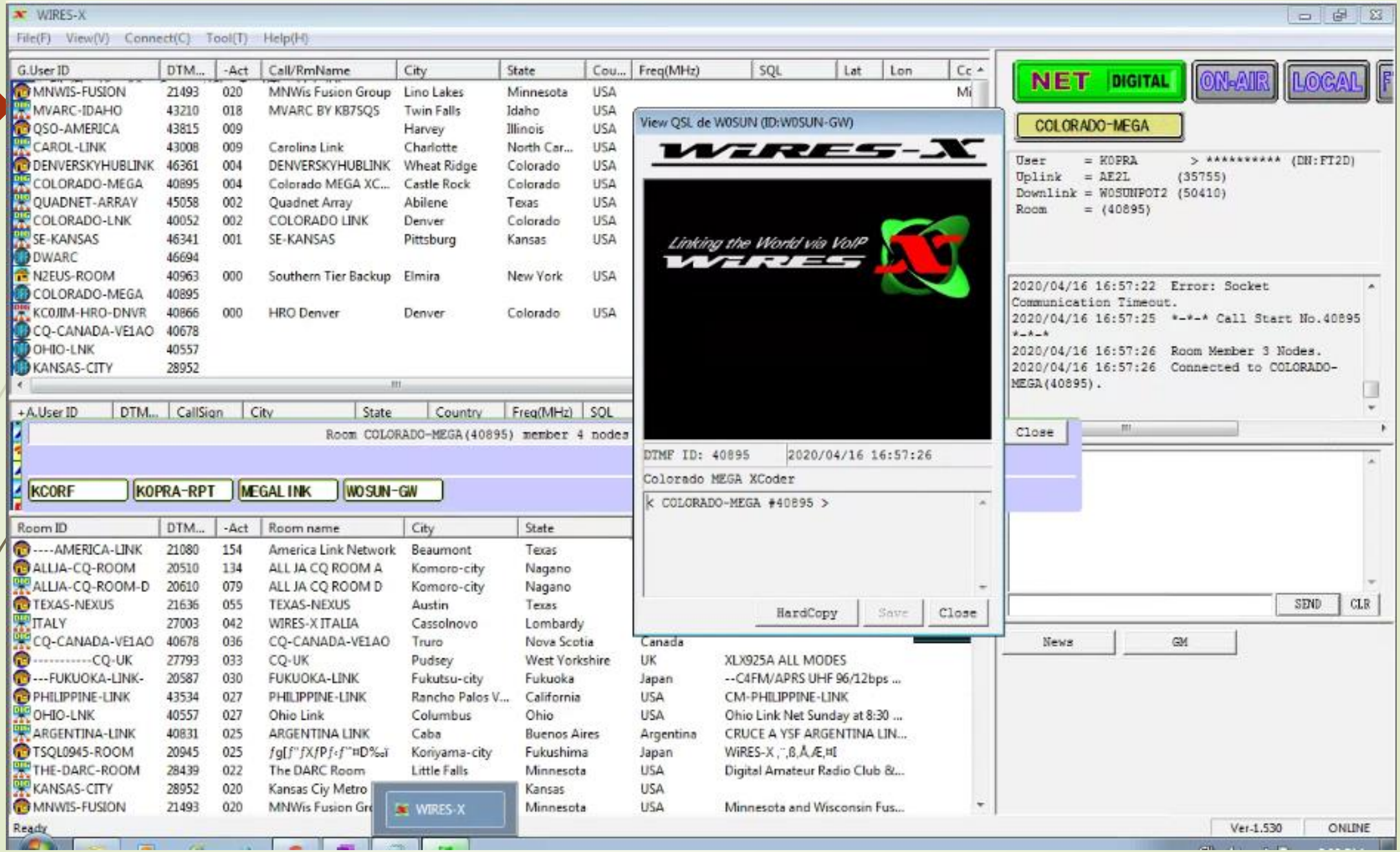


GM – Group Monitoring



WIRES-X

Wide-Coverage Internet Repeater Enhancement System


WIRES-X
File(F) View(V) Connect(C) Tool(T) Help(H)
G.User ID | DTM... | -Act | Call/RmName | City | State | Cou... | Freq(MHz) | SQL | Lat | Lon
MNWIS-FUSION 21493 020 MNWis Fusion Group Lino Lakes Minnesota USA
MVARC-IDAHO 43210 018 MVARC BY KB7SQS Twin Falls Idaho USA
QSO-AMERICA 43815 009 Harvey Illinois USA
CAROL-LINK 43008 009 Carolina Link Charlotte North Car... USA
DENVERSKYHUBLINK 46361 004 DENVERSKYHUBLINK Wheat Ridge Colorado USA
COLORADO-MEGA 40895 004 Colorado MEGA XC... Castle Rock Colorado USA
QUADNET-ARRAY 45058 002 Quadnet Array Abilene Texas USA
COLORADO-LNK 40052 002 COLORADO LINK Denver Colorado USA
SE-KANSAS 46341 001 SE-KANSAS Pittsburg Kansas USA
DWARC 46694
N2EUS-ROOM 40963 000 Southern Tier Backup Elmira New York USA
COLORADO-MEGA 40895
KC0JIM-HRO-DNVR 40866 000 HRO Denver Denver Colorado USA
CQ-CANADA-VE1AO 40678
OHIO-LNK 40557
KANSAS-CITY 28952
+A.User ID | DTM... | CallSign | City | State | Country | Freq(MHz) | SQL
Room COLORADO-MEGA(40895) member 4 nodes
KCORF
KOPRA-RPT
MEGALINK
W0SUN-GW
Room ID | DTM... | -Act | Room name | City | State
----AMERICA-LINK 21080 154 America Link Network Beaumont Texas
ALLJA-CQ-ROOM 20510 134 ALL JA CQ ROOM A Komoro-city Nagano
ALLJA-CQ-ROOM-D 20610 079 ALL JA CQ ROOM D Komoro-city Nagano
TEXAS-NEXUS 21636 055 TEXAS-NEXUS Austin Texas
ITALY 27003 042 WIRES-X ITALIA Cassolnovo Lombardy
CQ-CANADA-VE1AO 40678 036 CQ-CANADA-VE1AO Truro Nova Scotia
----------CQ-UK 27793 033 CQ-UK Pudsey West Yorkshire
---FUKUOKA-LINK- 20587 030 FUKUOKA-LINK Fukutsu-city Fukuoka
PHILIPPINE-LINK 43534 027 PHILIPPINE-LINK Rancho Palos V... California
OHIO-LNK 40557 027 Ohio Link Columbus Ohio
ARGENTINA-LINK 40831 025 ARGENTINA LINK Caba Buenos Aires
TSQL0945-ROOM 20945 025 Koriyama-city Fukushima
THE-DARC-ROOM 28439 022 The DARC Room Little Falls Minnesota
KANSAS-CITY 28952 020 Kansas Ciy Metro Kansas
MNWIS-FUSION 21493 020 Minnesota
Canada
UK XLX925A ALL MODES
Japan --C4FM/APRS UHF 96/12bps ...
USA CM-PHILIPPINE-LINK
USA Ohio Link Net Sunday at 8:30 ...
Argentina CRUCE A YSF ARGENTINA LIN...
Japan WiRES-X
USA Digital Amateur Radio Club &...
USA
USA Minnesota and Wisconsin Fus...
Ready
View QSL de W0SUN (ID:W0SUN-GW)
WIRES-X
Linking the World via VoIP
DTMF ID: 40895
2020/04/16 16:57:26
Colorado MEGA XCoder
< COLORADO-MEGA #40895 >
HardCopy
Save
Close
NET DIGITAL
ON-AIR
LOCAL
COLORADO-MEGA
User = K0PRA > ********** (DN:FT2D)
Uplink = AE2L (35755)
Downlink = W0SUNPOT2 (50410)
Room = (40895)
2020/04/16 16:57:22 Error: Socket Communication Timeout.
2020/04/16 16:57:25 *-*-* Call Start No.40895 *-*-*
2020/04/16 16:57:26 Room Member 3 Nodes.
2020/04/16 16:57:26 Connected to COLORADO-MEGA(40895).
Close
SEND
CLR
News
GM
WIRES-X
Ver-1.530
ONLINE

WiRES-X Node with Room Requires HRI-200

HRO Denver WiRES-X Node
with HRI-200
KC0JIM-HRO 2 M 146.535 mhz
Room Colorado-Link 40052

Hotspot FCS002 -07

Wires-X Nodes and Rooms

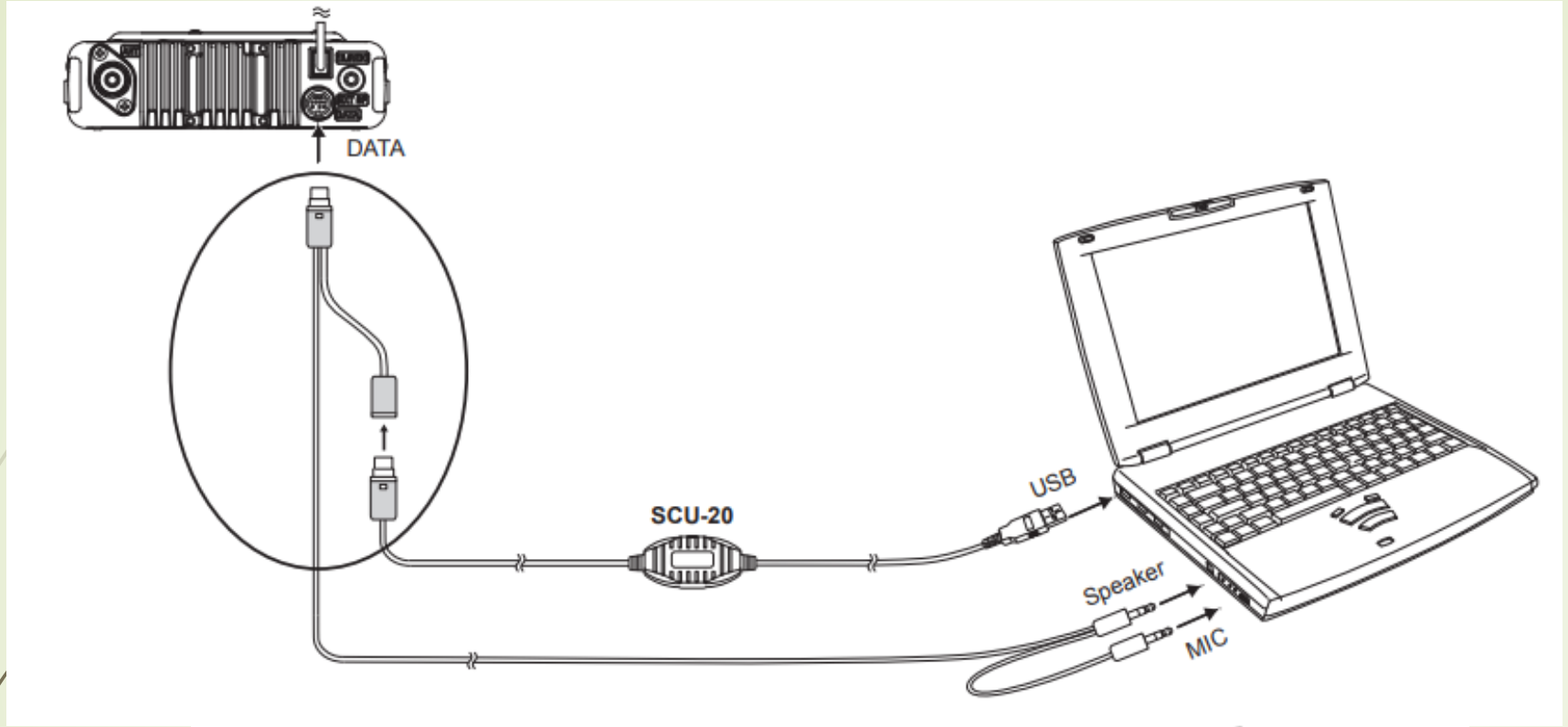
ie. COLORADO-MEGA 40895

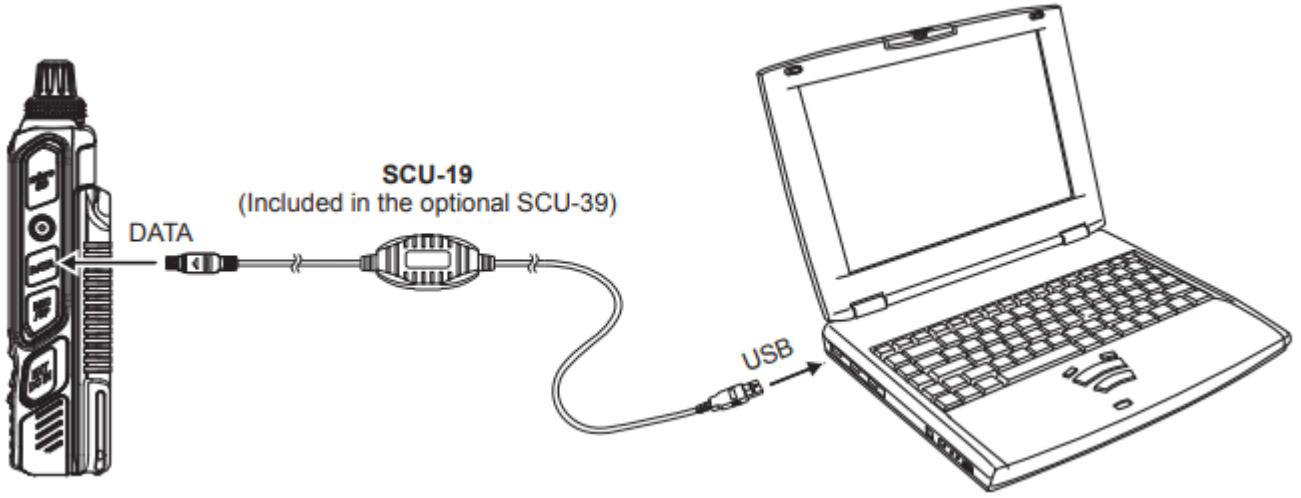
- **Yaesu Node ID Registraion - https://www.yaesu.com/jp/en/wires-x/index.php**
- **NODE NUMBERS/ROOM NUMBERS/DTMF ID's: To operate a node, you must first have registered with Yaesu. They will send you both a node number AND room number for every registration. It is only necessary to have one registration for every radio that will be operating in the WiRES-X system AT ONE TIME. That is, even if you have 50 digital radios, if you will never use more than one at a time, you will only need one registration. However, most stations get two or three. You may wish to have a fixed node at home and a mobile node that could be transmitting at the same time.**
- **These numbers are then used by your radio to establish contact with nodes or rooms. They can be input manually or saved into memory, or even searched.**
- **In order to operate or establish a room you MUST have an HRI-200.**
- **With the new Firmware you can operate a node without a room.**

Operating a WiRES-X Node without HRI-200 = PDN but No Room

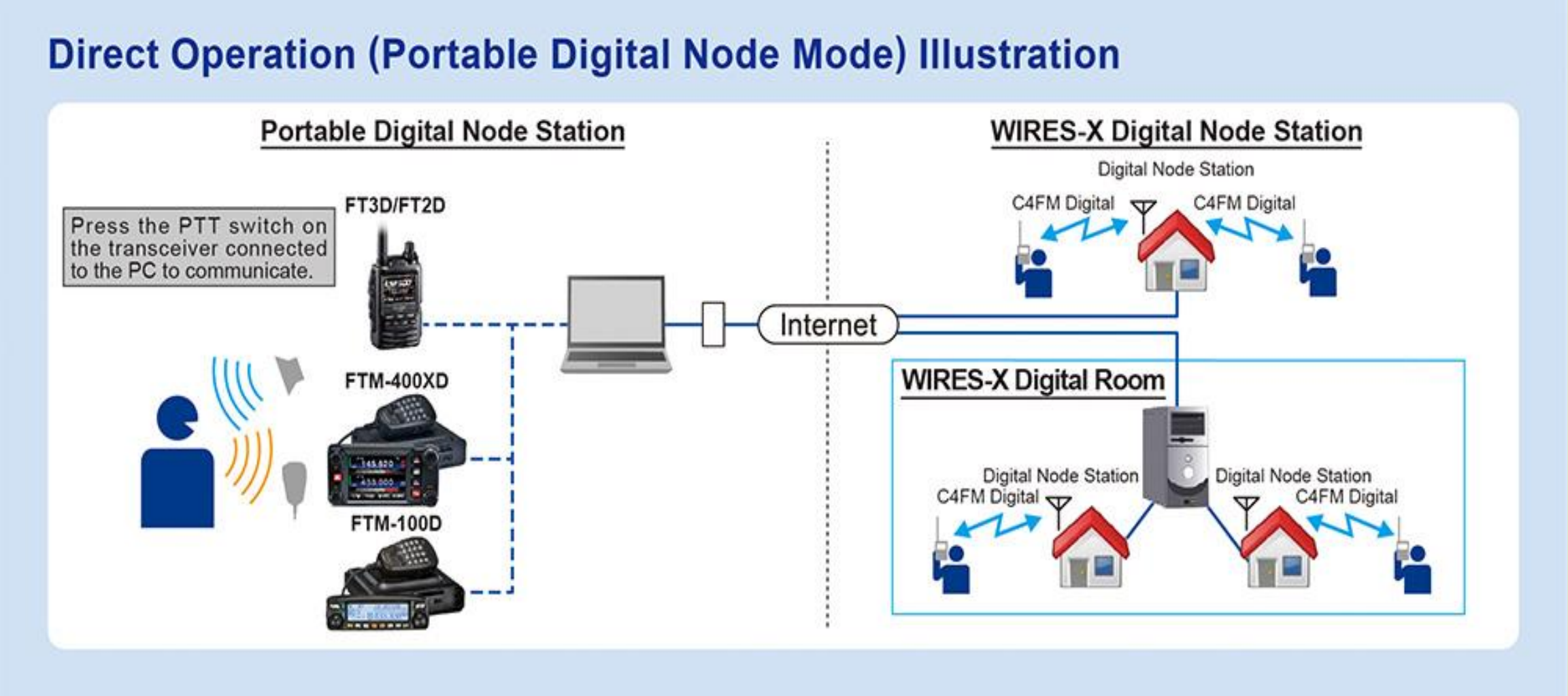
- The following radios can run in PDN mode without an HRI-200:

- FT3D; FT2D MAIN FW V3.10 - FT2D DSP FW V4.31
  SCU-39 Cable Kit
- FTM-400XD MAIN Ver 4.40/ DSP Ver 4.31
- FTM-400D MAIN Ver 3.40/ DSP Ver 4.31
- FTM-100D MAIN Ver 2.40/ DSP Ver 4.31/ PANEL Ver 2.10
  SCU-40 Cable Kit
- WiRES-X PC Software V1.50

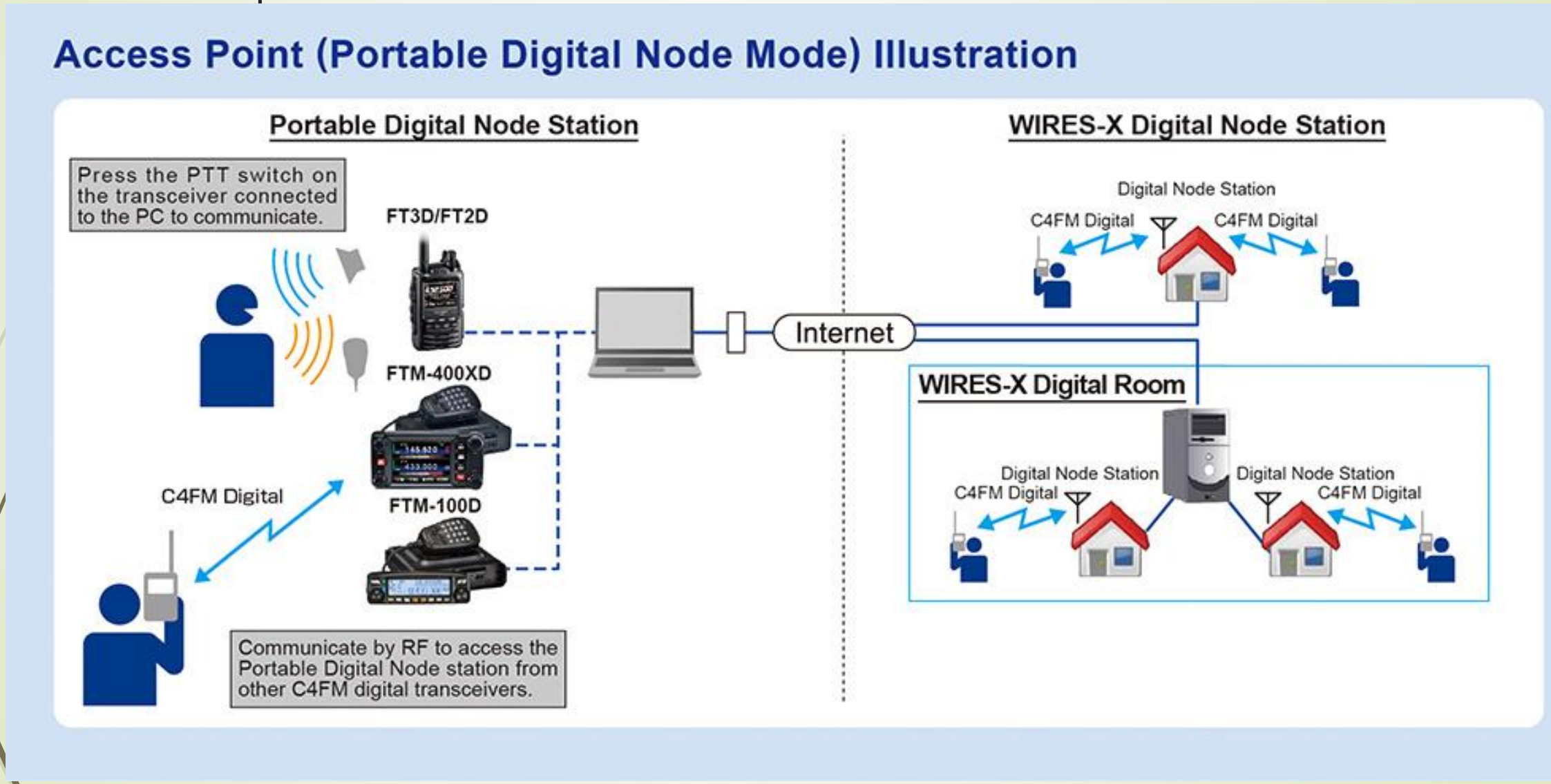

DATA
SCU-20
USB
Speaker
MIC


SCU-19
(Included in the optional SCU-39)
DATA
USB

PDN Mode Direct Connect, No RF, 1 Radio



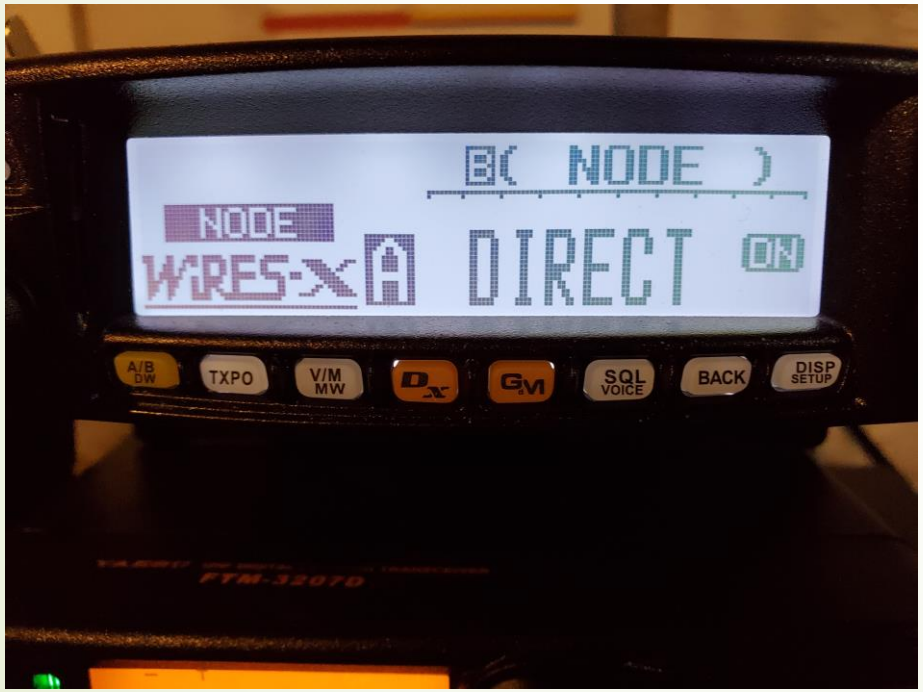
Access Point PDN Mode,
Requires 2 Fusion Radios



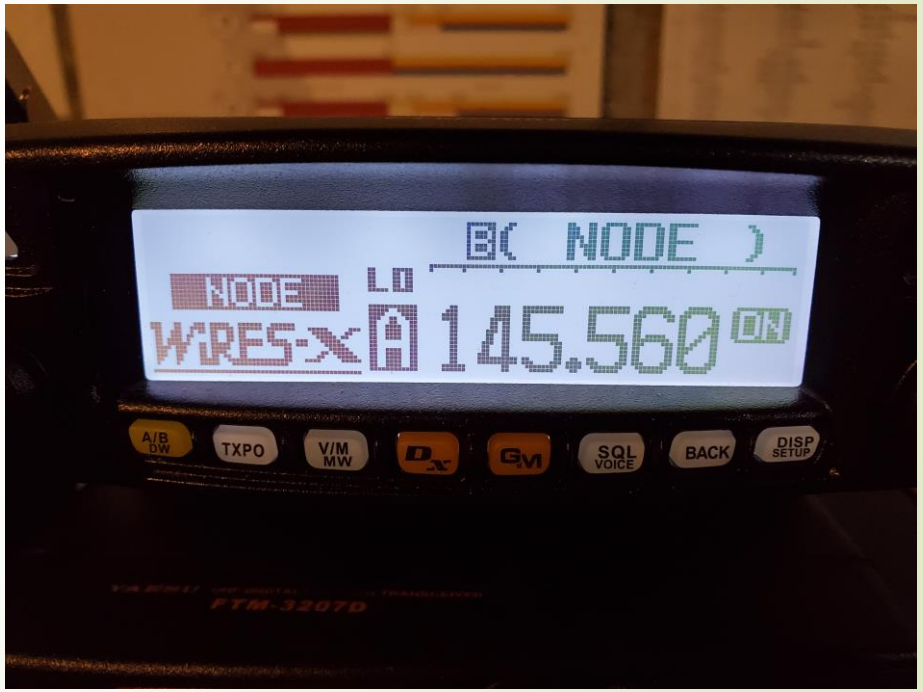
WIRES-X

Wide-Coverage Internet Repeater Enhancement System

PDN Mode Direct



PDN HRI Mode – Access Point



The Good, and Not So Good

- Yaesu Digital Method Works Well!
- AMS!
- Audio Is Superb.
- Simple Digital Radio.
- Designed for Ham Radio

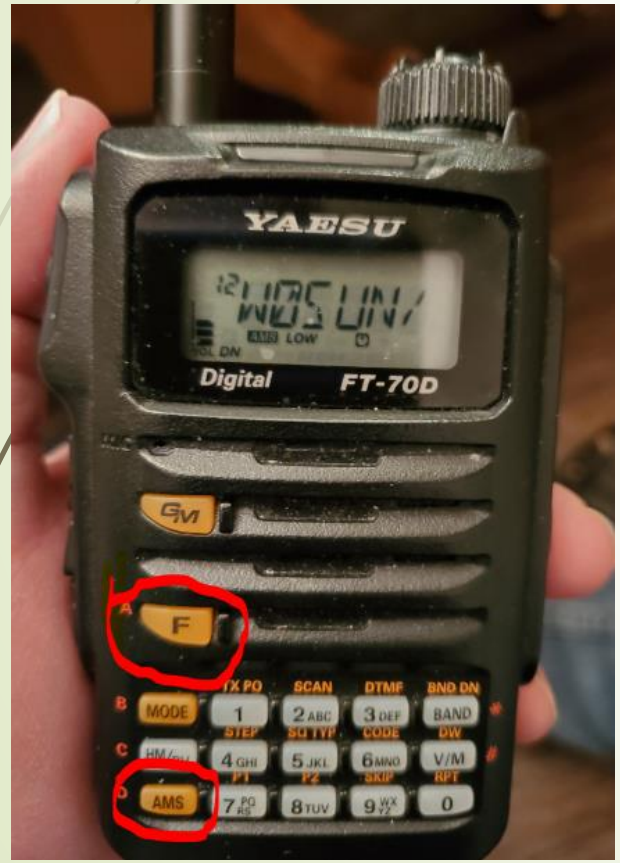
- Closed System.
- WiRES-X Requires PC Running MS Windows
- Expensive!

Quickest Way to Digital Radio using a Yaesu FT-70D

To Access WiRES-X → [F] + [AMS] then Twist Left Twice.

(WiRES-X Two Step) (HRO Denver 146.535)

(To Exit WiRES-X → Press and hold the [Mode] button)



For a Wires-X Node #40895 Press [AMS]

For a C4FM Hotspot #23160 (YSF Server)

HOTSPOTS and Digital Radio
Here's Where The Fun Begins!

D-STAR DMR System Fusion

Get A DMR ID
https://www.radioid.net/register

openSPOT·3

by SharkRF

The whole world in your pocket.

Digital World on a Budget

FUSION Yaesu FT-70D $150

DMR TYT MD-380 $80-$100

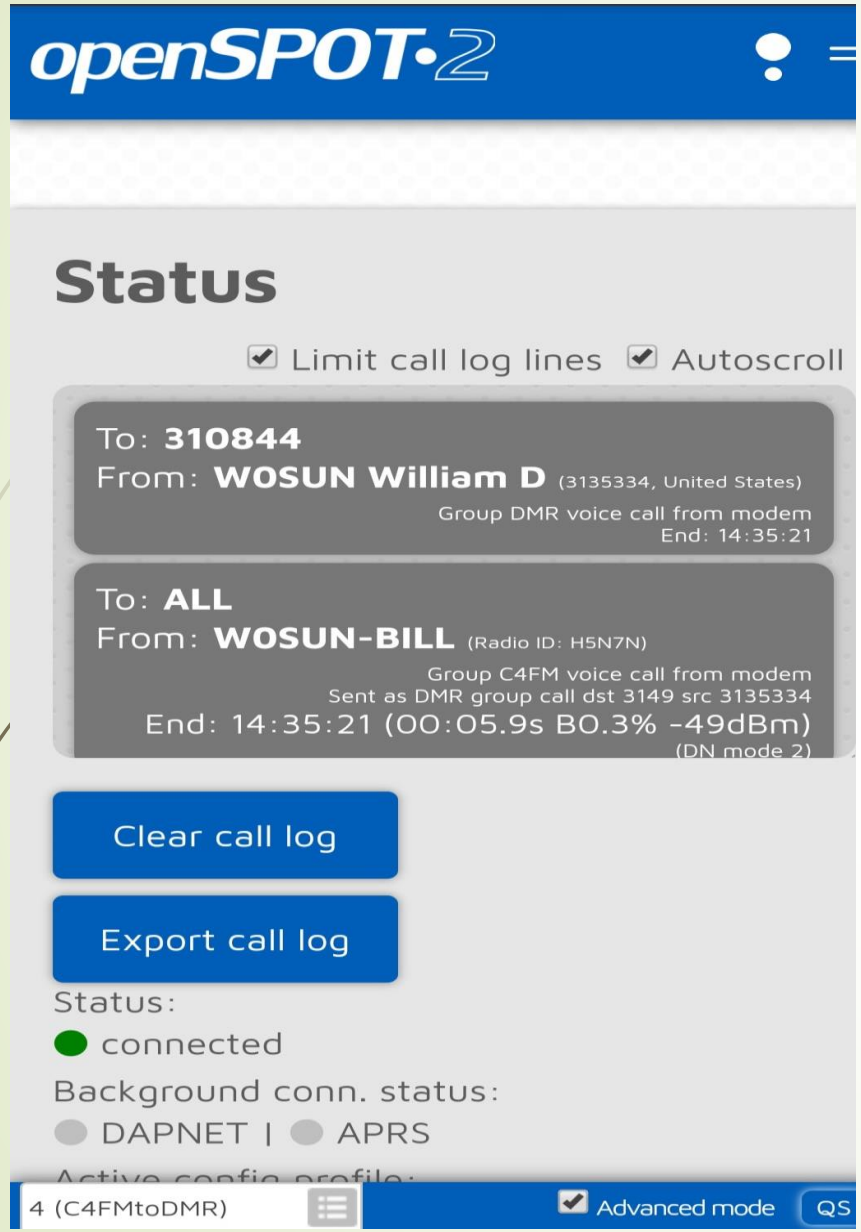
Jumbospot $70-$100

Build Your Own Hotspot - $40
https://www.dmr-utah.net/hotspot

Digital Deluxe

FUSION FT-3D

DMR Anytone 878

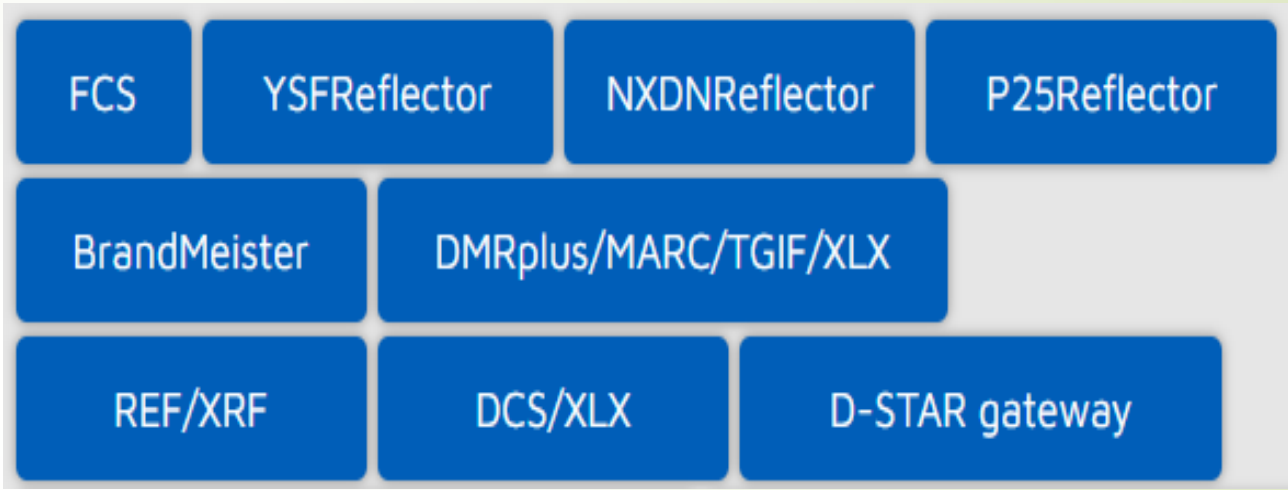

openSPOT•2
Status
Limit call log lines
Autoscroll
To: 310844
From: W0SUN William D (3135334, United States)
Group DMR voice call from modem
End: 14:35:21
To: ALL
From: W0SUN-BILL (Radio ID: H5N7N)
Group C4FM voice call from modem
Sent as DMR group call dst 3149 src 3135334
End: 14:35:21 (00:05.9s B0.3% -49dBm)
(DN mode 2)
Clear call log
Export call log
Status:
connected
Background conn. status:
DAPNET | APRS
4 (C4FMtoDMR)
Advanced mode
QS

openSPOT•3
Export call log
Background conn. status:
DAPNET | APRS
Active config profile:
1 (default)
Active connector:
DCS/XLX
Modem mode:
D-STAR
Modem RX/TX frequency, power:
432.400000/432.400000 100%
Server address:
75.145.119.225
Connected to:
DCS376/D
openSPOT3 info
Battery:
ready
78%
Hardware version:
1.0
1 (default)
Advanced mode
QS

Cross Mode – It Doesn't Get Any Better.

Choose Your Radio!

Choose Your Server!



Pi-Star Digital Voice Dashboard for W0SUN

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	434.100000 MHz
Rx	434.100000 MHz
FW	HS_Hat:v1.4.6
TCXO	14.7456 MHz

DMR Repeater	
DMR ID	3135334
DMR CC	1
TS1	disabled
TS2	enabled
TG 310844/No Ref	
DMR Master	
BM United States ..	

YSF Network
Room: US Colorado..

Gateway Activity

Time (MDT)	Mode	Callsign	Target	Src	Dur(s)	Loss	BER
14:18:43 Apr 20th	DMR Slot 2	W0SUN	TG 310844	RF	0.4	0%	0.2%
13:31:57 Apr 20th	YSF	K0PRA	ALL at XLX720	Net	6.4	0%	0.0%
13:31:30 Apr 20th	YSF	AC0YV	ALL at XLX720	Net	21.6	0%	0.0%
13:25:29 Apr 20th	YSF	W0SUN	ALL at XLX720	Net	3.1	0%	0.0%
11:56:19 Apr 20th	YSF	KF5XK	ALL at XLX720	Net	5.2	0%	0.0%
11:43:43 Apr 20th	YSF	K0OJ	ALL at XLX720	Net	0.9	0%	0.0%
10:57:46 Apr 20th	YSF	N4SJW	ALL at XLX720	Net	0.2	0%	0.0%
10:57:29 Apr 20th	YSF	W0SUN	ALL	RF	16.4	0%	0.6%
10:47:02 Apr 20th	YSF	W0SUN	ALL	RF	3.0	0%	2.0%
08:55:00 Apr 20th	YSF	W8XAL	ALL at XLX720	Net	0.6	0%	0.0%
06:57:58 Apr 20th	YSF	AA0RX	ALL at XLX720	Net	3.6	0%	0.0%
06:54:31 Apr 20th	YSF	WA0SPM	ALL at XLX720	Net	0.2	0%	0.0%
06:54:30 Apr 20th	YSF	K0FTN	*****EAHN5 at K0FTN	Net	0.9	0%	0.0%
05:06:08 Apr 20th	DMR Slot 2	KA5GTM	TG 310844	Net	2.2	0%	0.0%
21:09:05 Apr 19th	YSF	KE0PCI	ALL at XLX720	Net	0.6	0%	0.0%
21:00:40 Apr 19th	YSF	AE0IN	*****EA9jI at AE0IN	Net	0.3	0%	0.0%
19:12:09 Apr 19th	DMR Slot 2	KB4SMK	TG 310844	Net	5.9	0%	0.0%
16:54:00 Apr 19th	YSF	AF9O	ALL at XLX720	Net	10.0	0%	0.0%
16:04:45 Apr 19th	YSF	KE0WHY	ALL at XLX720	Net	0.8	0%	0.0%
15:24:12 Apr 19th	YSF	3164008	ALL at XLX720	Net	1.6	0%	0.0%

Local RF Activity

Time (MDT)	Mode	Callsign	Target	Src	Dur(s)	BER	RSSI
14:18:43 Apr 20th	DMR Slot 2	W0SUN	TG 310844	RF	0.4	0.2%	S9+44dB
10:57:29 Apr 20th	YSF	W0SUN	ALL	RF	16.4	0.6%	S9+39dB
10:47:02 Apr 20th	YSF	W0SUN	ALL	RF	3.0	2.0%	S9+41dB

Pi-Star / Pi-Star Dashboard, © Andy Taylor (MW0MWZ) 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.

Where To Begin?

PI-STAR

- https://www.pistar.uk/

FCS Reflectors

- An FCS reflector is a large server that can host up to 100 “Modules”. In this case each module is like a Room or a channel. There can be 100 independent groups that are only separated by their module or channel number. The modules are identified by a number, such as “FCS003-23”.
- There are only 8 FCS reflectors in the world. They are FCS001: Europe, FCS002: Florida, FCS003: Canada, FCS004: Spain
- FCS005: Experimental Semi-Production
- FCS222, FCS224, FCS232: New Experimental

FCS Reflectors

Production

- **FCS001** - http://fcs001.xreflector.net/
- **FCS002** - http://fcs002.xreflector.net/
  - **FCS00207, FCS002-07 Colorado → WiRES-X 40052**
  - **FCS00290, FCS002-90 AmericaLink → WiRES-X 21080**
- **FCS003** - http://www.laboenligne.ca/fcs003/
  - **FCS00390, FCS003-90 AmericaLink → WiRES-X 21080**
- **FCS004** - http://fcs004.xreflector.net/
- **FCS005** - http://fcs005.xreflector.net/

Experimental

- FCS222
- FCS224
- FCS232

YSF

- YSF reflectors can only host one Room or Reflector per instance. Unlike FCS, it is easy for an individual or a club to set up their own YSF Reflector. YSF Reflectors are identified by their name or their number. YSF Reflectors use a master List Server: ysfreflector.de.

- To Register a YSF Reflector - https://register.ysfreflector.de/
- YSF Reflector List - https://www.pistar.uk/ysf_reflectors.php

- 23160 US ColoradoMega → XLX376 → **WiRES-X 40895**
- 89804 AmericaLink → **WiRES-X 21080**
- ColoradoMega YSF Reflector Dashboard - http://ysf.parkerradio.org/

DMR Radio - Brandmeister

- What Is The Brandmeister Network?
- The Brandmeister Network was born from several worldwide hams and software engineers who joined together to create a digital repeater network consisting of master servers and peer repeaters all over the world.
- The network has over 4100 repeaters and more than 13,000 hotspots across the globe and it's growing every day!
- The Brandmeister Network allows for DMR repeaters to connect worldwide via the internet and link systems together by utilizing organized Talkgroups.
- The Colorado Mega Reflector is accessed through Brandmeister Talkgroup 310759.
- Parker Radio Association DMR Repeaters use TS1 310759 and TS2 310844
- Hotspots typically don't care about Time Slots,

DMR Radio – Brandmeister

Master Servers – 3101, 3102, 3103

- TG 9 Local or Reflector
- **TG 91 World-wide**
- TG 92 Europe
- **TG 93 North America**
- TG 95 Australia, NZ
- TG 235 United Kingdom
- TG 272 Ireland
- TG 302 Canada
- TG 404 India
- **TG 505 Australia**
- TG 515 Philippines
- TG 530 New Zealand
- TG 655 South Africa
- TG 913 English
- TG 923 European English
- TG 969 DMR-Caribbean
- TG 973 SOTA

- **TG 3100 USA – Nationwide (Bridge)**
- **TG 3108 - Colorado**
  - TG 31080 Colorado Chat
  - TG 31081 Park County Colorado
  - TG 31082 Colorado-Link
  - TG 31083 CO Severe WX
  - TG 31084 NOCO Mountain FR
  - TG 31085 SkiCountryARC
  - TG 31088 Colorado HD

- **TG 310759 Colorado Mega**
- **TG 310844 PRA**
- TG 310804 W0TX
- **TG 310847 DENVERSKYHUBLINK**
- **TG 31700 CRRG**

Popular Talkgroups

TG 310656 AmericaLink
TG 91 Worldwide
TG 93 North America
TG 3100 USA

Cross Connect

TG 31010 Alabama YSF 02034
TG 27246 CQ-UK WiRES-X 27793
TG 31444 RI YSF 02312

TAC Channels and Talkgoups

TAC 310 – TAC 319

Where is the Action?

- FCS
  - http://fcs002.xreflector.net/#
- Brandmeister
  - https://app.brandmeisteractivity.live/
  - https://hose.brandmeister.network/
- Learn how to use Brandmeister - https://brandmeister.network/
- Last Heard on Talkgroup - https://brandmeister.network/?page=lh&DestinationID=310759

Action on WiRES-X.

- **WiRES-X**
  - https://www.hamoperator.com/rw/

COLORADO-MEGA	40895	003	Colorado MEGA XCoder	Castle Rock	Colorado	USA	http://www.parkerradio.org
COLORADO-LNK	40052	003	COLORADO LINK	Denver	Colorado	USA	Colorado Amateur Radio Team
DENVERSKYHUBLINK	46361	003	DENVERSKYHUBLINK	Wheat Ridge	Colorado	USA	www.skyhublink.com

  - https://wires-x.yaesu.com/wires-x/en/id/active_room

LATEST WIRES-X ACTIVE ROOM ID LIST

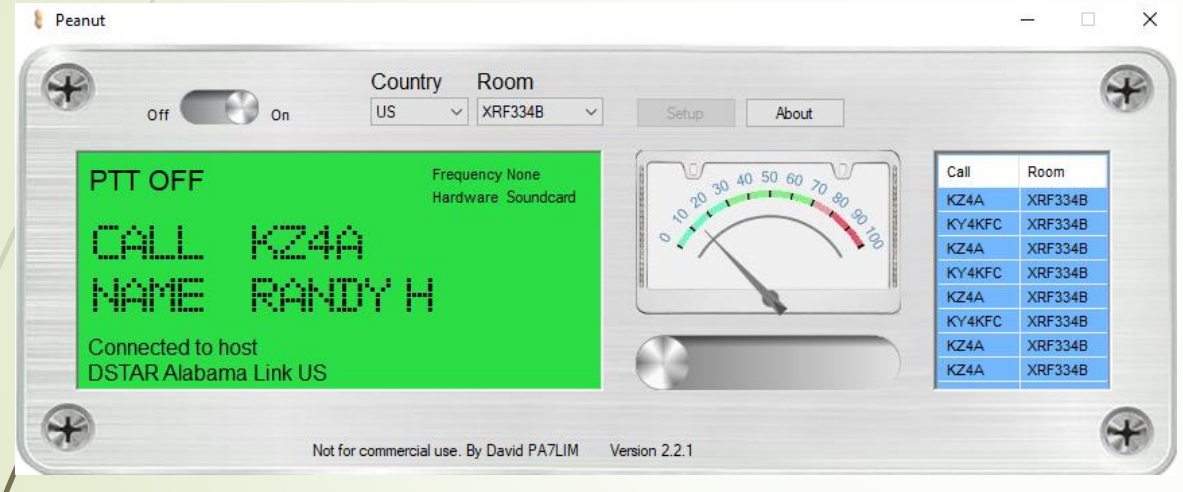
ROOM ID	DTMF ID	Act▼	Room Name	City	State	Country
ALLJA-CQ-ROOM	20510	160	ALL JA CQ ROOM#1	Yamato-city	Kanagawa	Japan
—AMERICA-LINK	21080	058	America Link Network	Beaumont	Texas	USA
ITALY	27003	048	WIRES-X ITALIA	Cassolnovo	Lombardy	Italy

BlueDV and ZUMspot USB Stick

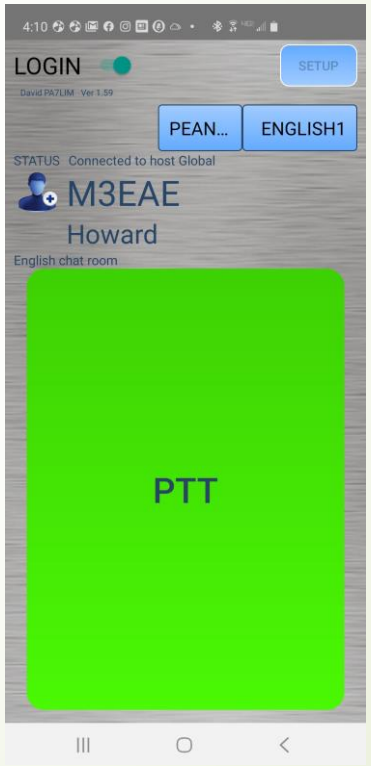
Peanut for Windows or Android

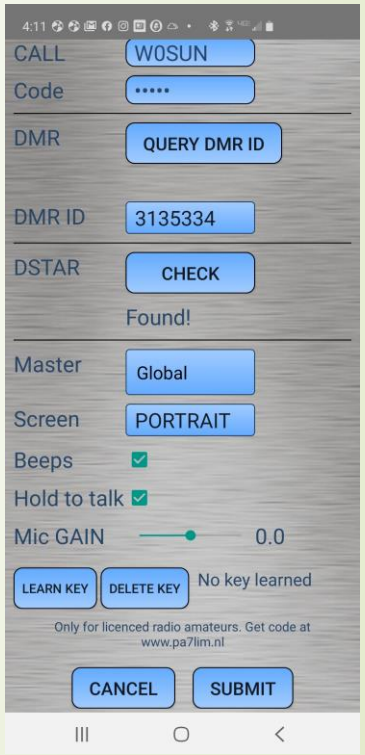
http://peanut.pa7lim.nl/

MS Windows



Android





Useful Links – WØSUN Favorites

- Parker Radio Association, Colorado Mega Transcoder
  https://www.parkerradio.org/on-the-air/
- Denver Skyhub Link – Society of Broadcast Engineers
  https://skyhublink.com/connections/
- WiRES-X Rooms and Nodes
  https://www.hamoperator.com/rw/
  http://www.yaesu.com/jp/en/wires-x/id/id_active.php
- Pi-Star
  https://www.pistar.uk
- FCS – FCS002
  http://fcs002.xreflector.net
- Brandmeister Last Heard
  https://app.brandmeisteractivity.live/
  https://hose.brandmeister.network/
  https://brandmeister.network/?page=lh&DestinationID=310759 ← ←