

Yaesu System Fusion

INTEGRATION OF DIGITAL AND CONVENTIONAL ANALOG FM



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C4FM DIGITAL

C4FM
DIGITAL CLEAR VOICE

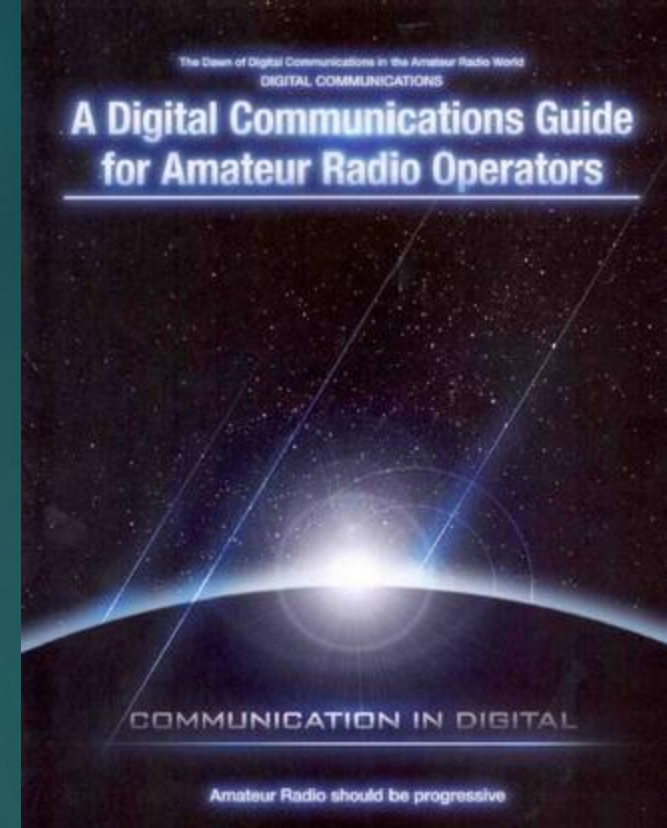
Clear and Crisp Voice Technology

Information presented here from Yaesu.com , Yaesu videos posted on the internet, other web sites, and actual use of Fusion and Wires-X by KC4ZMZ.

Yaesu Fusion uses C4FM

► C4FM per Yaesu's Digital Communications Guide document:

Compared to other digital modulation schemes within FDMA, C4FM has excellent communication quality (BER: Bit Error Rate characteristics). C4FM is the standard method for professional communication devices in FDMA, and is therefore considered to be the main stream digital communication mode in the future. Download our "Digital Communications Guide for Amateur Radio Operators" available on our web site that explains more about this efficient and reliable digital mode.



We are beginning to see digital modes used on the Amateur bands. Many Amateur radio operators are not familiar with digital type communications. However, we can expand our Amateur Radio world by learning about the characteristics and merits of digital type communications.

The range of frequencies and the bandwidths that hams are allowed to use is limited. If we want Amateur radio to move ahead into the future, we must begin to use these frequencies more effectively.

The first digital radios appeared in the 1980's. At that time systems using GMSK (GFSK) modulation technique were released.

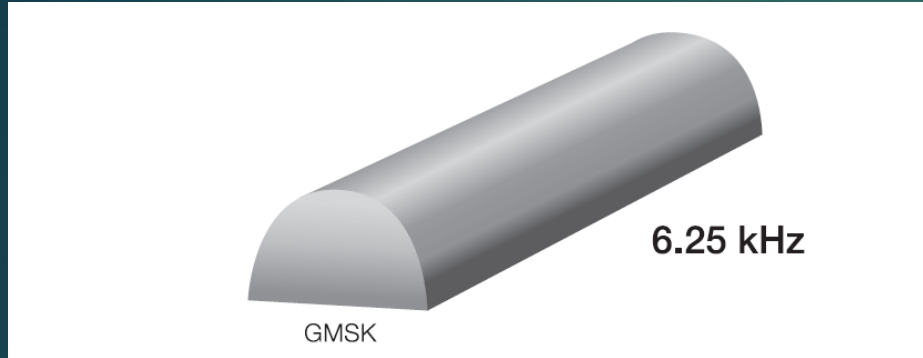
Since then various other digital systems were developed and used in commercial markets.

Currently GMSK has lost popularity in the land mobile market and C4FM has emerged as the dominant mode.

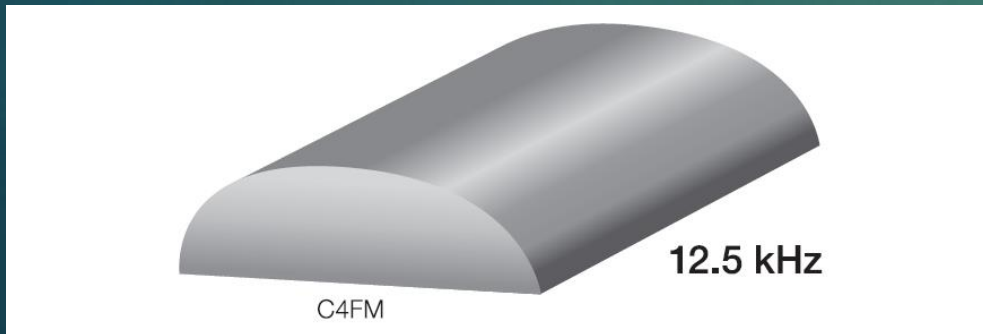
Why? Compared to the other modulation protocols, C4FM circuits are less complex and the Bit Error Rate is made much better.

- D-Star uses GMSK
- P-25 and DMR use C4FM

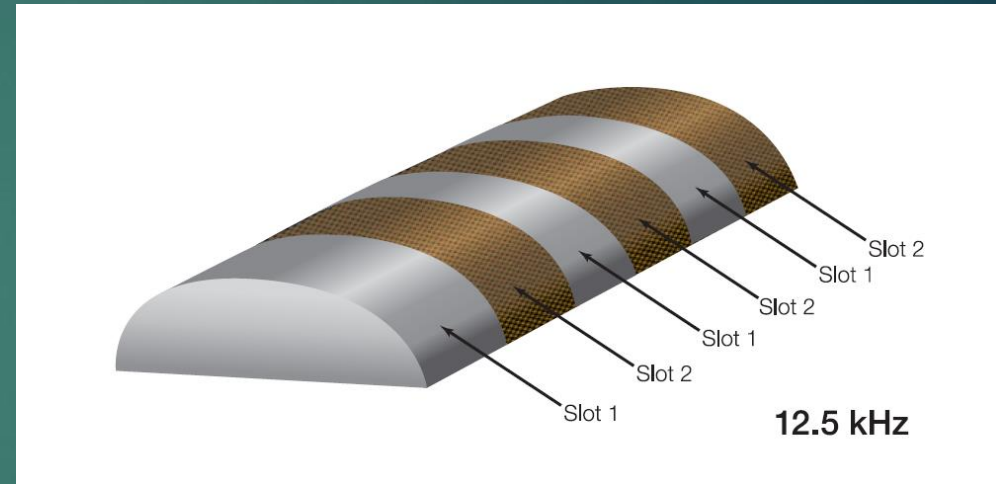
Conceptual Diagrams: Bandwidth...



GMSK (Gaussian Minimum Shift Keying)
(ICOM D-Star utilizes this protocol)



FDMA (Frequency Division Multiple Access)
(Yaesu Fusion utilizes this protocol)



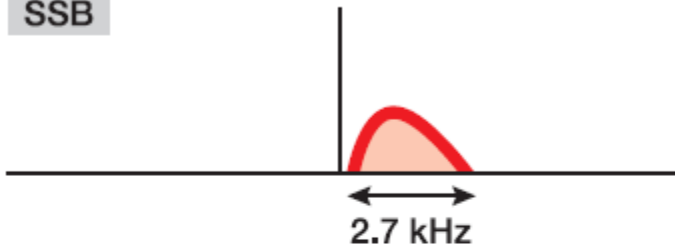
TDMA (Time Division Multiple Access)
(DMR utilizes this protocol)

One Misunderstanding: “The ultimate function of Digital Communications is the narrow bandwidth”

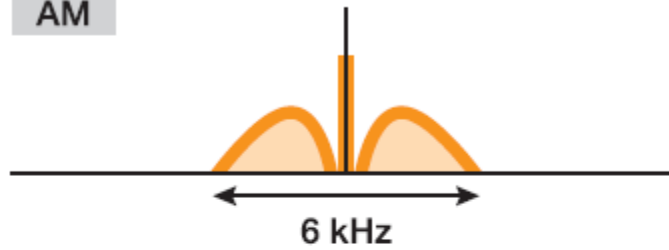
(There are other modes with narrower bandwidth.)

Analog modulation

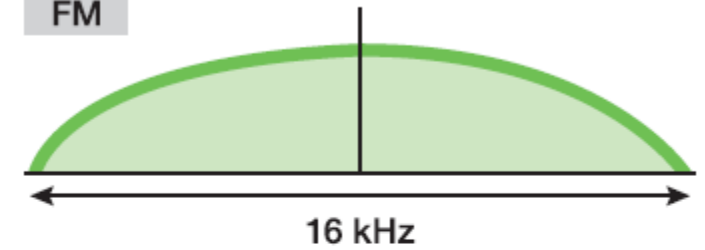
SSB



AM

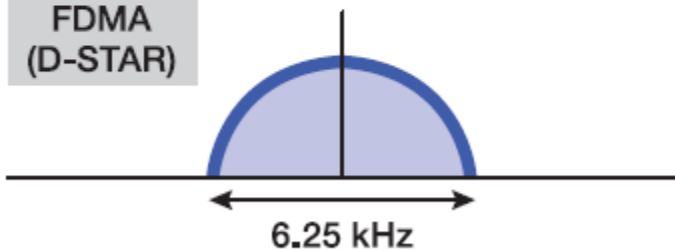


FM

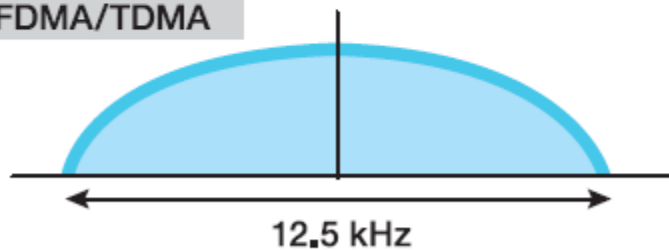


Digital modulation

FDMA
(D-STAR)



FDMA/TDMA



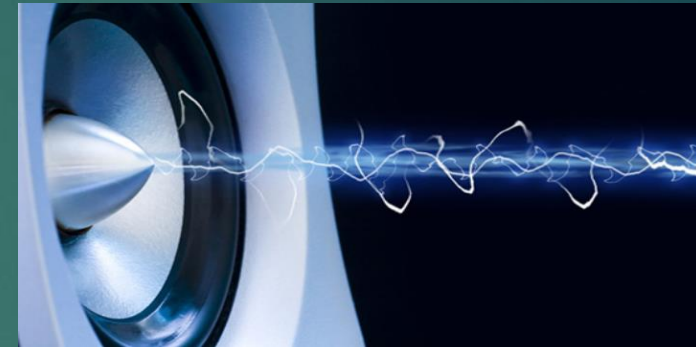
Comparison of the occupied bandwidth

Digital modulation Advantages

► Complex Data Exchange



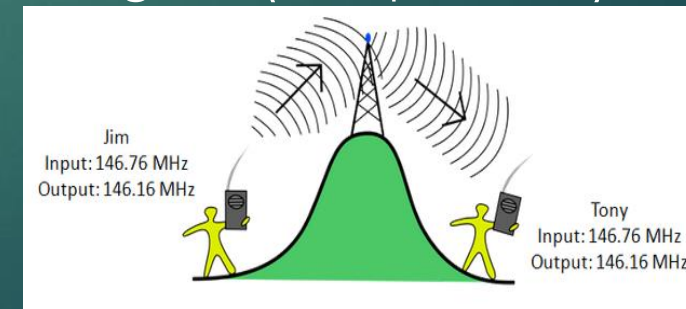
► High Quality Audio



► Resistance to Radio Interference



► In some cases, Improved Communication on the "Fringes" (it depends...)



System fusion joins Digital and conventional FM communication in a single system

SYSTEM FUSION RADIOS WILL HANDLE BOTH DIGITAL AND CONVENTIONAL FM



AMS – Automatic Mode Select

AMS

Digital



Analog



AMS

■ Digital

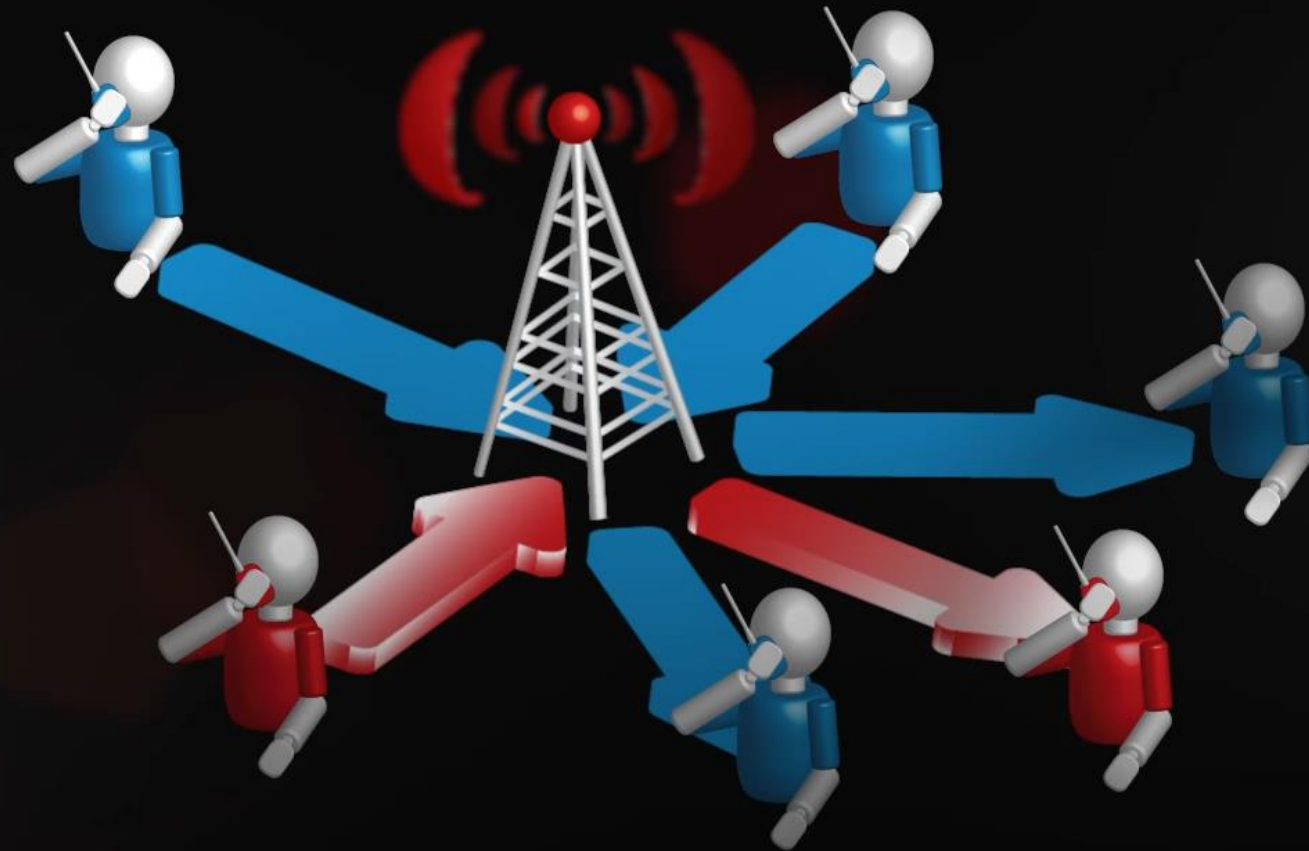
■ Analog FM

Rx

AUTO

Tx

AUTO



MORE VIDEOS

System Fusion
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4 Communication Modes of *Fusion*

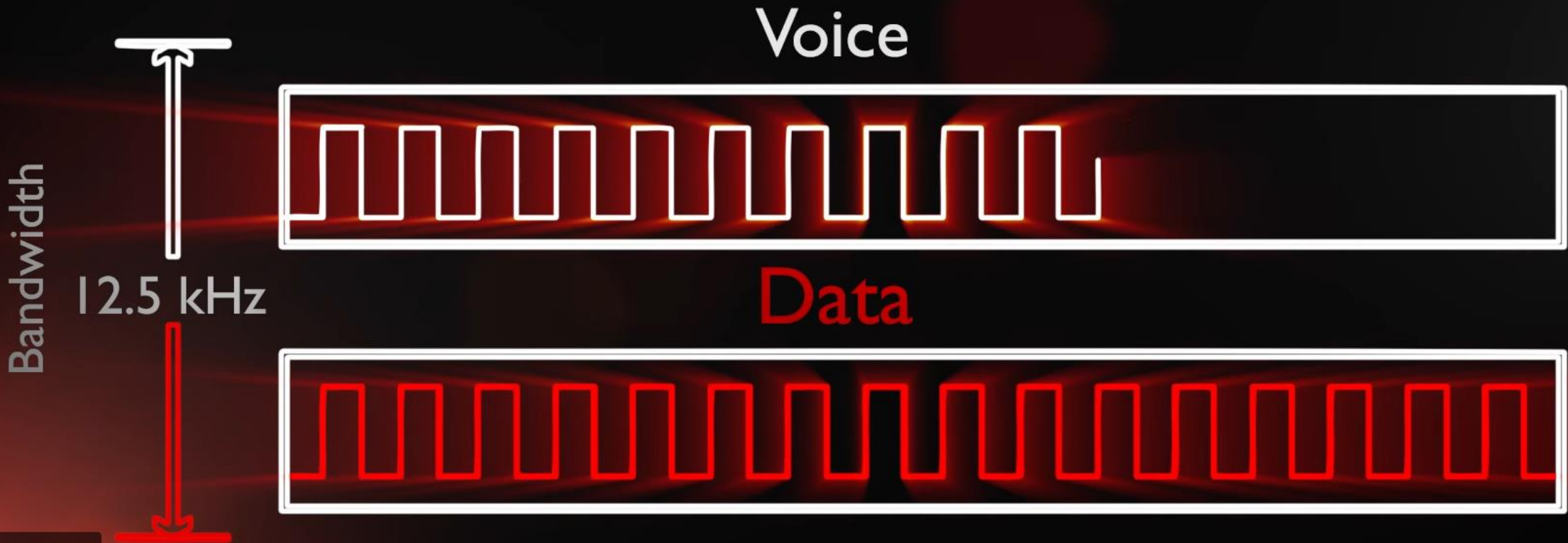
3 Digital Modes and 1 Analog Mode:

1. Voice/**Data** Mode (V/D Mode) - Shows as **DN** on radio
2. Voice Mode (VFR Mode) - Shows as **VW** on radio
3. **Data** Mode (DFR Mode) – Used to send text msgs, photos...
4. Conventional FM Analog Mode – Shows as **FM** on radio

This standard C4FM (FDMA) digital mode provides the Ideal error correction & sound quality balance

Mode
1

Voice / **Data** Mode (V/**D** Mode) Digital Narrow DN



MORE VIDEOS

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This digital mode provides high quality voice communication

Mode
2

Voice Mode (VFR Mode)

Voice Wide
VW

Voice



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This digital mode is used for transmitting snapshot pictures, and messages

Mode
3

Data Mode (DFR Mode)

Data

Bandwidth

12.5 kHz



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This analog mode is familiar to all; lower battery consumption

Mode
4

CONVENTIONAL FM ADVANTAGES

Analog Mode
FM

In some cases, better communications on fringes... with open squelch

LOW BATTERY CONSUMPTION

Useful Features of Digital Mode

► Digital Group Mode

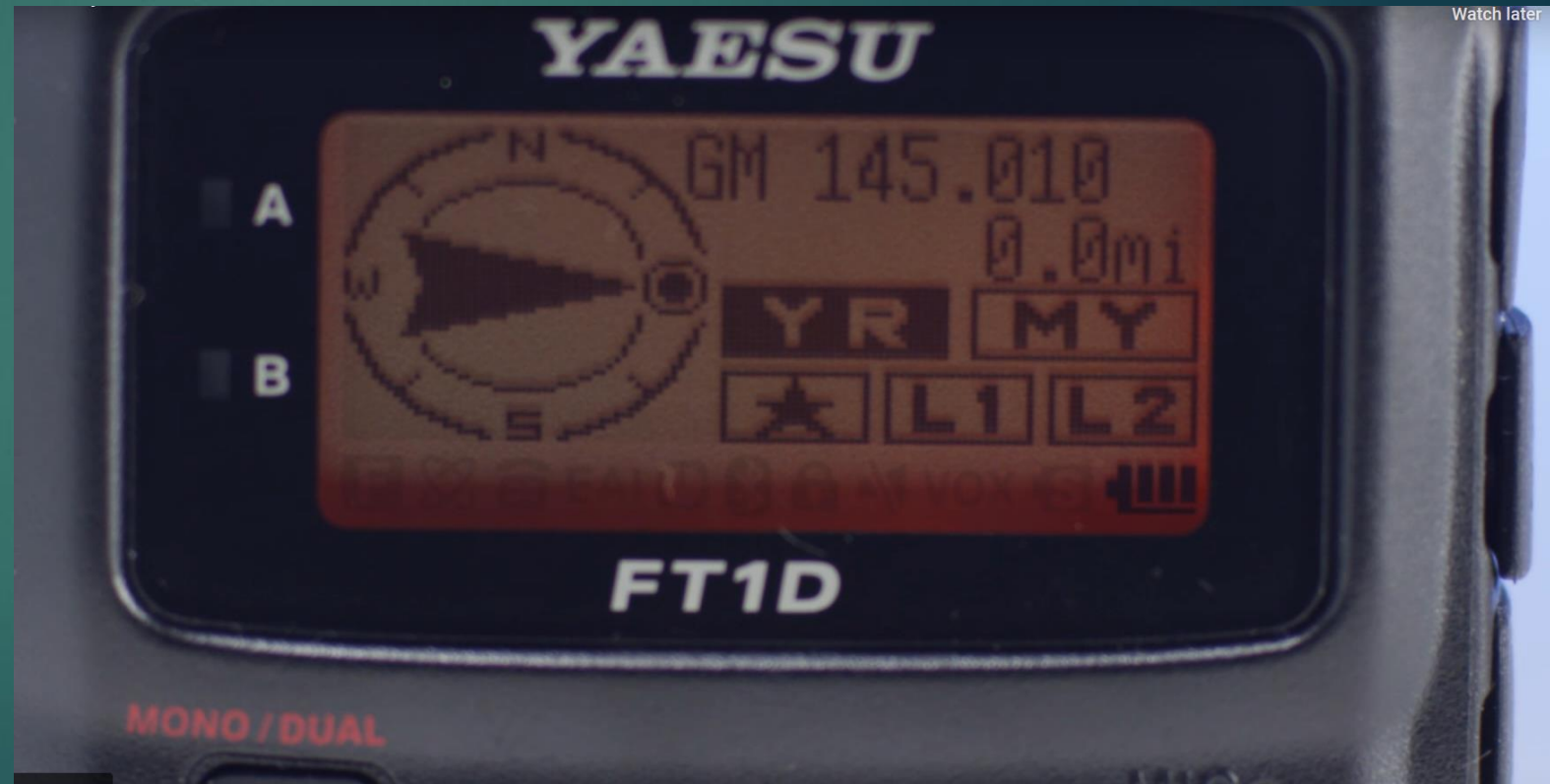
- Notifies you of when members registered to a group are in communication range
- Displays distance and bearing for other group members
- Members may send text messages and images when in simplex range



Useful Features of Digital Mode

► Digital V/ D Mode

- Position data is transmitted with voice signals
- Distance and direction of the other station is displayed in real time



Local System Fusion Repeaters

- ▶ 146.850 Clark County
- ▶ 147.180 Jefferson County
- ▶ 146.700 Bullitt County
- ▶ 147.390 Oldham County
- ▶ 444.050 Shelby County
- ▶ 147.090 Floyd County
- ▶ 145.280 Prospect
- ▶ 145.230 Downtown Louisville
- ▶ 442.625 Downtown Louisville

Local System Fusion Repeaters

Yellow text indicates repeaters that are linked* in Digital Mode ONLY

- ▶ 146.850 Clark County
- ▶ 147.180 Jefferson County
- ▶ 146.700 Bullitt County
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***Linked through Yaesu Wires-X**

Wires-X link sites provided and supported by KE4JVM, KC4ZMZ, N9GTO, WX8V, W4CN

So what does this mean?

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1. In Analog Mode all repeaters operate stand alone (not linked)
2. In Digital Mode all act as 1 wider-area repeater system
3. Other repeaters or nodes world-wide may connect to this system, in Digital Mode
4. You may hear/talk with people from anywhere in the world, in Digital Mode
5. You may navigate to other repeaters/nodes worldwide, in Digital Mode

What is Wires-X?

- ▶ **WIRES (Wide-coverage Internet Repeater Enhancement System)**
- ▶ **Wires-X provides linking between nodes/repeaters world-wide**
- ▶ **VoIP Communication using Internet backbone for Amateur Radio**

What is Wires-X?

- ▶ Yaesu Wires-II was extended as Wires-X to support System Fusion (both conventional FM and Digital Radio Communication)
- ▶ Logical “Rooms” (*not “Reflectors”*) are set-up by HAMS and maintained within the Wires-X System
- ▶ Everyone connected to the same “Room” hears everyone else in that “Room”

Wires-X User Page

[Link: User Page - Active Room List](#)

LATEST WIRES-X ACTIVE ROOM ID LIST

Update every 20 min 17 Oct 2019 20:09:21 GMT

ROOM ID	DTMF ID	Act	Room Name	City	State▲	Country	Comment
SANMARINO-ROOM	27139	000	room San Marino	Borgo Maggiore	-	San Marino	Test room full Digital San Marino jn63fw
SZ1SV-ROOM	44237	002	SV Chat room	Athens	ATIKI	Greece	Room open to everyone...
LAUFENBURG-AG	41504	000	LAUFENBURG-AG	Etzgen	Aargau	Switzerland	Region Laufenburg Aargau Nord-Westschweiz
HB9NA-ROOM	41707	000	HB9NA	Mellingen	Aargau	Switzerland	IG Notfunk Aargau - HB9NA
HB9DA-ROOM	27097	000	Verein HB9DA	Schmiedrued	Aargau	Switzerland	https://www.qrz.com/db/hb9da
ZZZZZ-CQ-UK-TEST	41619	001	GM7KBK CQ-UK Test	Aberdeen	Aberdeenshire	UK	Fusion Gateway For Aberdeen Scotland 144.8625
MM6BWS	41266	000		cuminestown	Aberdeenshire	UK	
2M0DRY-ROOM	41783	000	Dave's Room	Stonehaven	Aberdeenshire	UK	
ITALY-I6-ROSETO	41865	002	WIRES-X IT-I6-ROSETO	Bellante Stazione	Abruzzo	Italy	Wires-X Room, WIRES-X IT-I6-ROSETO 41865 <-> YSF Room, IT C4FM ROSETO 26765 <-> IT-DMR, TG 222035 Cluster TERAMO
ITALY-I6-ABRUZZO	44828	002	WIRES-X-ABRUZZO	Ortona	Abruzzo	Italy	Welcome to WIRES-X-ABRUZZO 44828 <=> IT-DMR ABRUZZO TG22261 <=> YSF ABRUZZO 46773
ITALY-I6	41403	001		Citta Sant' Angelo	Abruzzo	Italy	
YYT-ROOM	22348	001	JG2YYT	Chita-gun	Aichi	Japan	
JS2GFA-ROOM	42434	001	情報交換の広場	Chita-gun	Aichi	Japan	
JS2CT1-ROOM	26923	000		Kariva-city	Aichi	Japan	

Wires-X User Page

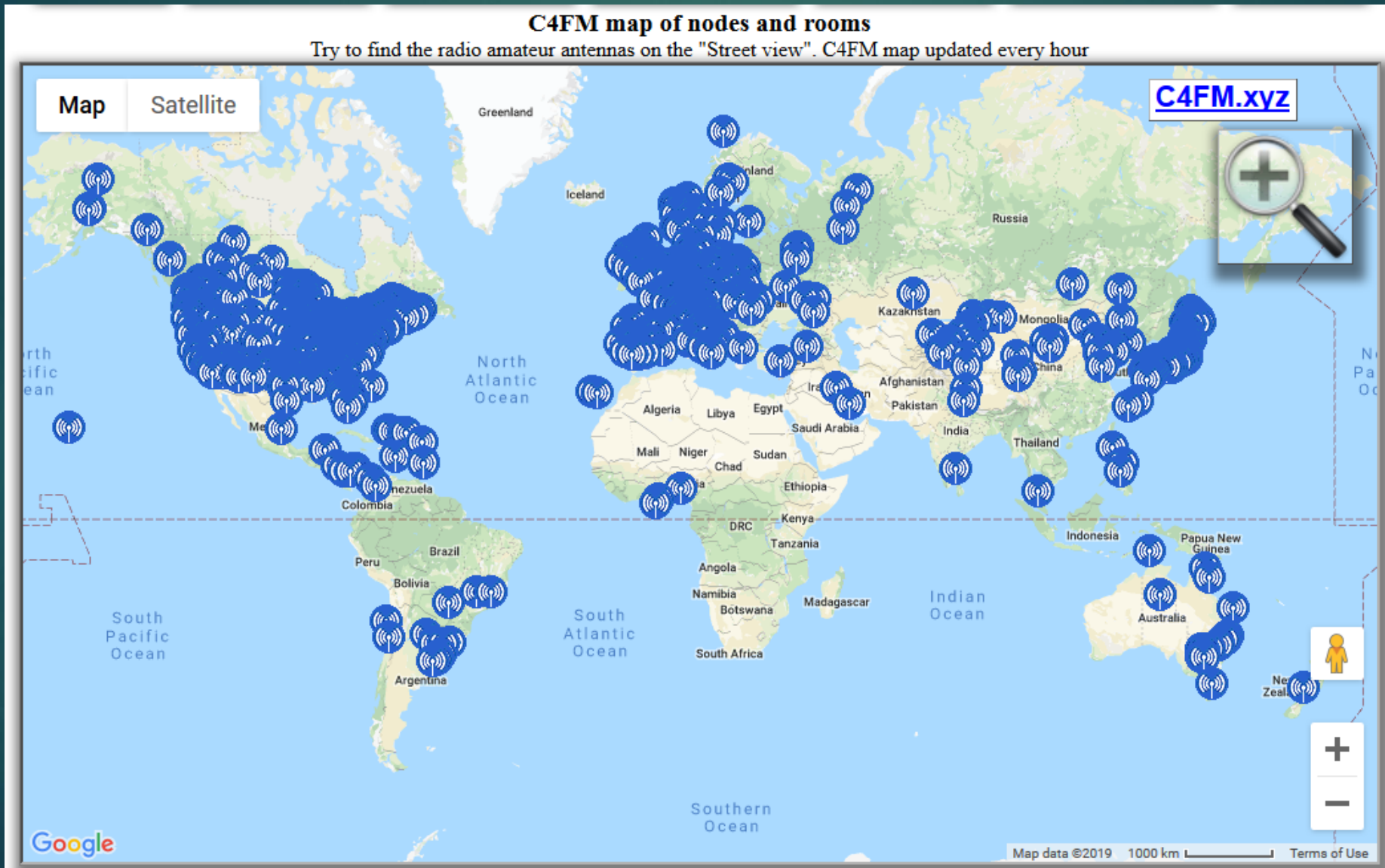
Sorted by State - Indiana

WD8NMZ-ROOM	46627	000		West Harrison	Indiana	USA
W9YZU-ROOM	28944	002	W9YZU ROOM	Avon	Indiana	USA
W9CLD	46866	000	W9CLD	kokomo	Indiana	USA
N9MR-ROOM	43494	000	N9MR-Fort Wayne IN	Fort Wayne	Indiana	USA
N9DBJ-ROOM	62105	000	N9DBJ Room	Ladoga	Indiana	USA
N9AWU-ROOM	43978	002	SGRL Room	MARTINSVILLE	Indiana	USA
N4SV-ROOM	40136	000	N4SV-ROOM	La Porte	Indiana	USA
KD9IYA-ROOM	43875	001	ARANCI	Lake Village	Indiana	USA
KD9GNW-ROOM	43431	000		Logansport	Indiana	USA
KA9VXS-ROOM	28548	000	KA9VXS-ROOM	West Lafayette	Indiana	USA
INDIANA-LINK-SO	43844	007	Indiana Link South	Washington	Indiana	USA
GREENTOWN-LINK	28398	002	KOKOMO INDIANA LINK	Greentown	Indiana	USA
CENTRAL-IND	61779	000	Central Indiana	Martinsville	Indiana	USA
-MIDDLEAMERICA	28467	000	-MIDDLEAMERICA	Evansville	Indiana	USA
-INDIANA-MIDWEST	21421	001		LaPorte	Indiana	USA
BR3HA-C4FM	24317	001		alashan	Inner Mongolia A.R.	China

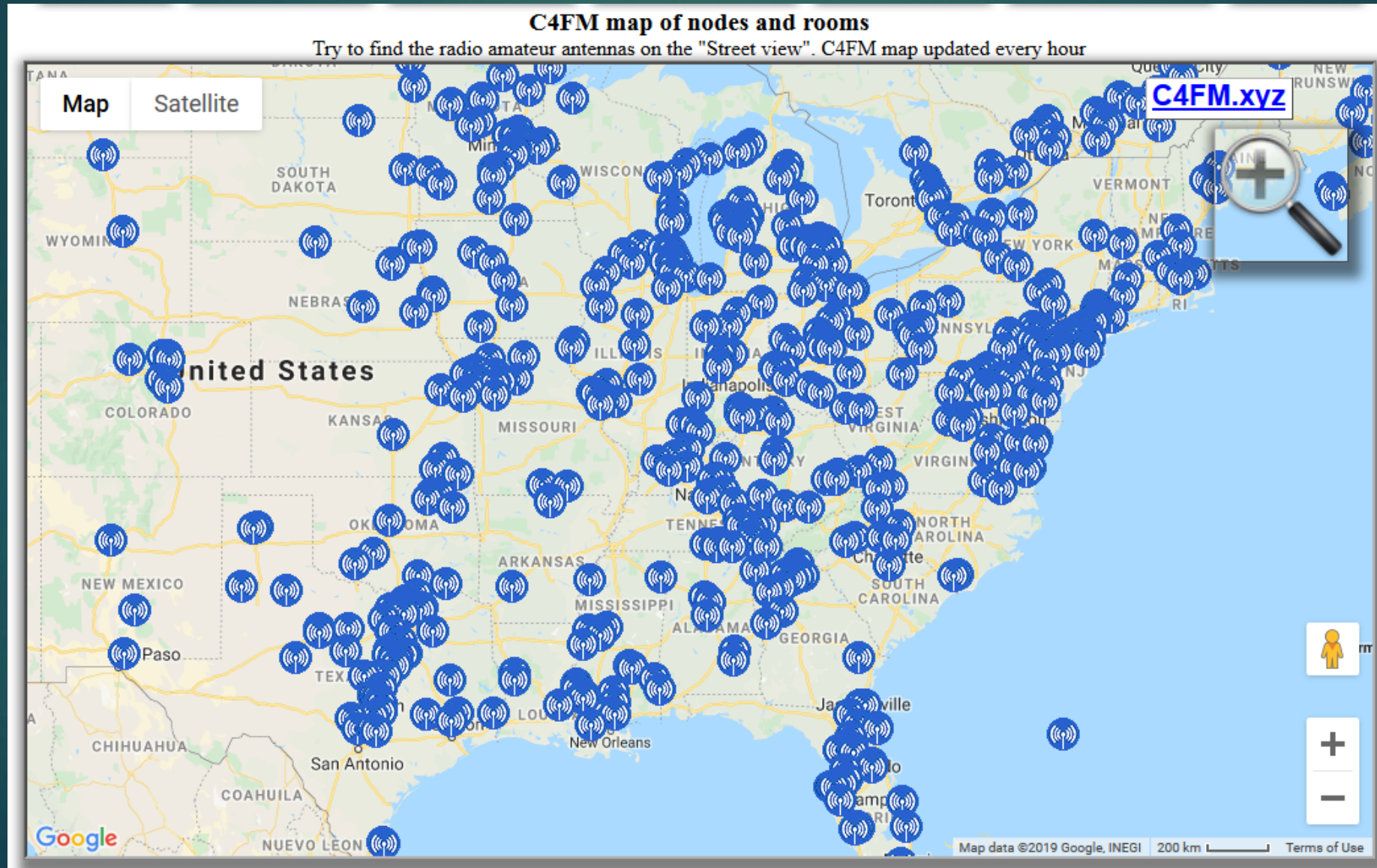
Sorted by State - Kentucky

WA4SKU-ROOM	40267	000	Eubank Kentucky	Eubank	Kentucky	USA
W4NHO-ROOM	43759	000	W4NHO-ROOM	Owensboro	Kentucky	USA
W4IOD-ROOM	43114	000	W4IOD-RPT	Stamping Ground	Kentucky	USA
W4CN-ROOM	45042	000		Louisville	Kentucky	USA
PRINCETONKY	40806	015	KY Fusion Network	PRINCETON	Kentucky	USA
PADUCAH-KY-ROOM	40396	000	Paducah KY K4KMW	Paducah	Kentucky	USA
N4HZX-ROOM	43405	001	N4HZX RPT	Frankfort	Kentucky	USA
LEXINGTON-KY-RM	21416	001	The Lexington Room	Lexington	Kentucky	USA
KE4YRI-ROOM	40282	001	KE4YRI ROOM	Shelbyville	Kentucky	USA
KC4ZMZ-ROOM3	60402	000	KC4ZMZ Room 3	Goshen	Kentucky	USA
KB4PTJ-ROOM	40408	001		Williamsburg	Kentucky	USA
K4ATR-ROOM	61351	003	K4ATR-RPT	Lawrenceburg	Kentucky	USA
HOPKINSCOUNTYKY	21832	000	Wires-x Madiosnville	Manitou	Kentucky	USA
CQ-LOUISVILLE	21014	005	CQ Kentucky	Louisville	Kentucky	USA
J15AHX-ROOM	29534	001	白鷺会西部西	Takaoka-gun	Kochi	Japan

Map of Nodes



Map of Nodes (<http://c4fm.xyz>)



How do I communicate through a Wires-X Room using my radio?

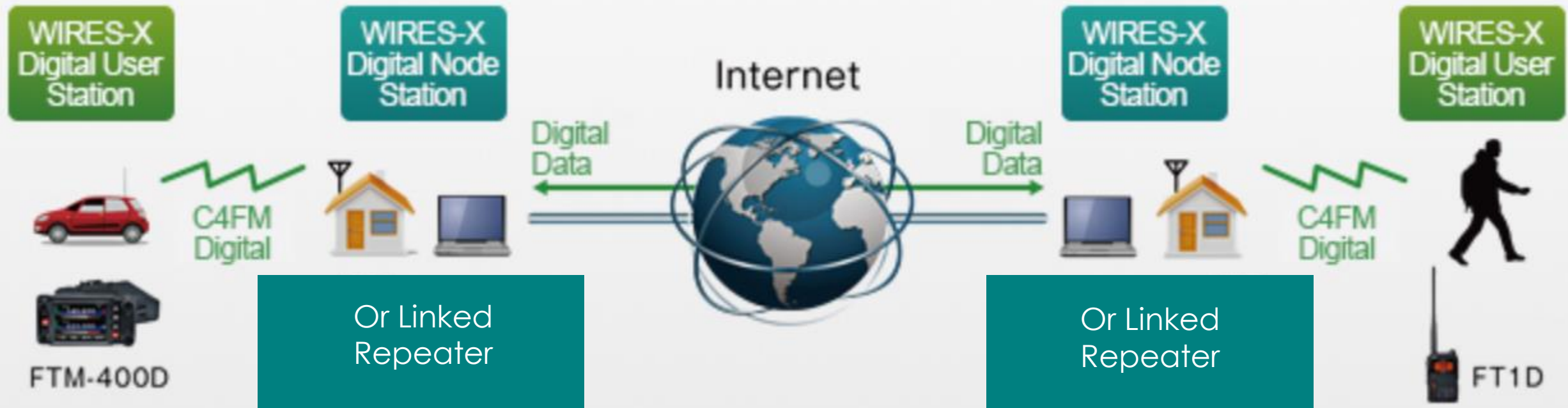
► A few methods:

- Transmit into a Wires-X Node (FM Analog or Digital depending on how the node is set up)
- Transmit into a repeater linked into Wires-X (Usually Digital Mode, the ones listed earlier are linked in digital mode only)
- Connect certain model Yaesu System Fusion radios to a computer running Wires-X software

For more information refer to Wires-X documentation provided by Yaesu ([Click Here for Radio Info](#)); or the [Wires-X User Page](#);

Also [Wires-X, The Bible at HamOperator.com](#)

With Wires-X, use your radio to communicate with HAMS across the US or around the World!



Linked Repeaters – Digital Mode



Local System Fusion Repeaters Linked through Yaesu Wires-X

- ▶ Simply transmitting in a digital mode through one of these repeaters automatically connects you to everyone else in the “Room”
- ▶ The “Home” Room is named “CQ-Louisville” but... You can navigate any of the repeaters to a different Room temporarily – generally after 20 to 40 minutes the repeater will revert back to the Home Room

Mono-Band Mobile Fusion Transceivers

FTM-3200DR

Description

Files



65 Watts - 2M Mobile

FTM-3207DR

Description

Files



55 Watts – 70 cm Mobile

[Click Here for Radio Info](#)

Dual-Band Mobile Fusion Transceivers

FTM-7250DR

Description

Files



50 Watts – both bands
\$210 (\$200 sale price)

FTM-100DR

Description

Files



50 Watts – both bands
\$305 (\$265 sale price)

Dual-Band Fusion HTs



[Click Here for Radio Info](#)

Dual-Band Mobile Fusion “Flagship” Transceiver



50 Watts – both bands

[Click Here for Radio Info](#)

- **Simultaneous receive on both VFOs**
(Upper VFO uses all 4 modes lower analog only)
- **Cross Band Repeat Function** (analog only)
- **1200/9600bps APRS® (Automatic Packet Reporting System) Data communication capability included**
- **Screen options include:**
 - Dual VFO Screen as shown on left
 - Band Scope Screen
 - Altitude Screen
 - APRS Screen
 - Smart Navigation Screen
 - Group Mode Screen
 - Frequency Direct Input Screen
 - Clock/Timer Screen

All-Band Portable Fusion Transceiver

FT-991A

Description

Files



SUMMARY

FT-991A ALL-BAND, MULTIMODE PORTABLE TRANSCEIVER

The FT-991A is the next generation in all mode, all band MF/HF/VHF/UHF transceiver with C4FM (System Fusion) Digital capability. The FT-991A includes multi-mode operation on CW, AM, FM, SSB, and Digital Modes (Packet, PSK31, RTTY and C4FM), with 100 Watts of HF/50mhz Capability (50 Watts VHF/UHF).

The New FT-991A now includes a high-resolution full color 3.5" TFT Touch panel for superior operability and visibility, incorporating a High Speed Spectrum and High Resolution real-time scope with ASC (Automatic Spectrum-scope control) built right in.

The FT-991A is designed for the most competitive operating situations, with a suite of new features to enhance the experience. Whether you primarily operate at home, mobile or in the field, the FT-991 will provide outstanding fundamental performance plus give you easy access to the full range of exciting modes available on the ham bands today.

[Click Here for Radio Info](#)

FTM-400 & Wires-X Demo Video

<https://www.youtube.com/watch?v=FBTn0SQDZKw>

