

Brief Introduction to Digital Mobile Radio (DMR)

Topics

- Benefits of Digital over Analog
- Overview of DMR terms
- Comparison of DMR vs Wires-X
- How to get on DMR
- Common questions
- Getting help with DMR

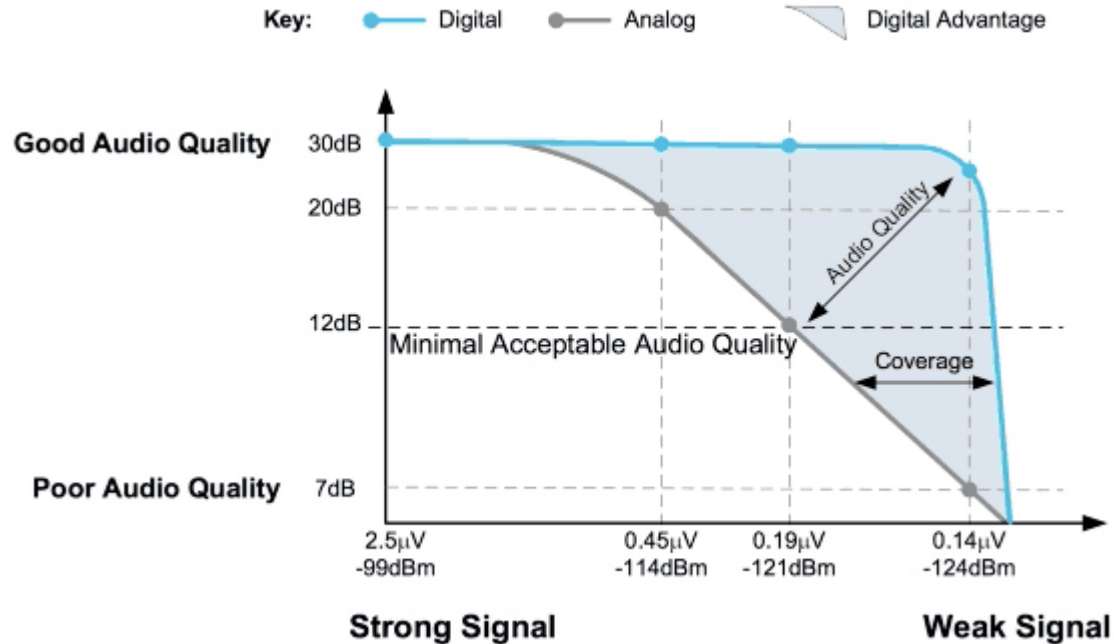
Why stay on Analog?

- Analog radios are less complex
 - Less complex hardware
 - Less complicated to program and use
- Analog radios are cheaper
- Analog radios are more common
 - Services like FRS/GRMS are required to use analog voice

Why go digital?

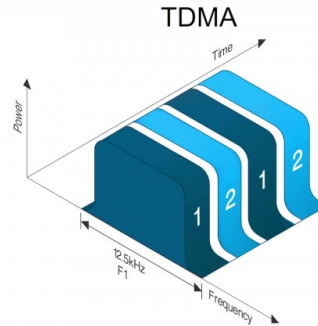
Why go digital?

- Clarity/Range



Why go digital?

- Clarity/Range
- Bandwidth / Spectrum efficiency
 - Analog uses 25kHz bandwidth to provide 1 QSO
 - DMR uses 12.5kHz bandwidth to provide 2 simultaneous QSOs
 - This is achieved using Time Division Multiple Access (TDMA)



Why go digital?

- Clarity/Range
- Bandwidth / Spectrum efficiency
- Better Battery Life
 - Since DMR is only transmitting half the time while transmitting (TDMA) and the improved range requiring less TX power, improved battery life of 40% can be achieved.

Why go digital?

- Clarity/Range
- Bandwidth / Spectrum efficiency
- Better Battery Life
- Digital Data
 - Ability to send messages to other DMR users
 - Text messages to/from cell phones
 - Digital or Analog APRS to communicate location
 - Digipeaters can have contention with each other and because of this, many can't be placed nearby to each other. This creates competition and make it more difficult to TX on analog APRS. DMR does not suffer from this.

Why go digital?

- Clarity/Range
- Bandwidth / Spectrum efficiency
- Better Battery Life
- Digital Data
- DMR Networks
 - Provides 2m/70cm communication to groups/communities around the world. This typically could not be achieved without HF.
 - Targeted communication. You can specifically target a region to help provide communication. ie. I want to talk to people in Texas because some event occurred. I can tune into Talkgroup 3148 (Texas Statewide).

Why go digital?

- Clarity/Range
- Bandwidth / Spectrum efficiency
- Better Battery Life
- Digital Data
- DMR Networks
- Accessible
 - DMR has a great community behind it and people have developed many methods of getting on the DMR Networks. Repeaters, Hotspots (DMR, YSF2DMR), DroidStar (Android phones), DudeStar (PC/Mac)

Why go digital?

- Clarity/Range
- Bandwidth / Spectrum efficiency
- Better Battery Life
- Digital Data
- DMR Networks
- Accessible
- Roaming
 - DMR radios can automatically switch between DMR repeaters in the area without the user needing to manually change frequencies/memory.

Overview of DMR Terms

- Traditional analog repeaters you typically need to know 3 things
 - 1) Receive frequency
 - 2) Transmit frequency
 - 3) Tone - CTCSS/DCS

Overview of DMR Terms

- DMR repeaters you need a little more
 - 1) Receive frequency
 - 2) Transmit frequency
 - 3) ~~Tone — CTCSS/DCS~~ - replaced with CC
 - 4) Color Code (CC) – Think of this like tone. Wrong tone and you won't hear anything and TX won't work.
 - 5) Timeslot (1 or 2) – This is due to TDMA. 2 conversations can go on at once
 - 6) Talkgroup – Ultimately, this is just a number. But, this determines how voice/data is routed to different repeaters/hotspots.

Overview of DMR Terms

- Radio ID (DMR ID) – A unique number that identifies an operator just like your call sign. Get yours at <https://www.radioid.net/account/register>
- Contacts – A listing of Radio IDs and their data (Name, Location, etc). These are stored in the radio for display. Full listing of all current contacts can be found at <https://www.radioid.net/static/user.csv>
- Talker Alias (TA) – Most people allow tx of their TA. This tucks your contact information (DMR ID/Name) in the voice transmission for those receiving and do not have your Radio ID in their radio.
- Dynamic Talkgroups – Simply a talkgroup temporarily assigned to a timeslot. This talkgroup will be removed after 15 minutes if no one transmits on that repeater/hotspot to that talkgroup. You add a dynamic talkgroup by simply kerchunking that talkgroup.

DMR vs Wires-X

DMR	Wires-X
Open Source: More manufactures, More competition, Cheaper equipment.	Proprietary: One manufacturer (Yaesu), More Expensive, More Control over infrastructure, More Secure, plug & play.
Bandwidth: 12.5kHz for 2 simultaneous QSOs	Bandwidth: 12.5kHz for 1 QSO
Talkgroups: Can monitor multiple static talkgroups/dynamic talkgroups per timeslot. This allows users more freedom to connect with other hams.	Room: Can only be connected to 1 Wires-X room at a time. For a user to navigate away from the Wires-X room, this will disconnect the default room.
Infrastructure: DMR has MANY masters for Brandmeister as well as other networks including TGIF and DMR+.	Infrastructure: Proprietary. If the Wires-X Master Server (controlled by Yaesu) goes down, there's no alternative to go to.

Getting Started with DMR

- Repeaters
 - None in the Southern Tier currently
- Hotspots
 - A duplex hotspot will function similar to repeater just very low TX power.
- Android Cell Phone
 - DroidStar is a free app to get on DMR. Software based voice encoding.
- PC/Mac/Linux
 - DudeStar is also a free application. Also software based voice encoding.

Common Questions on DMR

- I'm already heavily invested in Yaesu and I don't want to buy a new DMR radio.
 - You don't have to. A hotspot will convert C4FM to DMR and communicate to a DMR talkgroup. To get onto a DMR repeater, yes, you'd need a DMR radio but again, you can get one for less than \$100 (Radioddity GD-77 or others) because of competition.
- Ok, but a hotspot is expensive.
 - Not really but it can be.
 - Bridgecom Skybridge \$350
 - Amazon duplex pi zero hotspot ~\$100 – pre-assembled, no soldering required

Common Questions on DMR

- I can't afford (or don't want to pay) for a hotspot right now. What else can I do?
 - Free applications for Android or PC can get you started with DMR without investing any money. These applications will work for both RX and TX. They use a software based voice encoder so, while they work well, the audio on a hardware based voice encoder is much cleaner (in my opinion). These tools also work in a pinch if say you're traveling and forgot your radio at home.

Common Questions on DMR

- Ok. SHTF situation. No internet or cellular coverage. Isn't a DMR repeater useless then?
 - No, without internet a DMR repeater will still act a standalone repeater. In fact, there's a specific talkgroup for that. Local (talkgroup 9) will only repeat the transmission locally on that repeater without transmitting it through the internet. This will still work without internet access.
- But I'm limited then to 2m/70cm locally
 - Yes, you can't reach the rest of the world. Only HF can reach vast distances without any infrastructure. But DMR can still be a great tool in these times to provide clearer voice communications locally and with better range than analog. Additionally, the spectrum efficiency/timeslots can get more "channels" on the air and talkgroups can be used to help coordinate different teams of individuals.

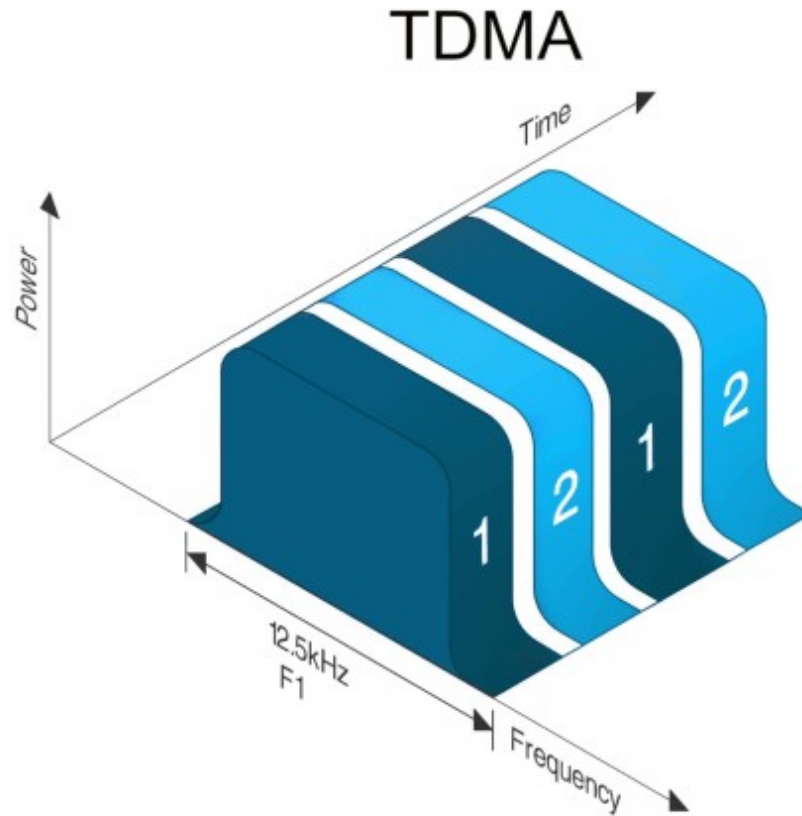
Help with DMR

- Facebook
 - Southern Tier NY DMR Facebook Group
<https://www.facebook.com/groups/292804322352536>
- Local Hams – Frank (W2FJH), Elliot (N2OJM), and several others
- YouTube

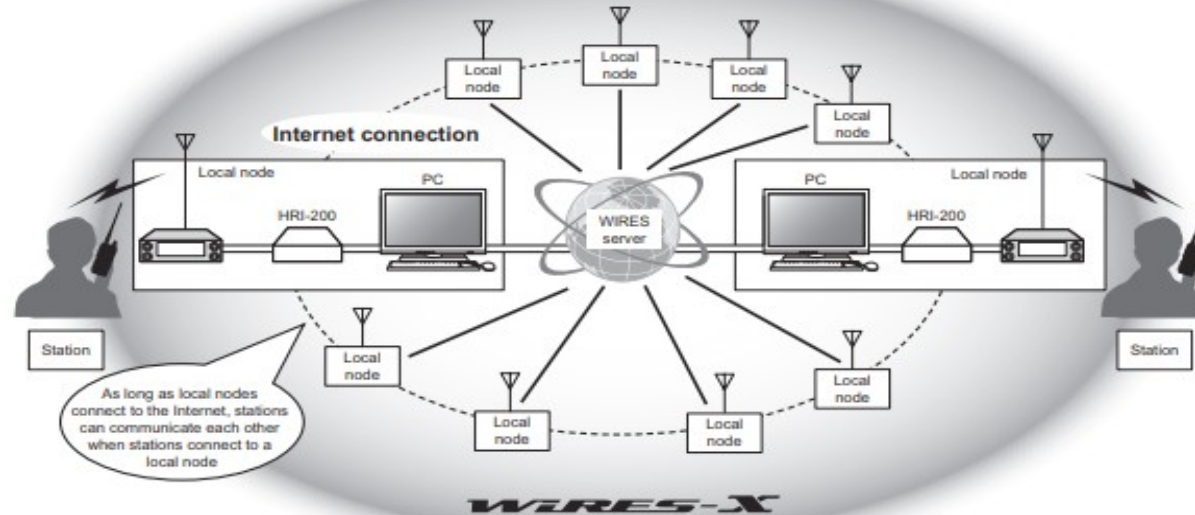
Questions?

Backup Slides

Time Division Multiple Access (TDMA)



Wires-X Infrastructure



Caution

If YAESU MUSEN management judges, in the future, that technological advancements or regulatory changes make it unfeasible for YAESU to continue hosting the WIRES server, it may be necessary to discontinue the management of the WIRES server.

Wires-X Infrastructure

The screenshot displays the Wires-X software interface. At the top, the title bar reads "WIRES-X" with standard window controls. Below the title bar is a menu bar with "File(F)", "View(V)", "Connect(C)", "Tool(T)", and "Help(H)".

The main interface is divided into several sections:

- Control Panel:** Located at the top right, it features a row of buttons: "IDLE", "DIGITAL", "ON-AIR", "LOCAL", "FTSD", and "RADIO 1". Below these buttons is a yellow rectangular display area and a small control panel with three dashes.
- Log Window:** A scrollable text area on the right side of the interface. It contains the following log entries:

```
2021/05/02 15:22:02 Transceiver Mode:Digital/Digital
2021/05/02 15:22:04 Server Access Error : "A connection with the server could not be established"
2021/05/02 15:22:18 Server Access Error : "A connection with the server could not be established"
2021/05/02 15:22:30 Server Access Error : "A connection with the server could not be established"
```
- Tables:** On the left side, there are two tables with headers. The top table has columns: "G.User ID", "+DT...", "Act", "Call/Rm...", "City", "State", "Cou...", "Freq(MHz)", "SQL", "Lat", "Lon", and "Comment". The bottom table has columns: "-A.User ID", "DTMF...", "CallSign", "City", "State", "Cou...", "Freq(MHz)", "SQL", "Lat", "Lon", and "Comment".
- Bottom Panel:** At the bottom right, there are buttons for "SEND" and "CLR". Below these are tabs for "News" and "GM".
- Status Bar:** At the bottom left, it says "Ready". At the bottom right, it shows "Ver-1.530" and a red "OFFLINE" indicator.

Wires-X Infrastructure

```
2021/05/02 15:22:02 Transceiver Mode:Digital/Digital
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"
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"
2021/05/02 15:22:30 Server Access Error : "A connection with the server could not be established
"
```

Wires-X Infrastructure

hosts - Notepad

File Edit Format View Help

```
# Copyright (c) 1993-2009 Microsoft Corp.
#
# This is a sample HOSTS file used by Microsoft TCP/IP for Windows.
#
# This file contains the mappings of IP addresses to host names. Each
# entry should be kept on an individual line. The IP address should
# be placed in the first column followed by the corresponding host name.
# The IP address and the host name should be separated by at least one
# space.
#
# Additionally, comments (such as these) may be inserted on individual
# lines or following the machine name denoted by a '#' symbol.
#
# For example:
#
#       102.54.94.97       rhino.acme.com          # source server
#       38.25.63.10      x.acme.com            # x client host

# localhost name resolution is handled within DNS itself.
#       127.0.0.1        localhost
#       ::1             localhost
127.0.0.1               yaesu.com
127.0.0.1               www.yaesu.com
```

DMR Infrastructure

- DMR Hosts file: http://www.pistar.uk/downloads/DMR_Hosts.txt

Pi-Star Dashboard

Hostname: pi-star Pi-Star:4.1.4 / Dashboard: 20210428

Pi-Star Digital Voice Dashboard for W2FJH

Dashboard | Admin | Configuration

Modes Enabled	
D-Star	DMR
YSF	P25
YSF XMode	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	433.125000 MHz
Rx	438.125000 MHz
FW	MMDVM_HS:1.5.2
TCXO	14.7456 MHz

DMR Repeater	
DMR ID	3172810
DMR CC	1
TS1	enabled
TS2	enabled
DMR Master	
BM 3104 United St..	

Gateway Activity									
Time (EDT)	Mode	Callsign	Target	Src	Dur(s)	Loss	BER		
17:01:01 May 2nd	DMR TS1	W2TAO (GPS)	TG 31488	Net	0.5	0%	0.0%		
17:00:51 May 2nd	DMR TS2	W2FTL (GPS)	TG 3136	Net	7.0	27%	0.0%		
16:54:27 May 2nd	DMR TS2	KD2VRU (GPS)	TG 31367	Net	5.5	0%	0.0%		
16:40:31 May 2nd	DMR TS2	K2NTX (GPS)	TG 31361	Net	4.1	0%	0.0%		
16:17:24 May 2nd	DMR TS1	KI500E (GPS)	TG 31488	Net	5.2	0%	0.0%		
15:45:27 May 2nd	DMR TS2	N2BSN (GPS)	TG 31361	Net	0.7	0%	0.0%		
15:23:04 May 2nd	DMR TS2	KM4WE (GPS)	TG 31621	Net	0.5	12%	0.0%		
15:00:04 May 2nd	DMR TS1	W8ELD (GPS)	TG 31488	Net	1.6	0%	0.2%		
14:59:33 May 2nd	DMR TS2	KG5IBN (GPS)	TG 31361	Net	0.5	0%	0.0%		
14:50:18 May 2nd	DMR TS2	N3JPP (GPS)	TG 3142	Net	4.8	0%	0.0%		
14:45:07 May 2nd	DMR TS1	N3JPP (GPS)	TG 31488	Net	5.9	0%	0.0%		
14:33:28 May 2nd	DMR TS2	KO4TVS (GPS)	TG 31621	Net	0.5	0%	0.0%		
13:49:24 May 2nd	DMR TS1	KC5CMB (GPS)	TG 31488	Net	1.9	0%	0.0%		
13:43:27 May 2nd	DMR TS2	W2JON (GPS)	TG 3142	Net	0.8	0%	0.0%		
13:20:03 May 2nd	DMR TS2	W3QF (GPS)	TG 3142	Net	1.6	0%	0.0%		
13:02:17 May 2nd	DMR TS2	KM2E (GPS)	TG 31361	Net	1.8	0%	0.0%		
12:49:06 May 2nd	DMR TS2	KC2EQ (GPS)	TG 31367	Net	0.8	0%	0.0%		
12:37:56 May 2nd	DMR TS2	KC3RVI (GPS)	TG 3142	Net	0.5	0%	0.0%		
12:03:48 May 2nd	DMR TS1	K9KLC (GPS)	TG 31488	Net	2.6	0%	0.0%		
11:20:56 May 2nd	DMR TS2	KD9QMD (GPS)	TG 31621	Net	0.5	12%	0.0%		

Local RF Activity									
Time (EDT)	Mode	Callsign	Target	Src	Dur(s)	BER	RSSI		
22:33:06 May 1st	DMR TS2	W2FJH (GPS)	9990	RF	4.3	0.1%	S9+46dB (-47 dBm)		

Pi-Star Configuration

Pi-Star 4.1.4 / Dashboard: 20210428

Pi-Star Digital Voice - Configuration

Dashboard | Admin | Expert | Power | Update | Backup/Restore | Factory Reset

Gateway Hardware Information

Hostname	Kernel	Platform	CPU Load	CPU Temp
pi-star	5.10.11+	Pi Zero W Rev 1.1 (512MB)	1.9 / 1.5 / 1.37	37.9°C / 100.2°F

Control Software

Setting	Value
Controller Software:	<input type="radio"/> DStarRepeater <input checked="" type="radio"/> MMDVMHost (DV-Mega Minimum Firmware 3.07 Required)
Controller Mode:	<input type="radio"/> Simplex Node <input checked="" type="radio"/> Duplex Repeater (or Half-Duplex on Hotspots)

Apply Changes

MMDVMHost Configuration

Setting	Value
DMR Mode:	<input checked="" type="checkbox"/> RF Hangtime: 20 Net Hangtime: 20
D-Star Mode:	<input type="checkbox"/> RF Hangtime: 20 Net Hangtime: 20
YSF Mode:	<input type="checkbox"/> RF Hangtime: 20 Net Hangtime: 20
P25 Mode:	<input type="checkbox"/> RF Hangtime: 20 Net Hangtime: 20
NXDN Mode:	<input type="checkbox"/> RF Hangtime: 20 Net Hangtime: 20
YSF2DMR:	<input type="checkbox"/>
YSF2NXDN:	<input type="checkbox"/>
YSF2P25:	<input type="checkbox"/>
DMR2YSF:	<input type="checkbox"/> Uses 7 prefix on DMRGateway
DMR2NXDN:	<input type="checkbox"/> Uses 7 prefix on DMRGateway
POCSAG:	<input type="checkbox"/> POCSAG Paging Features
MMDVM Display Type:	OLED Type 3 Port: /dev/ttyAMA0 Nextion Layout: ON7LDS L2

Apply Changes

Pi-Star Configuration

General Configuration

Setting	Value
Hostname:	pi-star <small>Do not add suffixes such as .local</small>
Node Callsign:	W2FJH
CCS7/DMR ID:	3172810
Radio Frequency RX:	438.125.000 MHz
Radio Frequency TX:	433.125.000 MHz
Latitude:	42.045939 degrees (positive value for North, negative for South)
Longitude:	-76.2751 degrees (positive value for East, negative for West)
Town:	Owego, FN12ub
Country:	USA
URL:	https://www.qrz.com/db/W2FJH <input checked="" type="radio"/> Auto <input type="radio"/> Manual
Radio/Modem Type:	MMDVM_HS_Dual_Hat (DB9MAT, DF2ET & DO7EN) for Pi (GPIO) ▾
Node Type:	<input checked="" type="radio"/> Private <input type="radio"/> Public
APRS Host Enable:	<input checked="" type="checkbox"/>
APRS Host:	noam.aprs2.net ▾
System Time Zone:	America/New_York ▾
Dashboard Language:	english_us ▾

Apply Changes

DMR Configuration

Setting	Value
DMR Master:	BM_3104_United_States ▾
Hotspot Security:	*****
BrandMeister Network:	Repeater Information Edit Repeater (BrandMeister Selfcare)
DMR ESSID:	3172810_04 ▾
DMR Color Code:	1 ▾
DMR EmbeddedLCOnly:	<input type="checkbox"/>
DMR DumpTAData:	<input checked="" type="checkbox"/>

Apply Changes

Pi-Star Configuration (YSF2DMR)

MMDVMHost Configuration

Setting	Value		
DMR Mode:	<input type="checkbox"/>	RF Hangtime: <input type="text" value="20"/>	Net Hangtime: <input type="text" value="20"/>
D-Star Mode:	<input type="checkbox"/>	RF Hangtime: <input type="text" value="20"/>	Net Hangtime: <input type="text" value="20"/>
YSF Mode:	<input checked="" type="checkbox"/>	RF Hangtime: <input type="text" value="20"/>	Net Hangtime: <input type="text" value="20"/>
P25 Mode:	<input type="checkbox"/>	RF Hangtime: <input type="text" value="20"/>	Net Hangtime: <input type="text" value="20"/>
NXDN Mode:	<input type="checkbox"/>	RF Hangtime: <input type="text" value="20"/>	Net Hangtime: <input type="text" value="20"/>
YSF2DMR:	<input checked="" type="checkbox"/>		
YSF2NXDN:	<input type="checkbox"/>		
YSF2P25:	<input type="checkbox"/>		
DMR2YSF:	<input type="checkbox"/>	Uses 7 prefix on DMRGateway	
DMR2NXDN:	<input type="checkbox"/>	Uses 7 prefix on DMRGateway	
POCSAG:	<input type="checkbox"/>	POCSAG Paging Features	
MMDVM Display Type:	<input type="text" value="OLED Type 3"/> ▼	Port: <input type="text" value="/dev/ttyAMA0"/> ▼	Nextion Layout: <input type="text" value="G4KLX"/> ▼

Apply Changes

Pi-Star Configuration (YSF2DMR)

Yaesu System Fusion Configuration

Setting	Value
YSF Startup Host:	YSF00002 - Link YSF2DMR
UPPERCASE Hostfiles:	<input checked="" type="checkbox"/> Note: Update Required if changed
WiresX Passthrough:	<input type="checkbox"/>
(YSF2DMR)CCS7/DMR ID:	3172810 05
DMR Master:	BM_3101_United_States
Hotspot Security:	*****
DMR TG:	31367

Apply Changes

Brandmeister Duplex Hotspot Configuration

Actions

Get IP address Drop call on slot 1 Drop dynamic groups on slot 1 Drop call on slot 2 Drop dynamic groups on slot 2 Reset repeater connection

Static Talkgroups Timeslot 1

→ Texas-Nexus (31488) ←

Static Talkgroups Timeslot 2

→ New York (3136) ←
Pennsylvania (3142)
Upstate NY (31361)
Southern Tier NY (31367)

Clusters [+ Add Cluster](#)

Active Clusters:

Remove

Scheduled static [+ Add Scheduled Static](#)

Active Timed Statics:

Remove

Brandmeister Hotspot Info

User Dashboard

Last Heard

Repeaters **5294**

Hotspots **16323**

Masters **47**

Alerts

Data Visualisation <

Information <

Services <

Hotspot

My hotspots <

Repeater W2FJH

User Dashboard > Repeaters > W2FJH

Last Heard (TG Filter) Last Heard

Repeater Info

Number	317281004
City	Owego, FN12ub
Country	US
Website	Click here
Sysops	
Hardware	Nano_hotSPOT (MMDVM)
Firmware	20200615_Pi-Star_v4
Power (EIRP)	Unknown
Status	Slot 1 & 2 linked
Master	BM3104

Frequency Details

TX	433.1250 MHz
RX	438.1250 MHz
Shift	5.000 MHz
CC	1

Slot details

Timeslot **31488**

1

Timeslot **3136** **3142** **31361** **31367** **31424**

2 **31621**

W2FJH

Time	Master	My call	Destination	Options	RSSI	Duration
7 Minutes	3104	W2FJH [Francis] (3172810)	Southern Tier NY (31367)	TS2 DMR	S9+40dB	5
18 Hours	3104	W2FJH [Francis] (3172810)	Parrot (9990)	TS2 DMR	S9+40dB	4
18 Hours	3104	W2FJH [Francis] (3172810)	Parrot (9990)	TS2 DMR	S9+40dB	4
27 Hours	3104	W2FJH [Francis] (3172810)	Parrot (9990)	TS2 DMR	S9+40dB	3
27 Hours	3104	W2FJH [Francis] (3172810)	Parrot (9990)	TS2 DMR	S9+40dB	3

Showing 1 to 5 of 5 entries

Location

