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

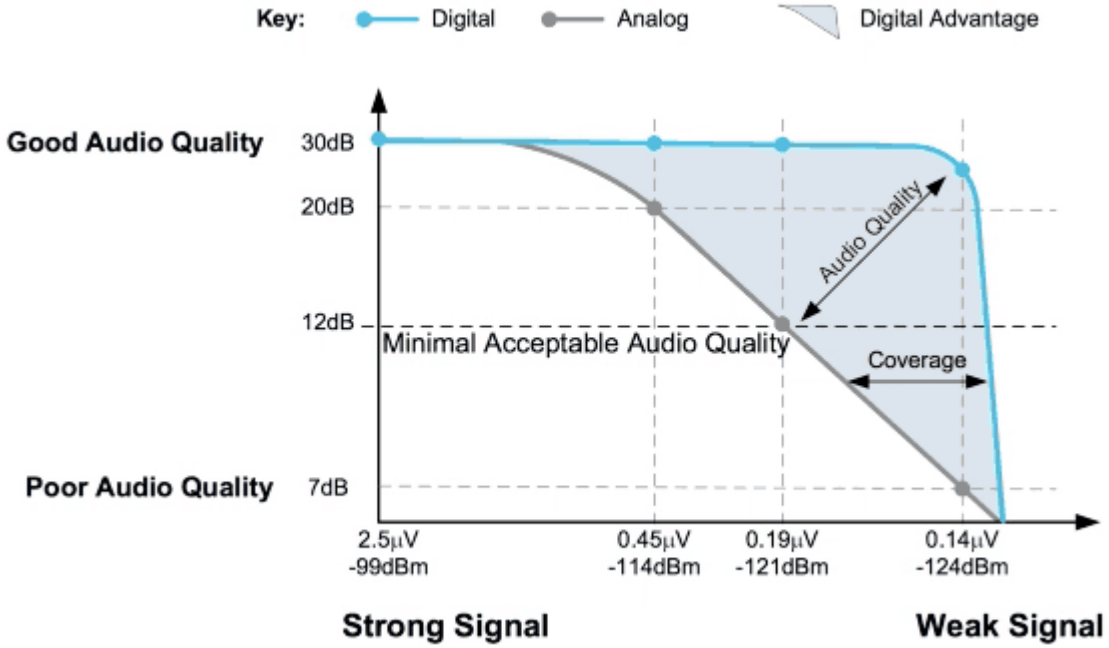
Why stay on Analog?

- 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?

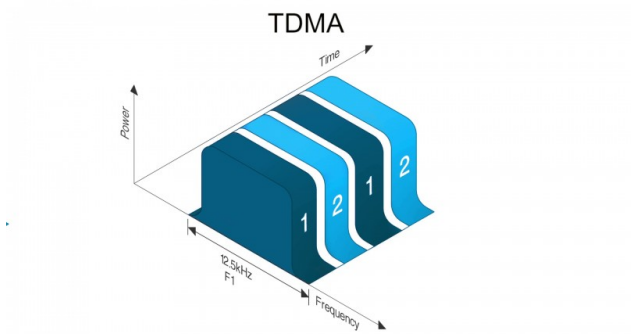
Why go digital?

- 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 then $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 then 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

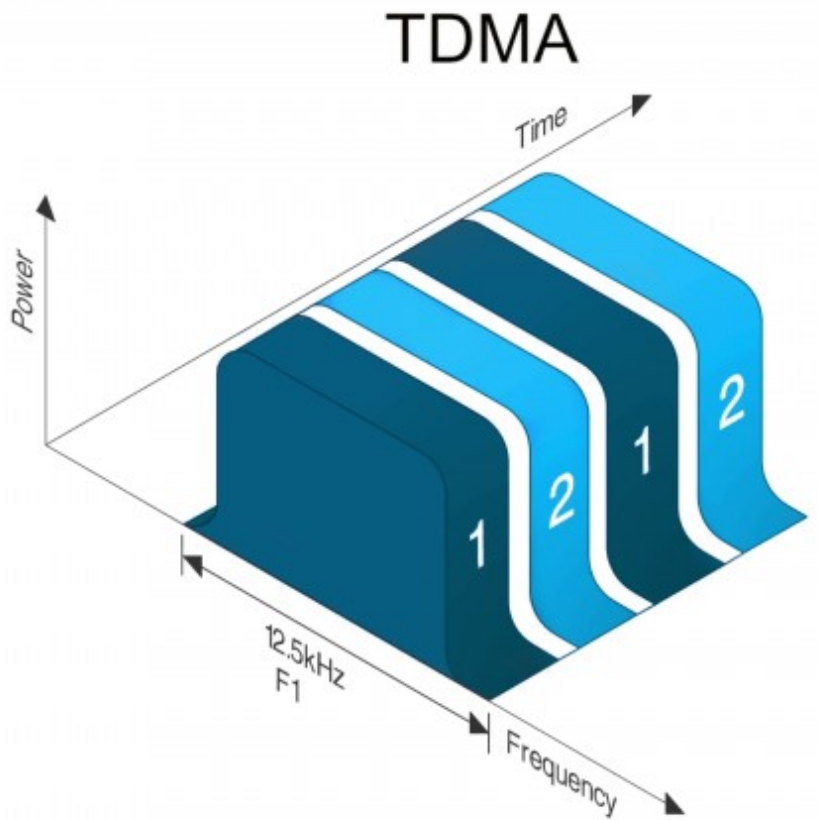
- Local Hams – Frank (W2FJH), Elliot (N2OJM), and several others

- YouTube

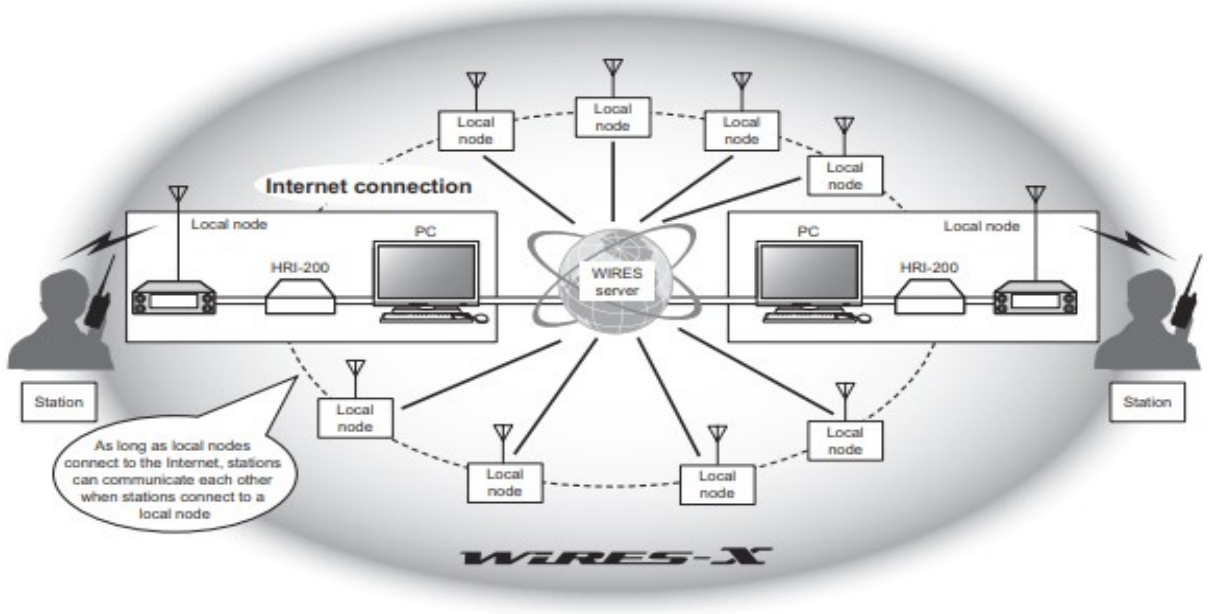
Questions?

Backup Slides

Time Division Multiple Access (TDMA)



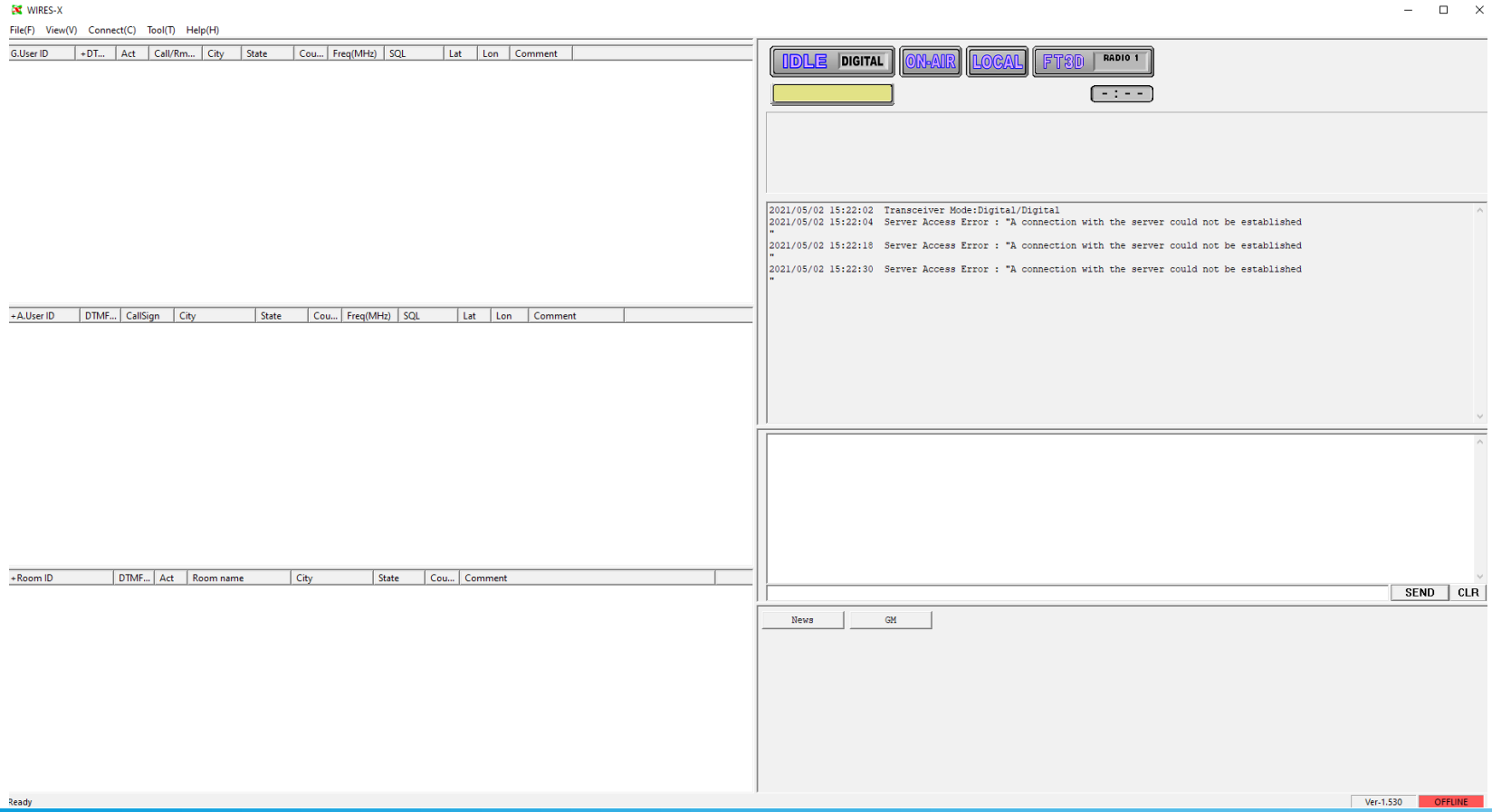
Wires-X Infrastructure



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.

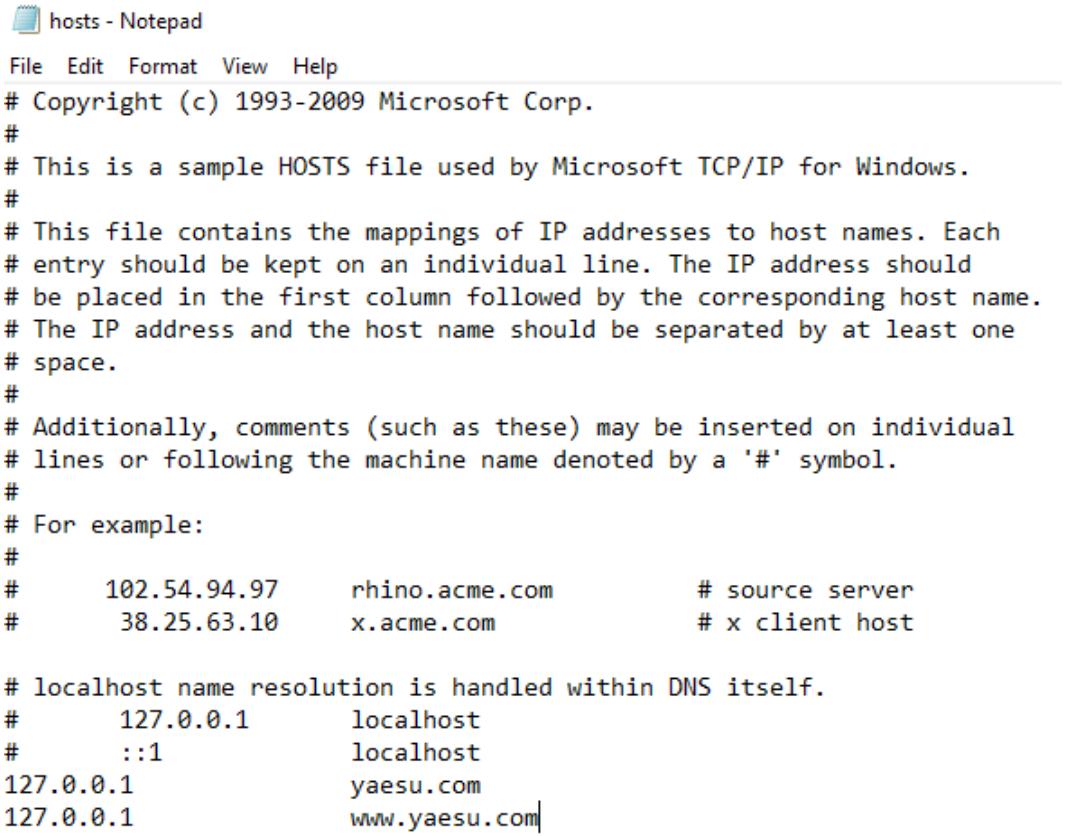
Wires-X Infrastructure



Wires-X Infrastructure

```
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
"
```

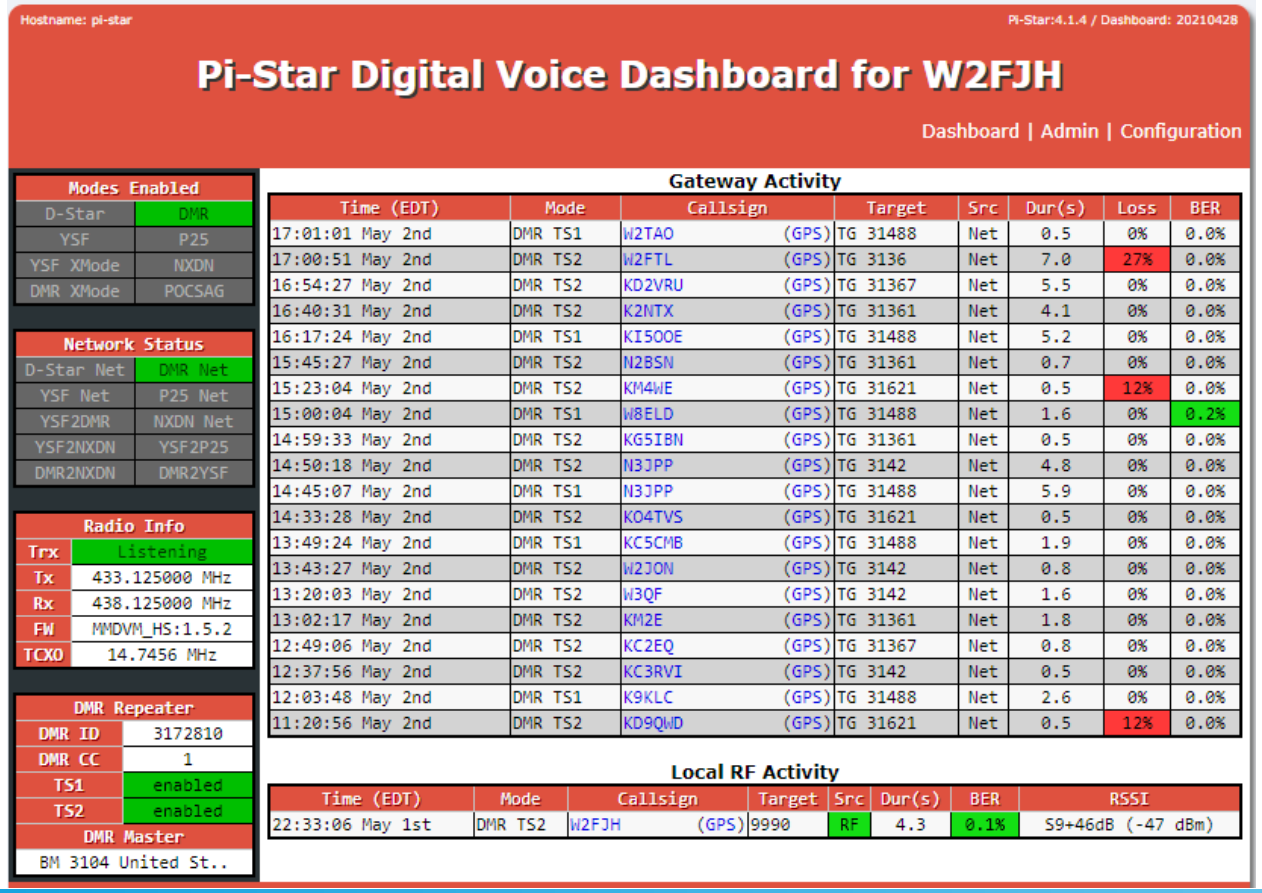
Wires-X Infrastructure



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..	

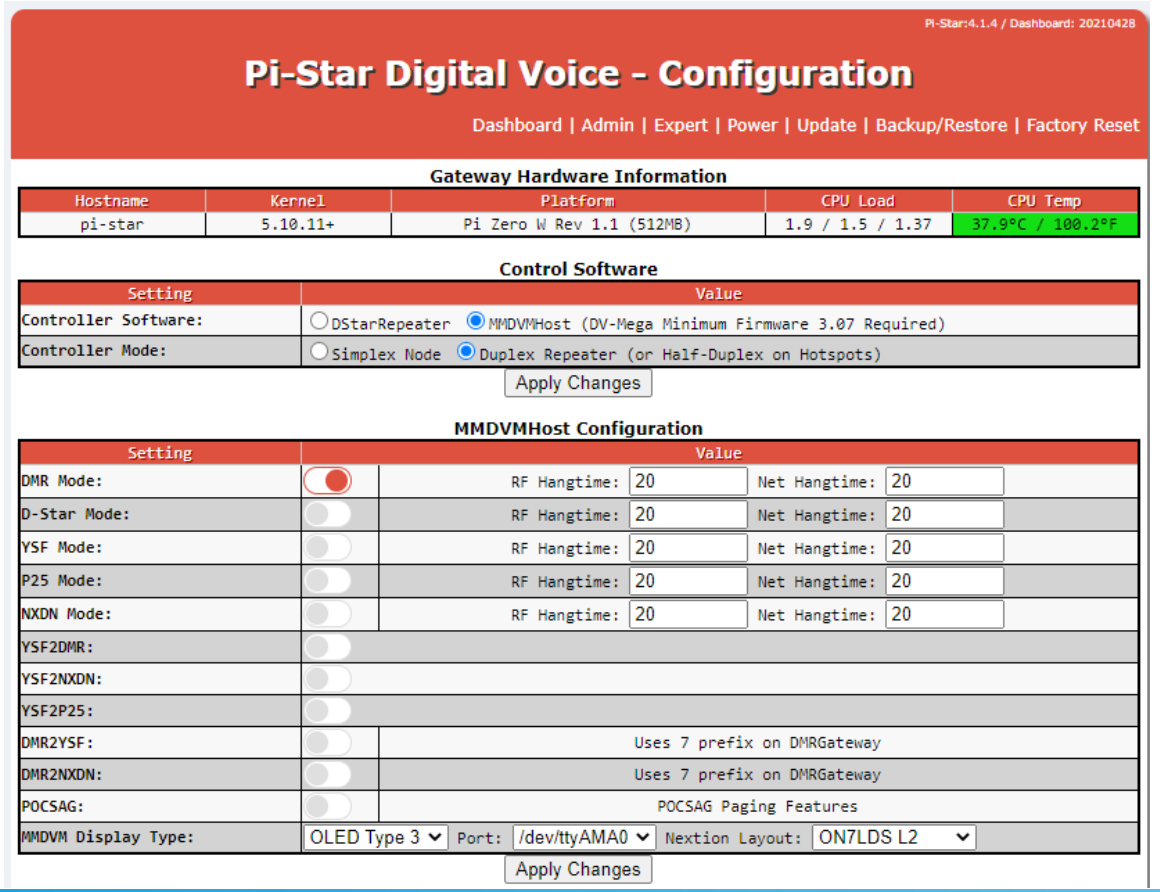
Gateway Activity

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	KI5OOE (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	KD9QWD (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:	○ DStarRepeater ◉ MMDVMHost (DV-Mega Minimum Firmware 3.07 Required)
Controller Mode:	○ Simplex Node ◉ Duplex Repeater (or Half-Duplex on Hotspots)

Apply Changes

MMDVMHost Configuration

Setting	Value			
DMR Mode:	RF Hangtime:	20	Net Hangtime:	20
D-Star Mode:	RF Hangtime:	20	Net Hangtime:	20
YSF Mode:	RF Hangtime:	20	Net Hangtime:	20
P25 Mode:	RF Hangtime:	20	Net Hangtime:	20
NXDN Mode:	RF Hangtime:	20	Net Hangtime:	20
YSF2DMR:				
YSF2NXDN:				
YSF2P25:				
DMR2YSF:	Uses 7 prefix on DMRGateway			
DMR2NXDN:	Uses 7 prefix on DMRGateway			
POCSAG:	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 — Do not add suffixes such as .local
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 — Auto / Manual
Radio/Modem Type:	MMDVM_HS_Dual_Hat (DB9MAT, DF2ET & DO7EN) for Pi (GPIO)
Node Type:	Private / Public
APRS Host Enable:	
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:	
DMR DumpTAData:	

Apply Changes

Pi-Star Configuration (YSF2DMR)

MMDVMHost Configuration

Setting	Value				
DMR Mode:		RF Hangtime:	20	Net Hangtime:	20
D-Star Mode:		RF Hangtime:	20	Net Hangtime:	20
YSF Mode:		RF Hangtime:	20	Net Hangtime:	20
P25 Mode:		RF Hangtime:	20	Net Hangtime:	20
NXDN Mode:		RF Hangtime:	20	Net Hangtime:	20
YSF2DMR:					
YSF2NXDN:					
YSF2P25:					
DMR2YSF:		Uses 7 prefix on DMRGateway			
DMR2NXDN:		Uses 7 prefix on DMRGateway			
POCSAG:		POCSAG Paging Features			
MMDVM Display Type:	OLED Type 3	Port:	/dev/ttyAMA0	Nextion Layout:	G4KLX

Apply Changes

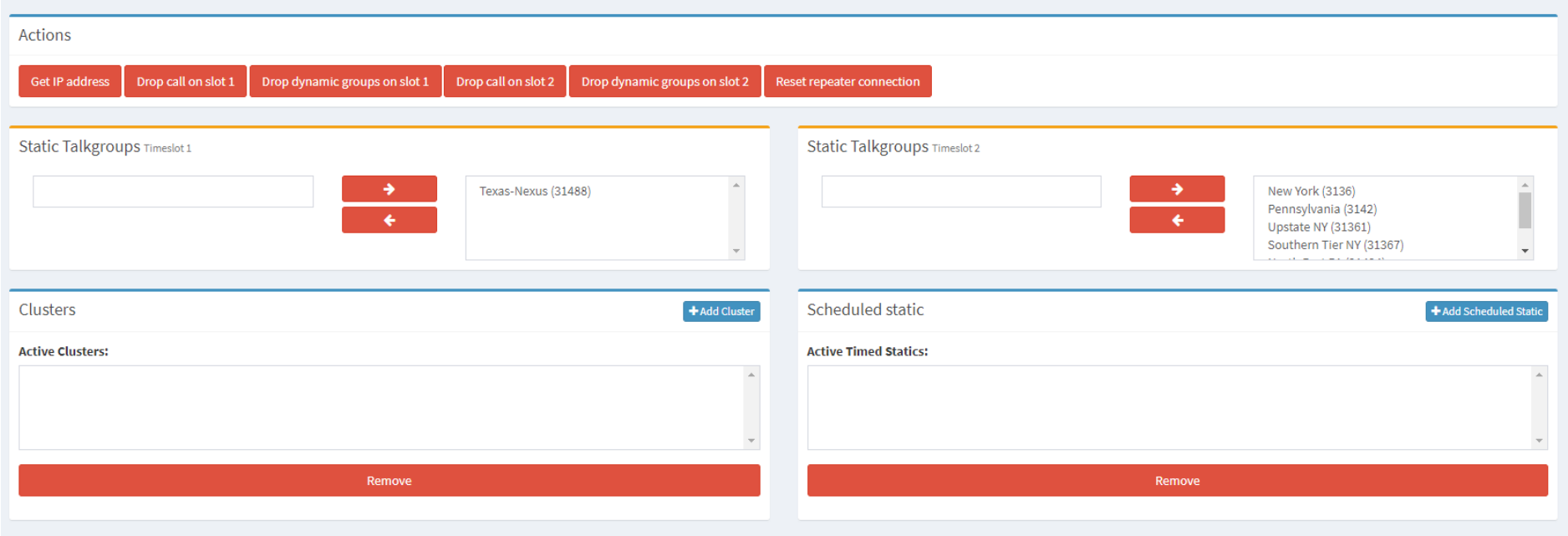
Pi-Star Configuration (YSF2DMR)

Yaesu System Fusion Configuration

Setting	Value
YSF Startup Host:	YSF00002 - Link YSF2DMR
UPPERCASE Hostfiles:	Note: Update Required if changed
WiresX Passthrough:	
(YSF2DMR)CCS7/DMR ID:	3172810 05
DMR Master:	BM_3101_United_States
Hotspot Security:	••••••••••••
DMR TG:	31367

Apply Changes

Brandmeister Duplex Hotspot Configuration



Brandmeister Hotspot Info