Intro to Digital Voice Modes (D-STAR, DMR and YSF)

Presented By: John Betz
KI5YIF

Rio Rancho, NM

Developed by: Paul Bouthillier
KBØWMA

Albuquerque, NM

Who is Paul Bouthillier – KBØWMA?

- First licensed as a Technician in May 1996 in Denver Colorado
- Moved to Albuquerque, New Mexico in 2001
- Upgraded to General in November 2023
- Upgraded to Amateur Extra in April 2024

- Ham Interests:
  - HF through 440Mhz – Both Analog and Digital modes
  - Own and operate a 24/7 YSF Reflector
    - YSF Reflector ID: US-NM505-KB0WMA
  - D-STAR, DMR, YSF, FT8, Wires-X, AllStarLink and EchoLink (openSPOT, Raspberry Pi Hotspots, etc.)
  - Bernalillo County ARES (BCARES) – Volunteer Member

- I'm an enthusiast, not an expert

Who is John Betz II – KI5YIF?

- First licensed as a Technician in October 2022
- Born and Raised in Rio Rancho NM
- Upgraded to General in February 2023
- Upgraded to Amateur Extra in April 2024

- Ham Interests:
  - HF through 440Mhz – Both Analog and Digital modes
  - D-STAR, DMR, YSF, FT8, Wires-X, AllStarLink and EchoLink (openSPOT, Raspberry Pi Hotspots, etc.)
  - nmscares.org (SCARES) – Volunteer Member
  - Building anything and everything
- Education is learning what you didn't even know you didn't know.

Agenda

- Background: D-STAR, DMR and Yaesu System Fusion
- Options for personal operations
- DMR-focused hotspot setup
- More D-STAR and YSF info
- Things I've learned
- Portable operation
- Q&A

What is D-STAR and DMR Anyway?

- **D-STAR:** **D**igital **S**mart **T**echnologies for **A**mateur **R**adio
  - Developed in **Japan** in the late '90s, but most changes appeared in 2004
  - **Digital voice (DV) and Digital Data (DD)**
  - **Less bandwidth** than analog – just 6.25 kHz vs. 16 kHz
  - Radios by Icom, Kenwood*
  - 2m, (1.25cm), 70cm, 23cm and HF
  - Longer P2P (point to point) distance compared to FM
  - Registration required for communications beyond your local repeater
    - **Access to Reflectors** (conference bridges)
  - Reflector networks include D-Plus (REF), along with DCS and D-Extra (XRF)

- **DMR:** **D**igital **M**obile **R**adio
  - European standard – commercial roots
  - DMR Tier II (used by amateurs) was published in 2005
  - 12.5 kHz channel spacing, effectively **2 time slots** on each channel (TDMA)
  - 2m and 70cm in use (differs by region)
  - Longer P2P distance compared to FM
  - ID required, which you program in your radio
  - DMR-Marc: Worldwide, Motorola-focused wide-area repeater system
  - **Brandmeister and TGIF Networks** of worldwide homebrewed repeaters and well-supported by hotspots
  - **Talkgroups** are similar in concept to D-STAR Reflectors

And what about Yaesu System Fusion?

- **YSF (C4FM): Y**aesu **S**ystem **F**usion
  - **Yaesu's implementation** of “Digital Amateur Radio”
  - **C4FM** - 4-level FSK Technology to transmit digital voice and data
  - **Less bandwidth** than analog – just 6.25 kHz or 12.5 kHz voice modes
  - Shared simultaneous voice and data sharing 12.5 Khz
  - FDMA (Frequency Division Multiple Access)
  - 2m and 70cm in use
  - Longer P2P distance compared to FM
  - **Yaesu repeaters**: Analog or Digital conversations supported
  - Wires-X Network (all Yaesu – **“Rooms”**)
  - Alternative networks:
    - FCS Network
    - YSFReflector Network
  - Similar concept to D-STAR Reflectors and DMR Talkgroups

Why get interested in D-STAR, DMR or YSF?

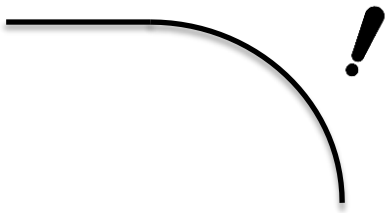
- More repeater choices
- The P2P (point to point) distance signal remains intelligible
- Talk worldwide with an HT (Internet-aided)
- RF and non-RF (PC-only) options for all
- Support for cross-mode linking
- It's another way you can put a hotspot to use
- Learn something new in ham radio communications

Digital FM

As distance increases, your signal remains clear… until you fall off the cliff

Analog FM

As distance increases, noise also increases on your signal



Repeaters vs. Hotspots

- Public Repeaters
  - Internet connection required
    - D-STAR: Access to **Reflectors**
    - DMR: Access to **Talkgroups**
    - YSF: Access to **Rooms** (Wires-X)
    - Access to other repeaters
  - Linking to Reflectors, Talkgroups ,or Rooms is defined by the repeater owner
    - Fixed/Scheduled or limited on-demand

- Personal Hotspots
  - Internet connection required
  - Some assembly (or configuration) required
  - Most DIY Hotspots involve a Raspberry Pi
  - There are also standalone hotspot products (openSPOT)
  - You control access to what you connect to, and for how long
  - D-STAR: Access to the D-Plus (REF) Reflectors, along with DCS, XLX and D-Extra (XRF) Reflectors – many choices!
  - DMR: Hotspots allow access to the Brandmeister and DMR+ networks' Talkgroups
    - Access to back to repeater networks, only if a repeater owner provides a bridge between the networks
  - YSF: Hotspots allow access to FCS and YSF Reflector networks

Where are the local Repeaters?

- **D-STAR**
  - Albuquerque, Op Center (K5URR): 449.450 MHz -5.00
  - Albuquerque, OP Center (K5URR): 146.860 MHz -0.6
  - Albuquerque, Sandia Crest (W5MPZ): 443.800 MHz +5.00
  - Belen, Capilla Peak (W5URD): 444.525 MHz +5.00
- **DMR**
  - Albuquerque, Sandia Crest (WA5IHL): 442.250 MHz +5.00
  - Albuquerque, Sandia Crest (NM5HR): 442.900 MHz +5.00
  - Albuquerque, Sandia Crest (WR7HLN): 443.300 MHz +5.00
  - Albuquerque, 9 Mile Hill (WR7HLN): 443.550 MHz +5.00
  - Albuquerque, Southeast (N5GU): 444.600 MHz +5.00
  - Rio Rancho, Southern (NM5SH): 442.525 MHz +5.00
  - Mountainair, Capilla Peak (N5QD): 443.200 MHz +5.00
- **YSF**
  - Albuquerque (KBØWMA): US-NM505-KB0WMA YSF Reflector
  - Los Lunas, Meadow Lake (KC5OUR): 145.430 MHz -0.6
  - Belen (KC5OUR): 442.700 MHz -5.00
  - Belen (KC5OUR): 146.700 MHz -0.6

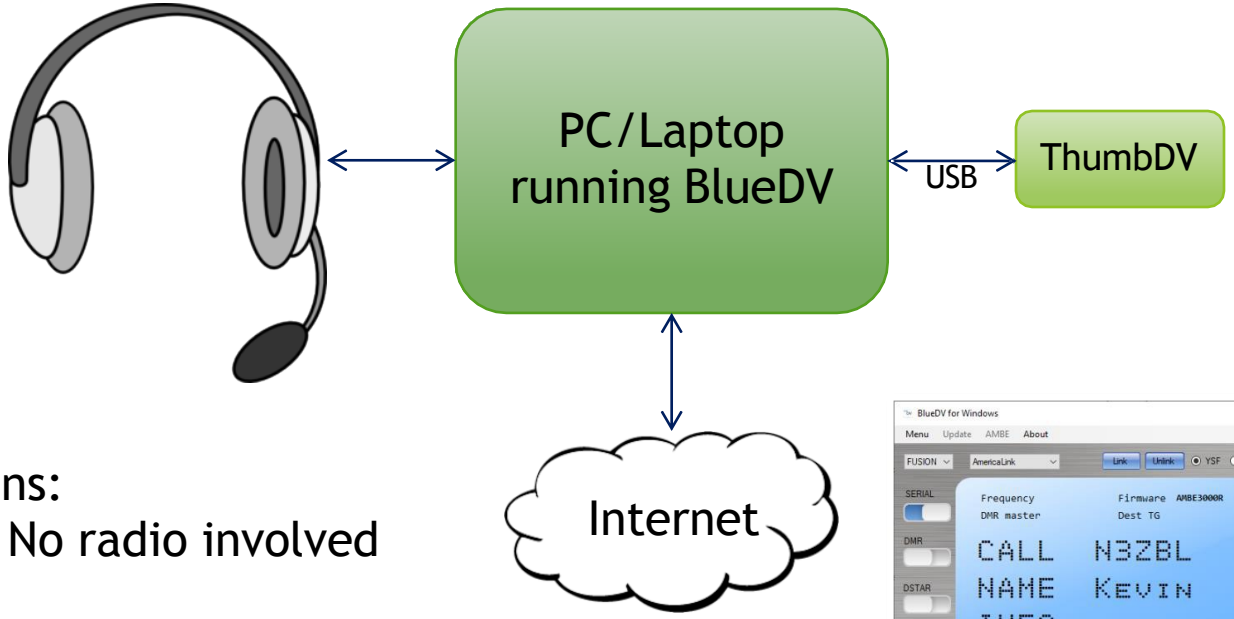
RepeaterBook

What are your options for personal D-STAR, DMR and YSF operations?

ThumbDV™ by NW Digital Radio

Pros:

- No radio required to play
- Your Windows PC is the Digital Voice Terminal
  - D-STAR, DMR and YSF via the AMBE300x chip
- Uses simple BlueDV software



Cons:

- No radio involved

Alternate:

- DVMEGA DVStick30

ZUMspot by ZUM Radio

Pros:

- Supports Multiple Modes: D-STAR, DMR, YSF, others
- Allows “walk-about” access to your own Hotspot
- Easy to setup for multi-mode, portable use
- You’re in control (Reflector, Talkgroup connections)

D-STAR DMR YSF

RF!

ZUMspot

Single Band UHF or Dual Band Versions

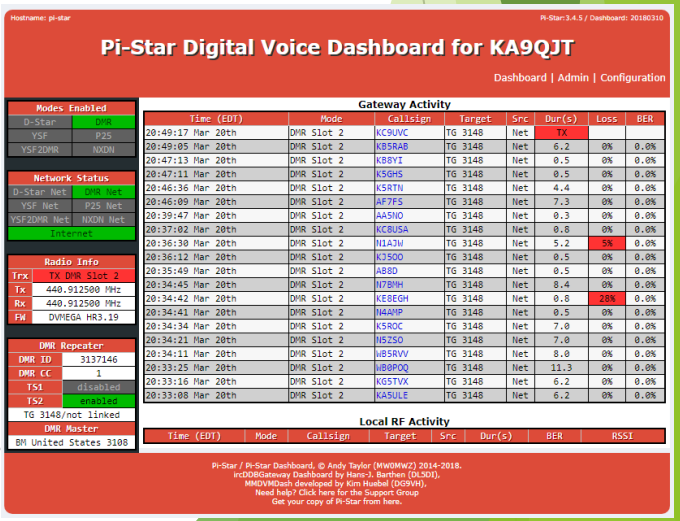
Power Source

USB

Raspberry Pi

Ethernet or Wi-Fi

Internet



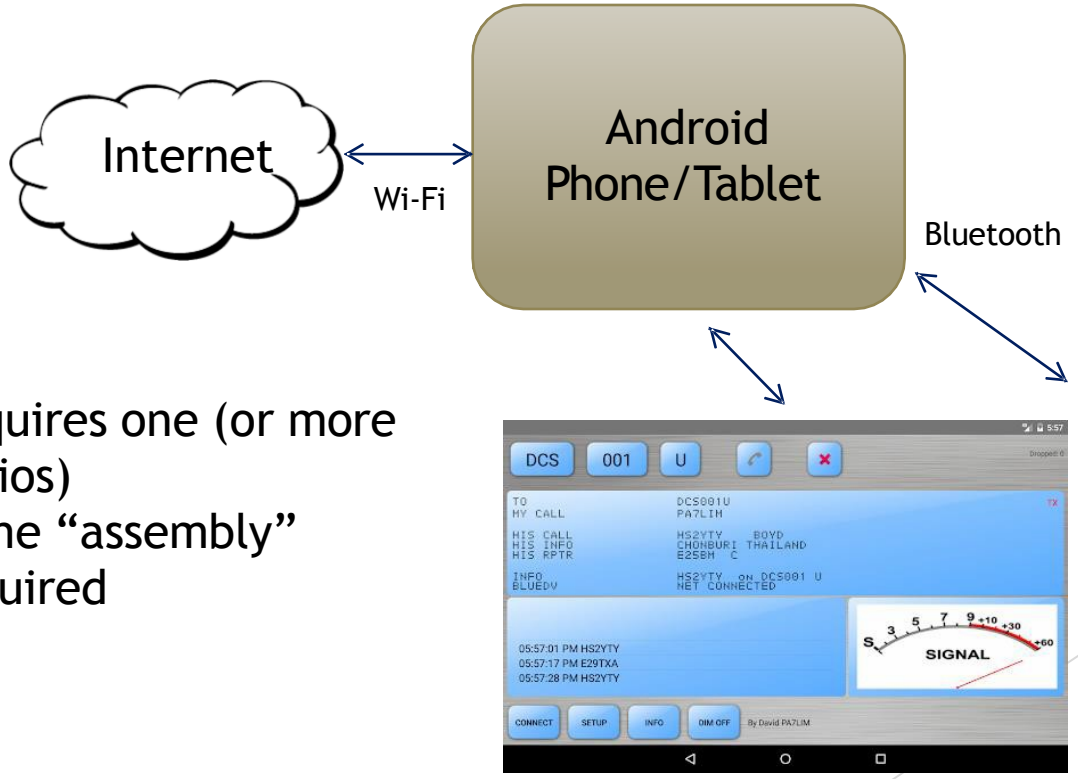
Cons:

- Requires one or more radios
- Some “assembly” required
- Configuration and setup required

DV Mega with BlueStack Micro+

Pros:

- Supports Multiple Modes: D-STAR, DMR, YSF, others
- Android Phone/Tablet used as the control interface with PA7LIM BlueDV software (Android, iOS, Linux, Windows)
- Allows "walk-about" and portable access to your own multi-mode Hotspot
- You're in control (Reflector, Talkgroup connections)



Cons:

- Requires one (or more radios)
- Some "assembly" required

Other Raspberry Pi-based multi-mode hotspots (D-STAR, DMR, YSF)

Zum Radio with Raspberry Pi Zero W with display

Common MMDVM Hotspot with Raspberry Pi W with small display

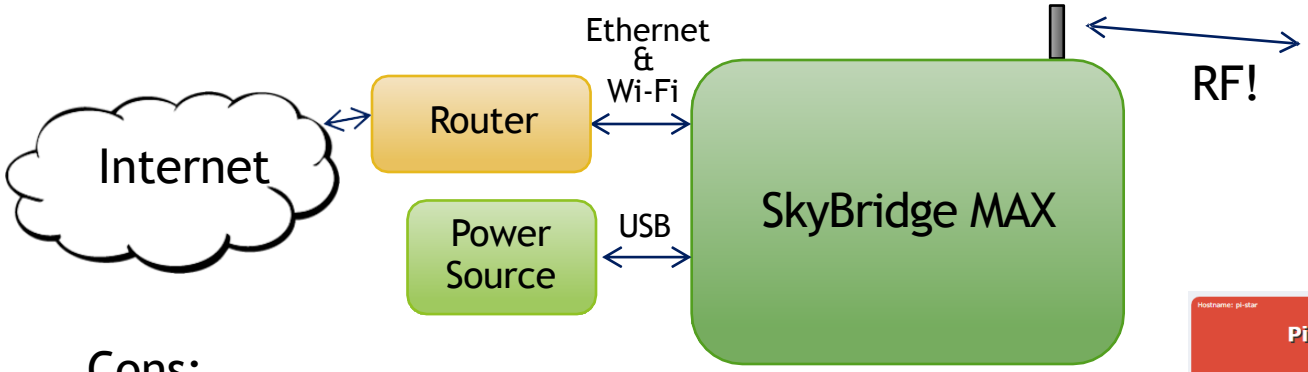
Rugged SPOT Nex-Gen with Raspberry Pi 3, display and case

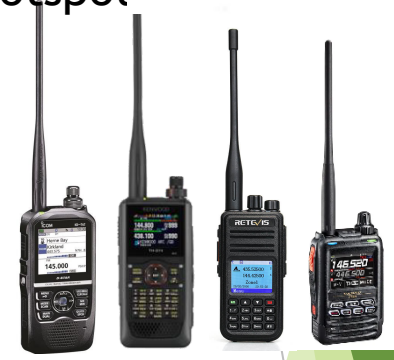
Turnkey Options

SkyBridge MAX Hotspot by [BridgeCom Systems]

Pros:

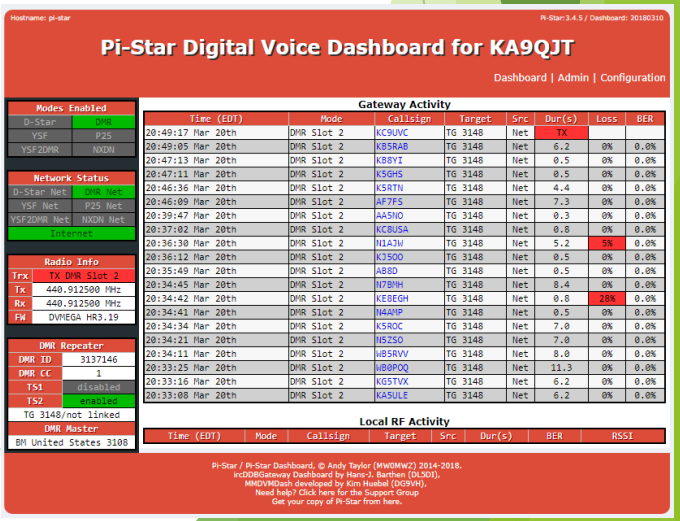
- Supports Multiple Modes: D-STAR, DMR, YSF, others
- Connect it via Wi-Fi and Ethernet
- Configured and managed with a web browser or phone app
- Allows “walk-about” access to your own multi-mode Hotspot
- You’re in control (Reflector, Talkgroup connections)





Cons:

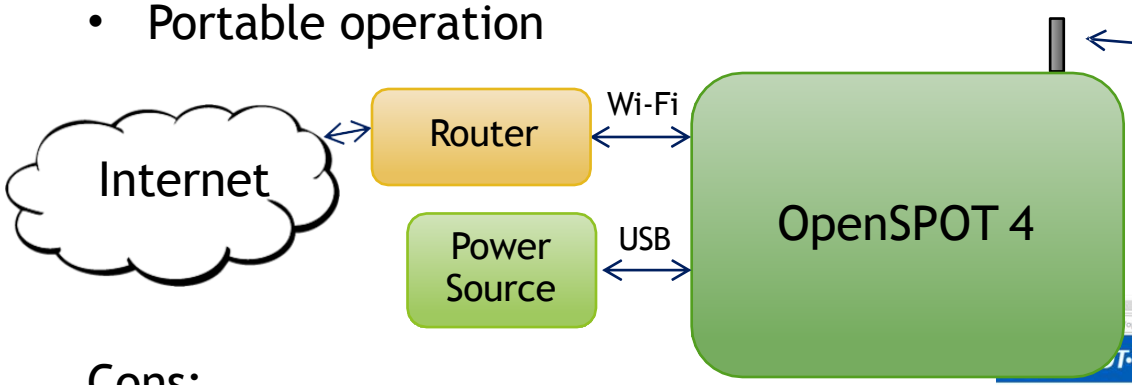
- Requires one or more radios
- Configuration and setup required
- Expensive!



openSPOT 4 by SharkRF

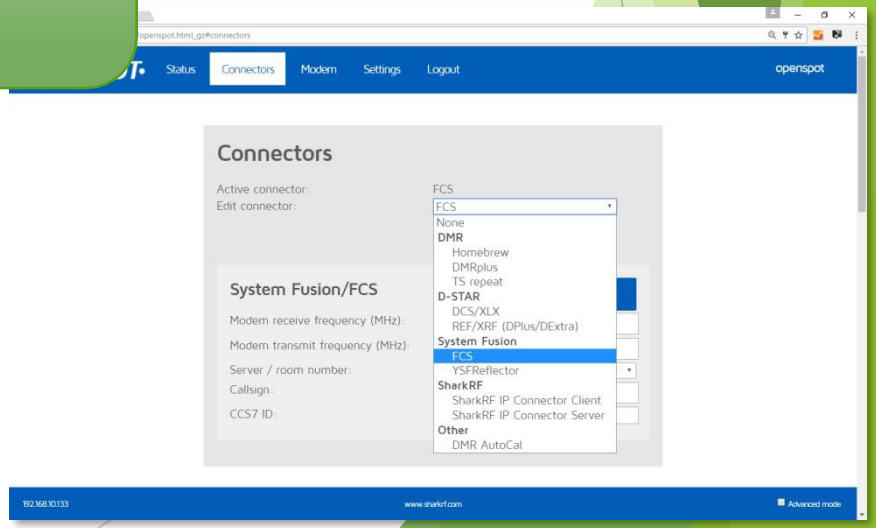
Pros:

- Supports Multiple Modes: D-STAR, DMR, YSF, others
- Self-contained with battery (connect it via Wi-Fi)
- Configured and managed with a web browser or phone app
- Allows “walk-about” access to your own multi-mode Hotspot
- You’re in control (Reflector, Talkgroup connections)
- Transcoder! Your one radio can work on multiple modes
- Portable operation



Cons:

- Only supports a Wi-Fi connection
- Very Pricy!



Cross-modes on the openSPOT 4 and 4 Pro

The openSPOT4 does transcoding, which allows it to be used as a cross-mode hotspot system.

It supports the following cross modes:

- ✓ You can use your DMR transceiver to access **D-STAR®**, **C4FM**, **NXDN®** networks
- ✓ You can use your D-STAR® transceiver to access **DMR**, **C4FM**, **NXDN®** networks
- ✓ You can use your C4FM transceiver to access **DMR**, **D-STAR®**, **NXDN®**, **P25** networks

AllStarLink Nodes

What is AllStarLink?

AllStarLink is a network of Amateur Radio repeaters, remote base stations and hotspots accessible to each other via **V**oice **o**ver **I**nternet **P**rotocol.

Features:

- Full Feature Repeater Controller
- VoIP Full Duplex Linking with great audio
- ASL/EchoLink Linking
- Simplex (half-duplex) Station
- Autopatch and reverse autopatch
- Frequency Agile Remote Base Station
- Based on Asterisk – the Open Source PBX
- Real-time status reporting to AllStarLink Active Nodes List

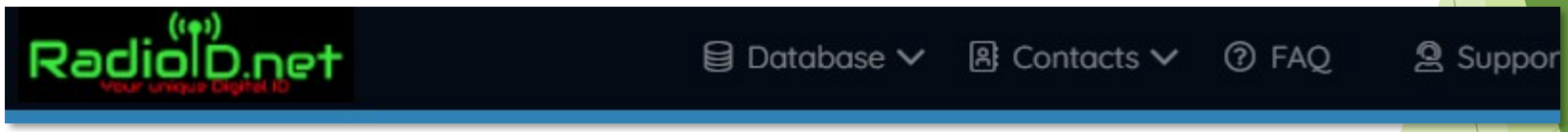
SHIFTING GEARS

Walking through a setup experience

DMR with a MMDVM Hotspot

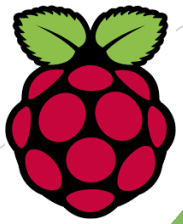
1st Step: Register for a personal DMR ID

- RadioID provides a registration service
- You only need one ID, even if you have multiple DMR Radios
- Today, there are nearly 70K registered DMR IDs in the US alone!



Example: DMR with a MMDVM Hotspot using a Raspberry Pi Zero W

- What's needed?
  - MMDVM board (UHF or VHF) (eBay and other sources)
  - Raspberry Pi Zero WH (H = with the header)
  - USB Power Source (5V, 2.5A!) and cable
  - Accessible Wi-Fi
  - Quality 8GB or larger MicroSD Card (Class 10)
  - Pi-Star "image"
  - PC for downloading and writing the "image" to the card
  - DMR HT or mobile radio

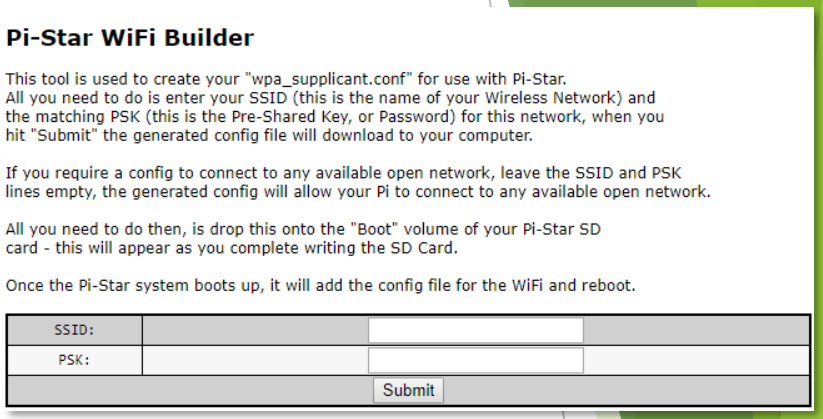


The Image? Which Image?

- Raspberry Pi runs Linux
  - The OS, file system and applications need to be organized on the MicroSD card
  - The chosen “image” must be written byte by byte to the card
- Ready-made, D-STAR-focused image are downloadable
  - Pi-Star (Today’s Gold Standard!)
  - The WPSD Project (Highly Recommended Option!)
  - Read the Playing with Pi-Star notes from Toshen KE0FHS
- Install an SD Card Reader/Writer
  - Win32Disk Imager (Windows)
  - Etcher (Windows and macOS)
  - Others for macOS and Linux
- Write the image to the card
  - A MicroSD card might require a full-size adapter or a USB-connected reader/writer
  - Ignore Windows telling you to format the card
  - Properly “Eject” the card before removal (Etcher does this for you)

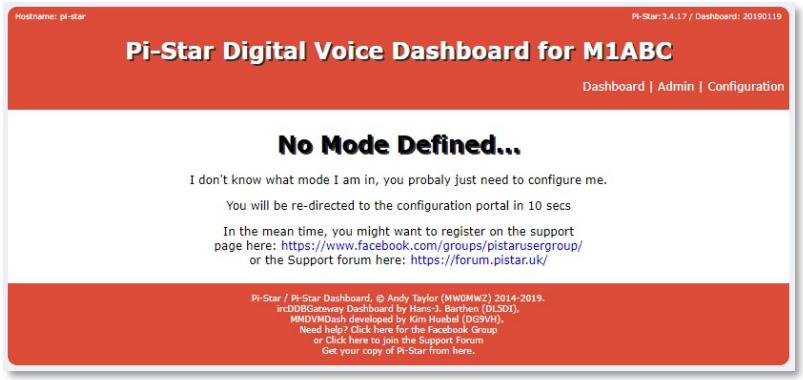
Preparing the Pi for 1st boot!

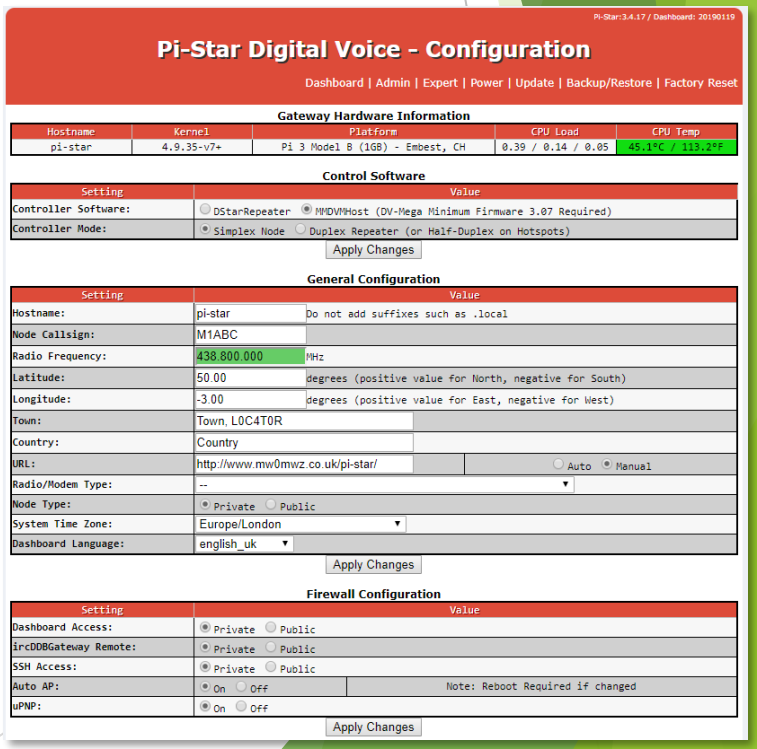
- Preparing for a Wi-Fi connection
  - Run the Pi-Star Wi-Fi Builder utility
  - Enter your Wi-Fi access point name (SSID) and password (PSK)
  - Creates a file called *wpa_supplicant.conf*
  - Copy this file onto your MicroSD card
  - On first boot, your Pi will immediately connect to your Wi-Fi network
- Carefully insert the MicroSD Card
  - One way in!
- Get ready to power things up
  - Suitable power supply? 2.5A or more
  - USB cable from power supply to Pi?
- Go for it!



Configuring Pi-Star for DMR use after 1st boot

- Find the Raspberry Pi on your home network – What IP address?
  - Check your router's DHCP clients list
- Point your PC's web browser at the Pi's IP address (192.168.xxx.xxx) or type http://pi-star.local
  - Success will result in you seeing the No Mode Defined screen (Normal!)





- Move on to setting things up for DMR connectivity

DMR Configuration

- Make the Control Software Selection
  - Choose MMDVH Host
  - Still a Simplex Node

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

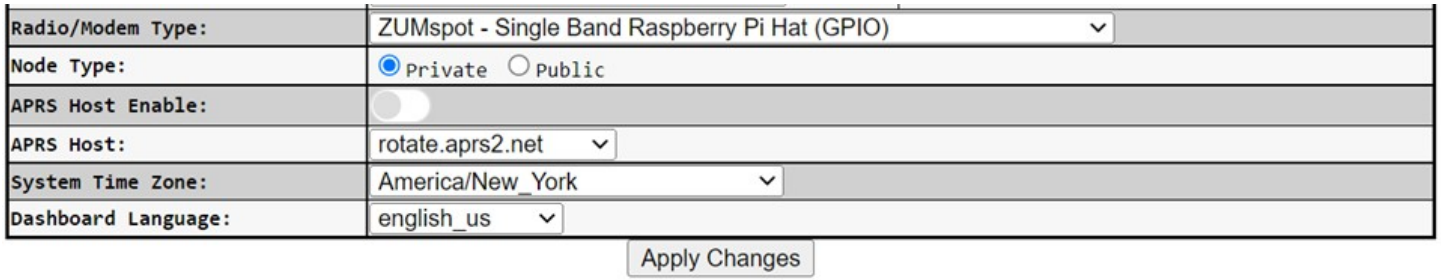
- Move on to General Configuration
  - Enter your Callsign
  - Enter your DMR ID
  - Enter the frequency for your Hotspot
  - Enter the Latitude and Longitude of your station
  - Enter your Town, locator and Country info
  - Select Auto, for callsign lookup, using QRZ

General Configuration

Setting	Value	
Hostname:	pi-star73 Do not add suffixes such as .local	
Node Callsign:	KA9QJT	
CCS7/DMR ID:	3137146	
Radio Frequency:	440.912.500 MHz	
Latitude:	35.897100 degrees (positive value for North, negative for South)	
Longitude:	-78.54960 degrees (positive value for East, negative for West)	
Town:	Raleigh NC	
Country:	USA	
URL:	https://www.qrz.com/db/KA9QJT	◉ Auto ○ Manual

Configuration continues…

- Choose ZUMspot Single Band Raspberry Pi Hat (GPIO) as your Radio/Modem Type
- Decide whether you want your Node Type (Hotspot) to allow Public access (other Hams will be able to us it with their radios) or remain private
- Enable APRS position reporting if interested
- Select the appropriate Timezone and Dashboard language
- Apply the Changes!



MMDVM Host Configuration…

- Turn on DMR Mode
  - Yes, you can use this section to add other modes. (KISS principle applies)
- If your board has a display, pick the MMDVM Display Type
  - OLED Type 3 in this example
- Apply the Changes! (after the reboot, the DMR Configuration settings section will appear)

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

DMR-specific Configuration…

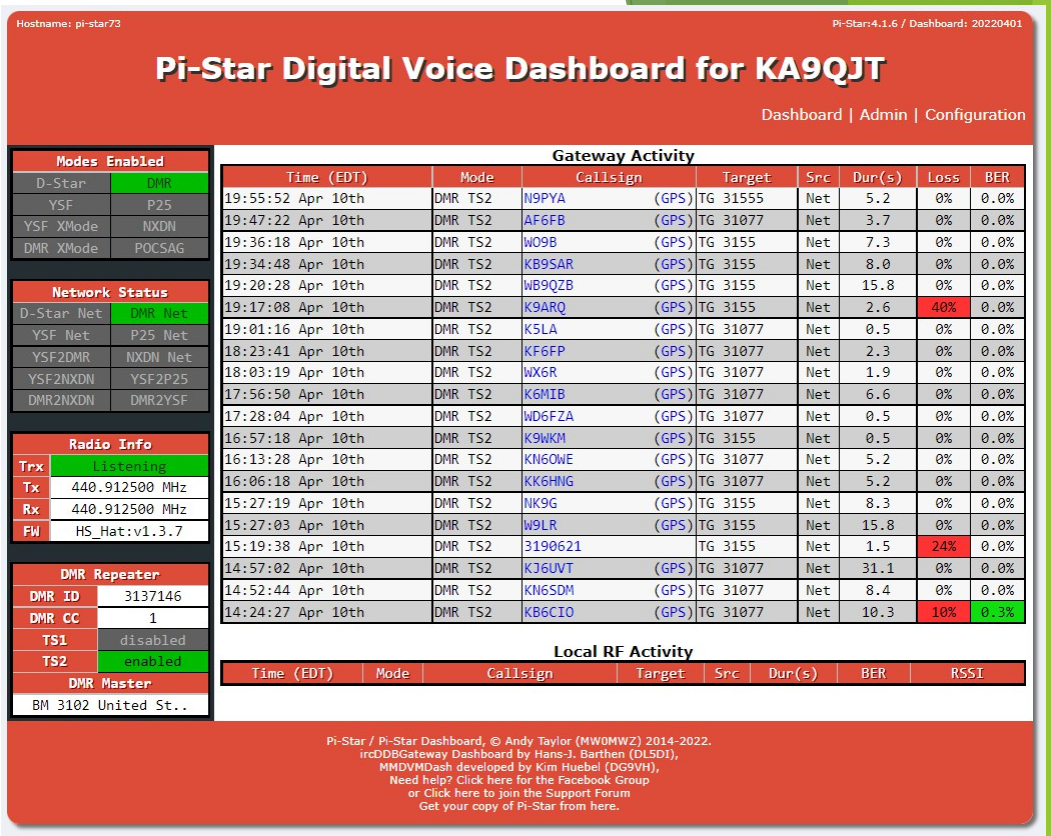
- Select a DMR Master from the list (3102 is a good choice)
- The Brandmeister Network now requires a self-managed password – enter it here (See the article here)
- If you have more than one DMR hotspot, they share your ID, but you can add a suffix to keep them separate (02 in this example)
- Set DMR Color Code to 1
- Turn DumpTAData on – this allows your hotspot to pass "Talker Alias" information to your radio. (i.e., name, callsign, location)
- Apply Changes… again

DMR Configuration

Setting	Value
DMR Master:	BM_3102_United_States
Hotspot Security:	•••••••••
BrandMeister Network:	Repeater Information | Edit Repeater (BrandMeister Selfcare)
DMR ESSID:	3137146 02
DMR Color Code:	1
DMR EmbeddedLCOnly:	
DMR DumpTAData:	

Apply Changes

Using your Hotspot for DMR



- After applying the final changes, the Hotspot will reboot again! Yay!
- Time to check out the Dashboard (same IP address again!)
  - Modes Enabled: DMR should be green
  - Network Status: DMR Net should also be green
  - Radio Info: Listing/Transmitting, your frequency and firmware info
  - DMR “Repeater”: ID, Color Code and Timeslot 2
  - Gateway Activity: Lists callsigns and info related to others heard
  - Local RF Activity: Should show information received from your radio!

Your DMR Radio

- Lots of radio choices
  - Anytone D878 HT and D578 mobile models
  - Retevis RT3S dual band HT with GPS
  - TYT MD-UV380 dual band HT
  - Connect Systems CS800D mobile
- **Build or share a Codeplug**
  - A Codeplug is a file containing the channel information you program into your given radio
  - Download and save the one from your radio (CPS: Customer Programming Software and cable required)
  - Organized by Zones – These are collections of related channels
  - Channels are specific to a frequency, but also link to a given Timeslot (1 or 2) and a Talkgroup
  - Talkgroups and individual user information (contacts) are also kept in the Codeplug
    - Radios display the name and registered location associated with the numerical ID of the radio transmitting
  - You will have multiple channels for each repeater or Hotspot you want to use – 1 per Talkgroup!
  - Is your radio Promiscuous or not?
- Use a Contact Manager program
  - N0GSG DMR Contact Manager
  - Easy to use – allows Codeplug content reuse between different radios
  - Supports importing the most recent user list
    - Newer radios have room for >200K users

OpenDG77 Amateur Radio Firmware for DMR Radios

website

Makes your current DMR radio into a real Ham Radio

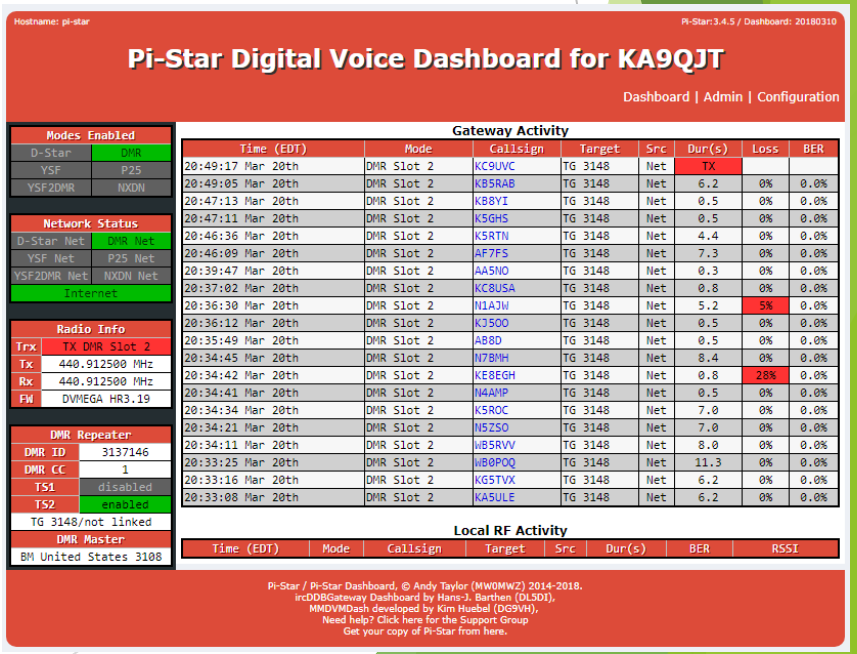
Helpful DMR-related websites

- (Local) NM5SH DMR Repeater Information Page
  - Codeplug and other DMR info and links
- Brandmeister Network
  - Overall Dashboard for the network
  - Create a user account to register and manage your Hotspot (e.g., adding/removing static Talkgroups)
- Brandmeister Hoseline
  - A place to go to listen to audio streams, including your own transmitted audio
- DMR-MARC website
- TGIF Network website
- Miklor DMR Radio website
  - DMR Radio Reviews
  - Codeplug and other DMR info and links
- AmateurRadio.digital
  - Per-radio wizard for DMR Contacts Database downloads
  - $12/yr. Donation

SHIFTING GEARS

Now, a little about D-STAR and YSF options

- Buy a D-STAR or YSF radio and work the local repeaters
- Buy a Hotspot
  - Shark RF openSPOT 4, Zum Radio, etc.
- Setup your own Pi-powered Hotspot for D- STAR, YSF, and of course DMR access
  - Download and use Pi-Star for DMR, D-STAR, YSF, etc.



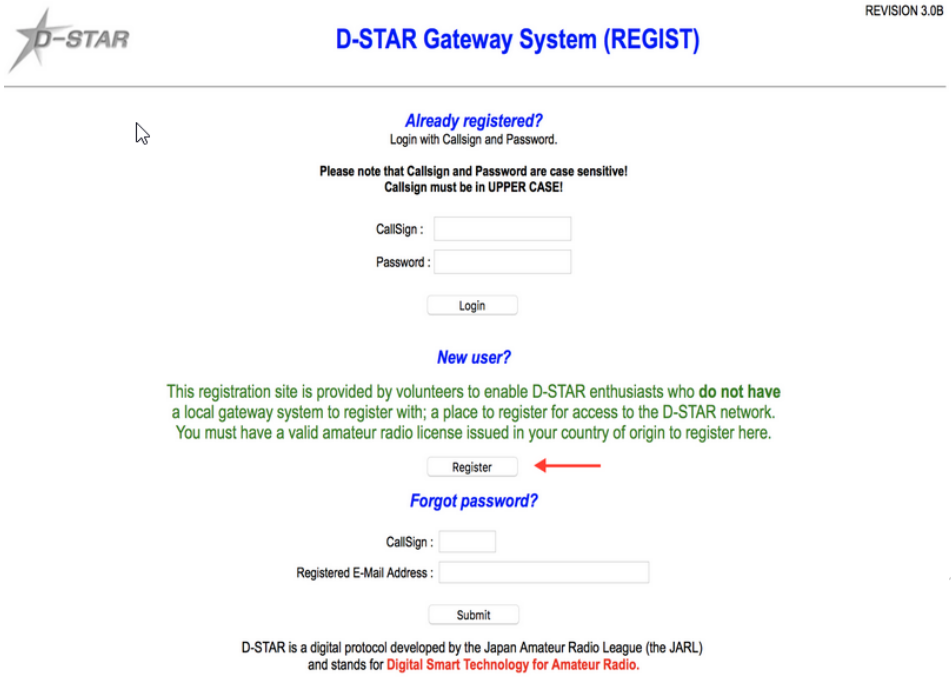
Get Registered!

- In order to be recognized on other D-STAR Repeaters and Reflectors, you must register your callsign

Extremely Important!!

If you have already registered on another gateway, do not submit an additional registration request. You only need to register once on any gateway to be able to use all of the gateways in the G2/ G3 network.

- D-STAR Registration Instructions
- D-STAR Gateway System (REGIST)

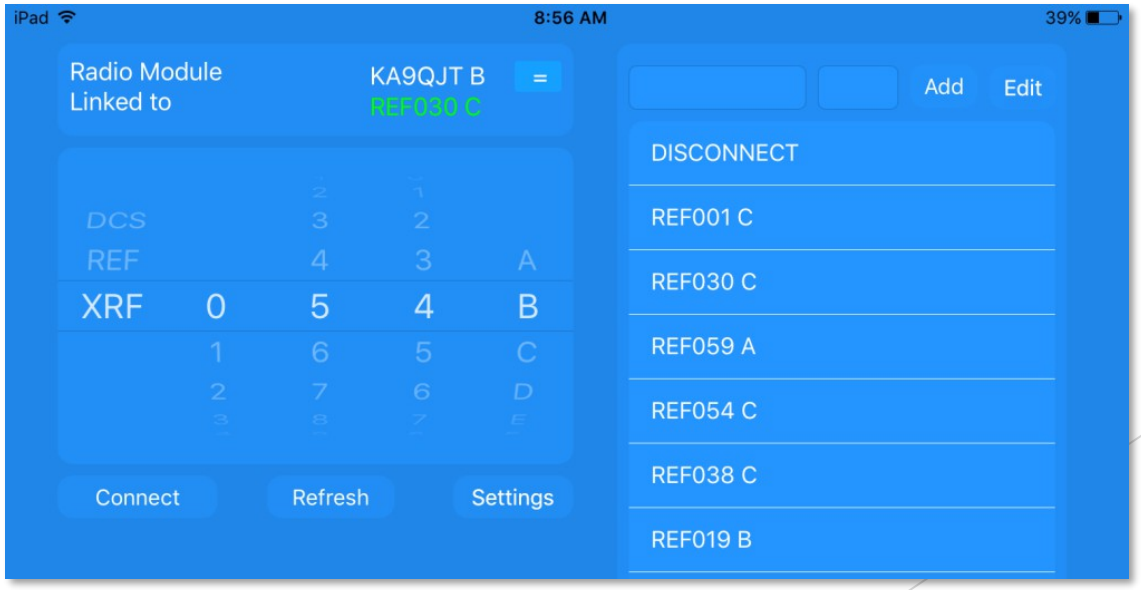


Setting up your D-STAR radio

- To Transmit and Receive using D-STAR:
  - Set *Your Call* to: CQCQCQ
  - Set *My Call* to your FCC assigned callsign
  - Set *RPT1* to your callsign with the corresponding band letter, A, B, C or D in the 8th position [The DVAP was UHF, so B]
    - Add spaces if necessary
  - Set *RPT2* to your callsign (as set in the Gateway Tab) with a G in the 8th position
    - Again, add spaces if necessary
  - Set Operating Frequency to the frequency of your Hotspot
  - Set the Offset to + or -
  - Set the Offset Frequency to 0.000000
    - We're simplex, so the offset frequency must be 0 and the + or - doesn't matter
  - Make sure the mode is set to DV (digital voice)
- Follow Pi-Star and your radio's documentation to configure memories for:
  - Repeater and Reflector selection (spin the dial, key the mic to link)
  - Hotspot Control (Unlink, Status, Echo Test, Restart, Reboot, Shutdown

What else?

- Remote Control your D-STAR Hotspot
  - Use your browser and the Pi-Star Admin web page to make Reflector selection
- (Easier) Use ircddb Remote app on your Android or iOS device
  - Select Reflectors on your hotspot(s)
  - Must be on the same Wi-Fi network as your Hotspot
  - Remote access is password-controlled (must match Remote Password)

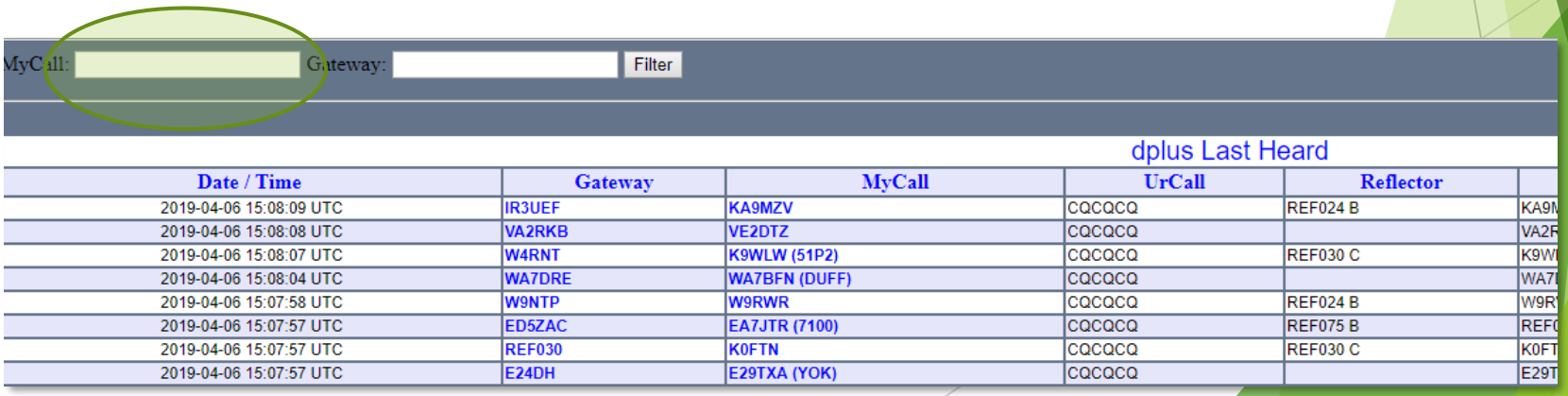


Helpful D-STAR-related websites


D-STARusers.org
Your Source for D-Star DIGITAL Information!
Current Time is 04/6/2019 21:14:35 UTC [Click here to disable refresh]

Callsign	Time Heard	Reporting Node	376 Unique callsigns heard in the last hour
WN4SFC	04/06/19 15:06:02 UTC	REF030 B 440 MHz DVD	Lawrenceville, GA, USA
W9RWR	04/06/19 15:06:02 UTC	REF024 B 440 MHz DVD	Owosso, MI, USA
K4JCB	04/06/19 15:05:57 UTC	REF030 C 2 Meters DVD	Lawrenceville, GA, USA
WA7BFN	04/06/19 15:05:55 UTC	WA7DRE B 440 MHz	Spokane, WA, USA
PC2EBE	04/06/19 15:05:52 UTC	REF001 C 2 Meters DVD	USA
WA8YXM	04/06/19 15:05:49 UTC	WD4EOG B 440 MHz	Clemson, SC, USA
KI7LWQ D	04/06/19 15:05:47 UTC	REF030 Dongle User DVD	Lawrenceville, GA, USA
KC2WSZ	04/06/19 15:05:42 UTC	REF030 Dongle User DVD	Lawrenceville, GA, USA
N1AEW	04/06/19 15:05:42 UTC	REF059 A 1.2GHz DVD	Unknown

- D-STAR Info
  - Repeater and Reflector List
- D-STAR Users Last Heard List
- DPLUS Reflector Dashboards
  - Access to who is currently connected, and who was last heard
  - Example: REF055
- D-STAR Dplus (REF) Last Heard List by NJ6N


MyCall: Gateway: Filter

dplus Last Heard

Date / Time	Gateway	MyCall	UrCall	Reflector	
2019-04-06 15:08:09 UTC	IR3UEF	KA9MZV	CQCQCQ	REF024 B	KA9M
2019-04-06 15:08:08 UTC	VA2RKB	VE2DTZ	CQCQCQ		VA2R
2019-04-06 15:08:07 UTC	W4RNT	K9WLW (51P2)	CQCQCQ	REF030 C	K9WL
2019-04-06 15:08:04 UTC	WA7DRE	WA7BFN (DUFF)	CQCQCQ		WA7B
2019-04-06 15:07:58 UTC	W9NTP	W9RWR	CQCQCQ	REF024 B	W9RW
2019-04-06 15:07:57 UTC	ED5ZAC	EA7JTR (7100)	CQCQCQ	REF075 B	REF0
2019-04-06 15:07:57 UTC	REF030	K0FTN	CQCQCQ	REF030 C	K0FT
2019-04-06 15:07:57 UTC	E24DH	E29TXA (YOK)	CQCQCQ		E29T

SHIFTING GEARS

Learnings

- Backup your MicroSD Card or Copy it to a 2nd card
  - They will fail!
  - See below
- Mind your power supply
  - Don't use a low-Amperage power supply for your Raspberry Pi
    - 2.5 Amp or greater, especially if you're also powering a "hat", or something connected via USB
  - Don't(!) just turn off the power – Properly shutdown your Pi!
- USB Cables are not created equally
  - Use higher quality/shielded cables
  - Keep lengths short
- Power matters
  - Don't overload your hotspot with unnecessary RF power from your HT or Mobile (lowest power!)
- Good Etiquette: Pause between transmissions
  - Gives others time to disconnect from a Reflector/Talkgroup/Room if they need to from their radio
  - Also gives other stations a chance to make their presence known (quick key, or verbal)
  - Take ragchewing off a busy Reflector, Talkgroup or Room
  - Turn your radio's beacon feature off
  - Never try to run two hotspots on the same frequency!

Avoiding digital audio frustration

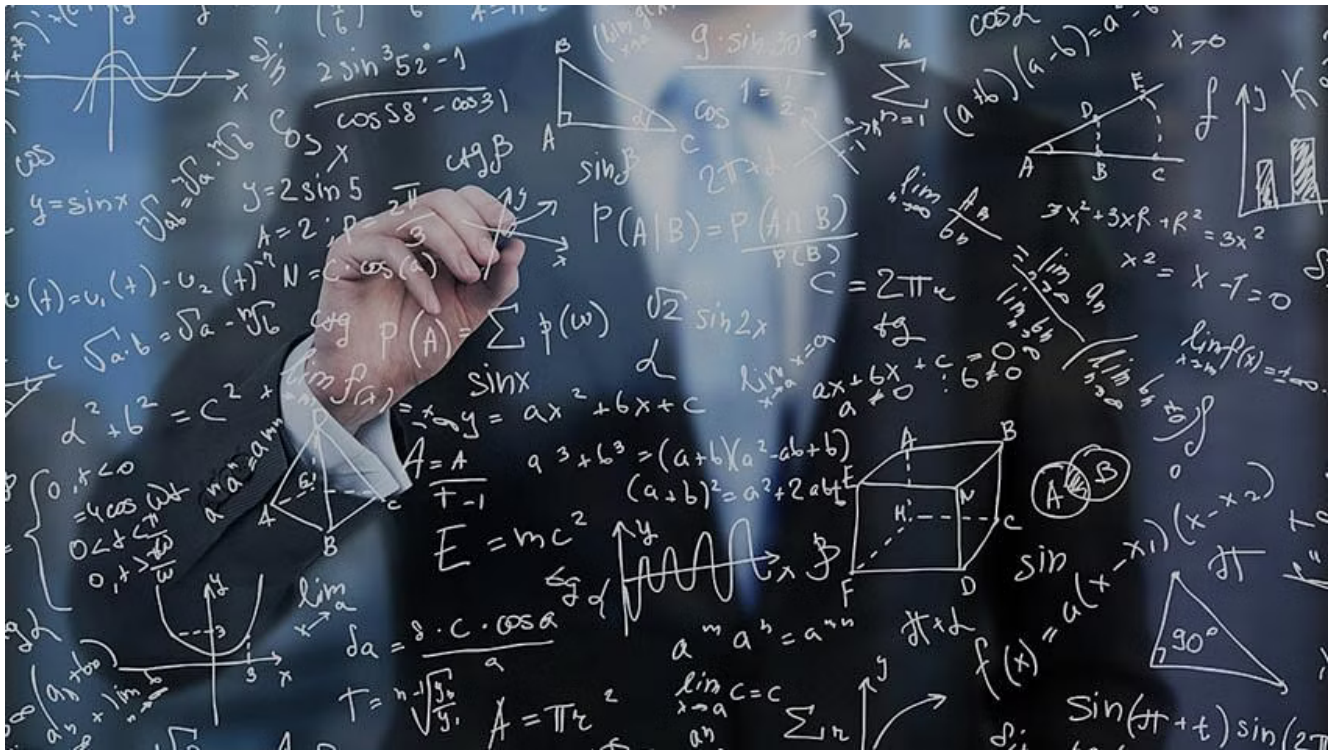
- Trouble hearing someone, or being heard?
  - The internet on your end, their end, or both ends affects success
    - 100% copy on both sides, occasional drop-outs - “R2D2” (High Bit Error rates)
  - The same goes for repeater-based digital transmissions
  - If you’re being told by someone that they didn’t copy everything you said, don’t assume the problem is on your end (or on the other guy’s end).
  - Ask for a 3rd party’s opinion of the situation
    - Lots of people monitor the D-Star Reflectors, DMR Talkgroups and YSF rooms
    - They’re more than willing to tell you what they heard (everyone has an opinion)
  - Test things out by listening to yourself
    - Echo Test for D-STAR, Parrot for DMR, etc.
  - If you’re using a PC and USB dongle like the ThumbDV, your PC is in charge of your “transmit” audio level
    - Test, get some feedback, remember the settings that work best (Windows might play games with your settings)

Portable Operation

- You'll need a reliable source of power
  - Must be constant vs. ignition switch-controlled
  - Remember that it's important to avoid just pulling the plug on a Raspberry Pi
  - "Shutdown" properly, then remove power
  - USB battery packs work well
    - "Pass-through" feature is important (harder to find)

- Wi-Fi on the road
  - Personal "MiFi" device, or another Cellular-based Wi-Fi hotspot
  - Your Cellphone in "Personal Hotspot" mode
    - No punctuation in the SSID!
  - Your D-STAR/DMR/YSF hotspot just needs to be configured to point at this new Wi-Fi source
  - Pi-Star allows you to add more than one Wi-Fi configuration

Questions?



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