

A Comparison of Amateur Radio Digital Voice Systems

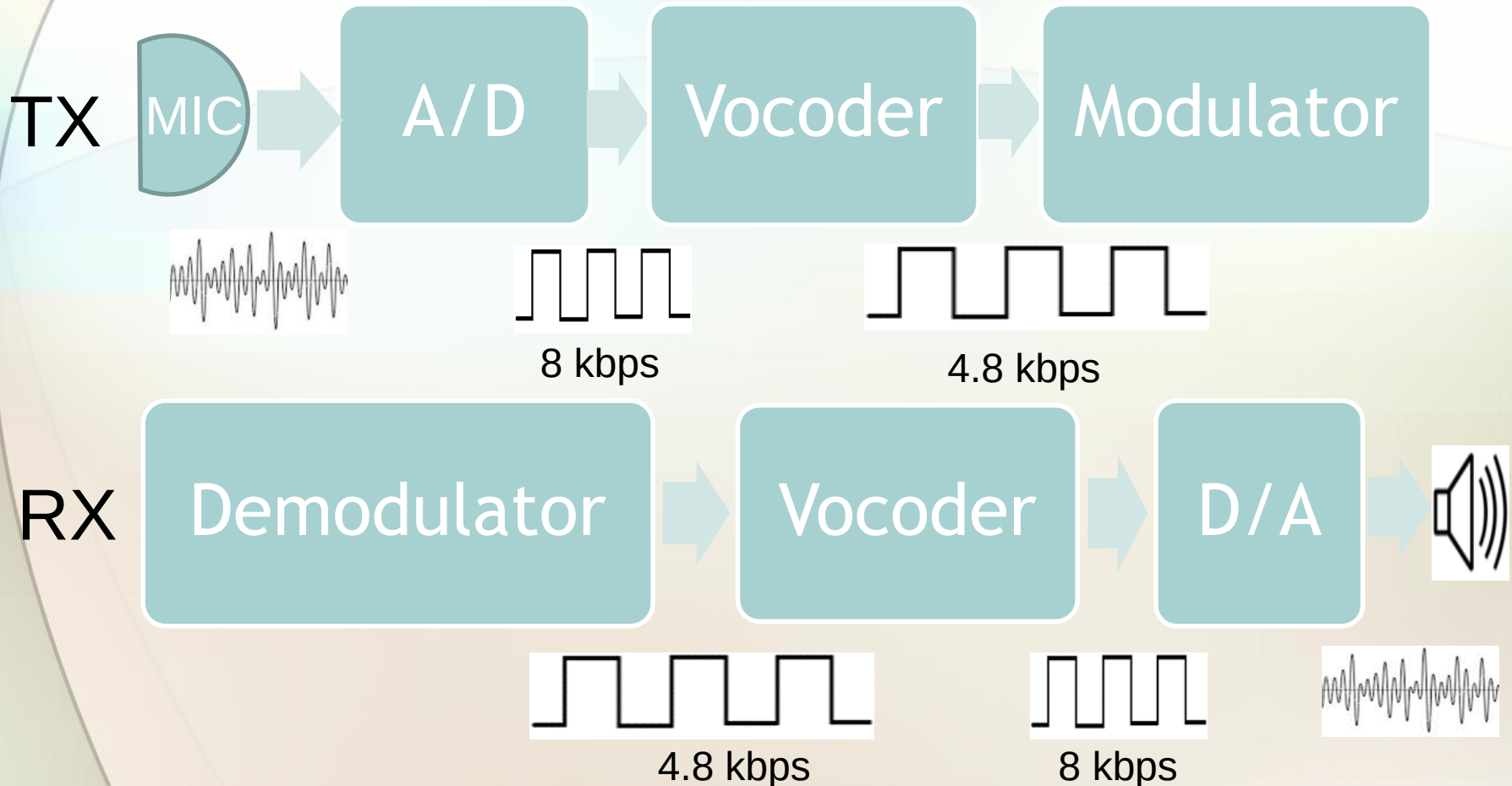


presented to
Randolph Amateur Radio Club
November 22, 2016
by Roland Kraatz W9HPX
Charlotte Digital Radio Group

Topics

- Digital Voice - what it is
- Compare three main modes
- Radio choices
- Experimentation
- Software
- Questions

What is Digital Voice?



The encoded data is sent in packets as the payload.

Technical Comparison

	D-STAR	DMR	Fusion
Vocoder (see note)	AMBE+	AMBE+2	AMBE+2
Modulation	GMSK	4FSK	C4FM
Multiplex Method	FDMA	TDMA	FDMA
Bit 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

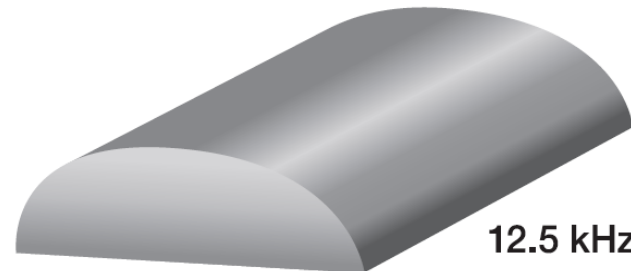
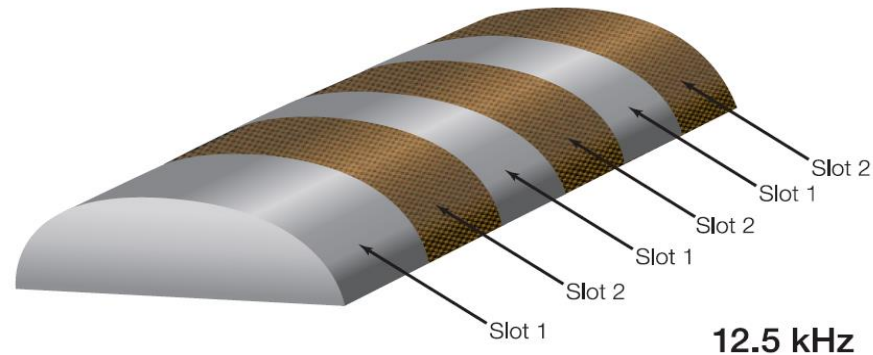
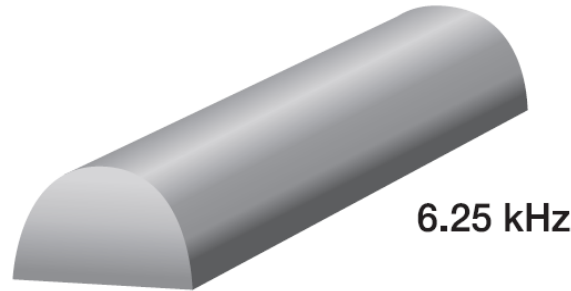
C4FM = Continuous 4-level Frequency Modulation

FDMA = Frequency Division Multiple Access

TDMA = Time Division Multiple Access

Note: AMBE is a product of Digital Voice Systems, Inc.

Bandwidth Pictorial Comparison



User ID Features

	D-STAR	DMR	Fusion
Registration required?	Yes	Yes	No
User ID in the header	Call sign	Subscriber ID	Call sign
Display on the radio	Call sign	Subscriber ID*	Call sign
Other displayed items	4 character suffix 20 characters text	None	Distance from station
Adequate for FCC ID?	Yes†	No	Yes†

* Call sign displayed if the receiving station's subscriber ID is in the radio's contact list; otherwise subscriber ID appears.

† ID by voice is still a good habit to keep.

Repeater Connectivity

	D-STAR	DMR	Fusion
Talk locally	Yes	Yes	Yes
Link to another repeater	Yes*	No	No
Multi-repeater connection	Reflector	TG / Reflector◇	WIRES-X Room
Selection method	UR entry	Programmed Channel	Room Name or Number
Route to another ham	Yes - CSR	No	Yes†

* Usually discouraged due to limited internet bandwidth at most repeaters. Sometimes blocked by the repeater administrator.

◇ “Talk Group” and “Reflector” are used interchangeably in different parts of the world.

† Only if the called station has a WIRES-X node.

Networking Features

- D-STAR
 - User control - substantial, if allowed by the repeater admin
 - Networking options - G2, D-Plus, ircDDB, XLX, others
 - Innovation - many ham accomplishments and ongoing work
- DMR
 - User control - limited by repeater admin but opening up
 - Networking options - c-bridge, Hytera, Brandmeister
 - Innovation - only on Hytera & DMR+; not on MotoTrbo
- Fusion
 - User control - substantial
 - Networking options - WIRES-X (Yaesu), reflectors
 - Innovation - hams are creating their own reflectors

Signal Quality

These ratings are the author's.
Your opinion may differ.

	FM	D-STAR	DMR	Fusion
Voice naturalness	Best	Good	Good	Narrow - Good Wide - Very Good
Noise	Varies	None	None	None
Weak signal sync capture	N/A	Fair	Good	Good
Re-sync speed	N/A	Poor	Excellent	Excellent

D-STAR HT's



ICOM ID-51A+

- 2M, 70 cm
- 5W
- 1300 memories
- Pre-programmed
- Internal GPS
- DPRS reporting
- Repeater geo search
- uSD card storage & record
- \$360



KENWOOD TH-D74A

- 2M, 1.25M, 70cm
- 5W
- Color TFT display
- 1100 memories
- Internal GPS
- Bluetooth
- APRS
- Keypad
- uSD storage & record
- \$650



D-STAR Mobile

ID-5100A

- 2M & 70 cm
- Touch Screen
- 50W
- 1000 + 1500 DR memories
- Pre-programmed
- Internal GPS
- DPRS
- Repeater geo search
- SD card storage & recording
- \$490



ID-880H (older mobile radio)

- 2M & 70 cm
- 50W
- 1000 memories
- \$240

DMR HT's



Motorola - XPR-7550

- 70 cm
- 4W
- Color screen
- 1000 memories
- Keypad
- \$700



Tytera MD-380

- 70 cm
- 4W
- Color screen
- 1000 memories
- Keypad
- \$120



DMR Mobile's



MotoTrbo - XPR-5550

- 70 cm
- 40W
- 1000 channels
- Color screen
- \$600



Hytera - MD782G-U1

- 70 cm
- 45W
- 1024 channels
- Color screen
- \$530

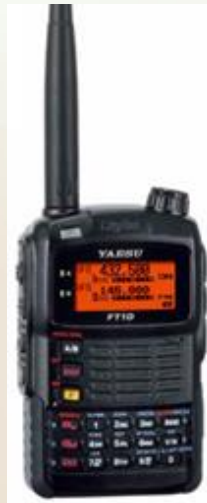


System Fusion HT's



Yaesu - FT-1XDR

- 2M, 70 cm
- 5W
- Automatic Mode Select
- WIRES-X digital mode
- 1266 memories
- GPS & APRS
- Keypad
- \$280 new



Yaesu - FT-2DR

- 2M, 70 cm
- 5W
- Automatic Mode Select
- WIRES-X digital mode
- 1245 memories
- GPS & APRS
- Touch screen
- \$340 new



System Fusion Mobile



Yaesu - FTM-400XDR

- 2M & 70 cm
- 50W
- Color Touch screen
- Automatic Mode Select
- WIRES-X digital mode
- 1000 memories
- GPS & APRS
- \$500



Yaesu - FTM-100DR

- 2M & 70 cm
- 50W
- Automatic Mode Select
- WIRES-X digital mode
- 1000 memories
- GPS & APRS
- \$300



Base Stations - (all in ones)

ICOM - IC-7100



- HF + 6M - 100W
- 2M - 50W, 70 cm - 35W
- Touch screen
- GPS & DPRS
- Repeater geo search
- 1600 memories
- \$870



Yaesu - FT-991



- HF + 6M - 100W
- 2M, 70 cm - 50W
- Color TFT touch display
- Automatic antenna tuner
- Automatic Mode Select
- WIRES-X digital mode
- GPS & APRS
- 1000 memories
- \$900



FT-991A - \$1480

All Mode Mobile

Wireless Holdings, LLC

DV4mobile

- Software defined radio
- 2M, 1.25M & 70 cm
- D-STAR, DMR, C4FM, P25
- 2 x 20W simultaneously
- RJ45 Ethernet port
- USB port
- LTE modem
- Internet programmable
- GPS & APRS reporting
- ~ \$1,200
- Available 2017?



Experimentation

In true Ham spirit, individuals and groups have taken DV technology to new levels by experimenting and developing new hardware, software and systems

- Much previous work has made D-STAR smarter
 - D-Plus linking system and reflectors
 - X-reflectors and DCS reflectors
 - Modems, dongles and access points
 - Support software such as D-RATS and WinDV
- Current work:
 - Other DV modes are being incorporated
 - Bridging between DV modes

Dongles

- Used to get on the DV network
- No radio needed
- Great for travel
- Low cost



Device	Manufacturer	Supports	Vocoder	Connects to	Price
DV Dongle	Internet Labs	D-STAR	AMBE-2000	USB	185
DV 3K	Internet Labs	D-STAR	AMBE-3000	USB	145
PiDV	Northwest Dig	D-STAR	AMBE-3000	RaspPi GPIO	100
ThumbDV	Northwest Dig	D-STAR	AMBE-3000	USB	120

Access point (hotspot)

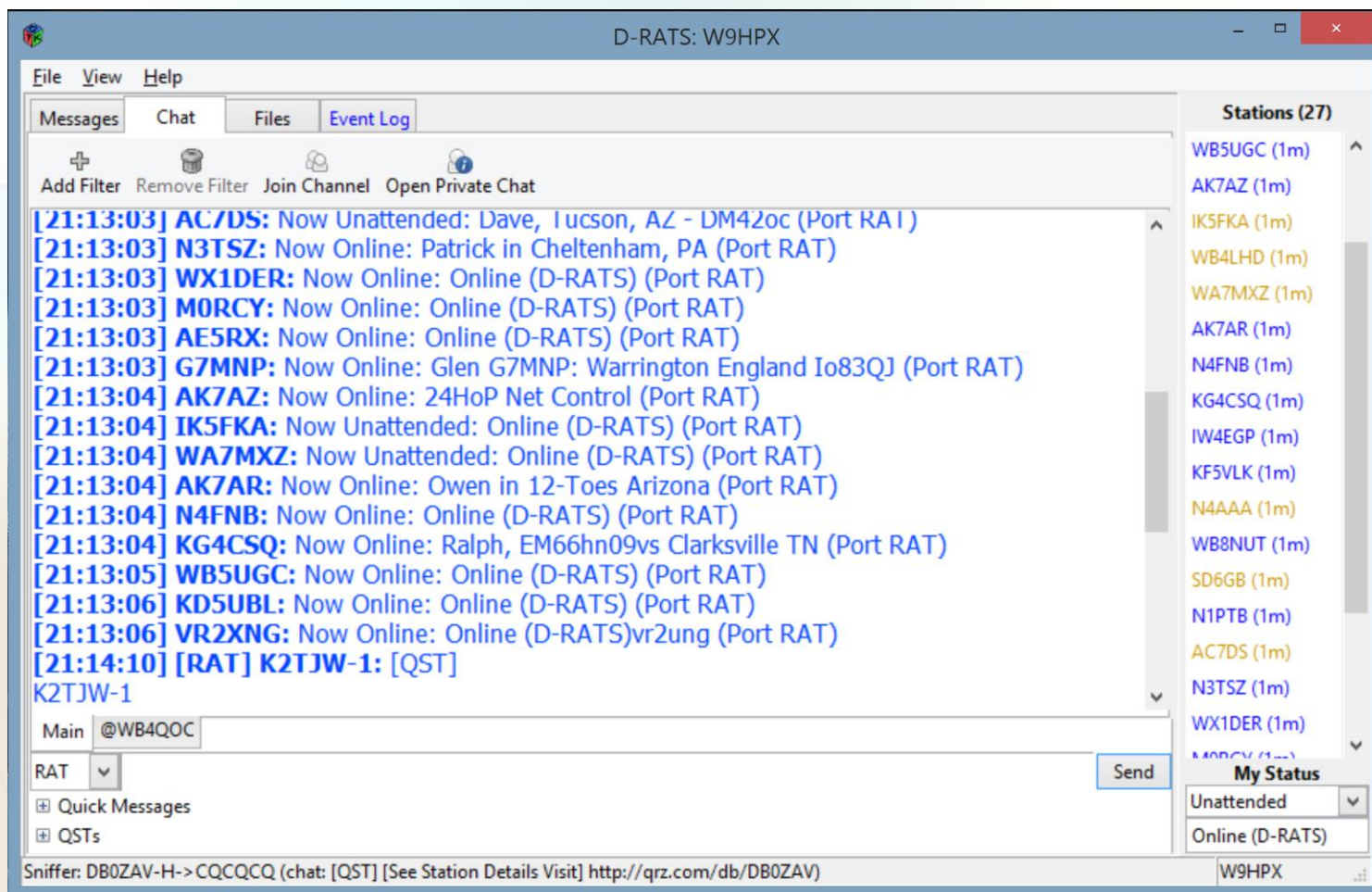
- Your own simplex repeater
- Radio(s) required - one for each mode



Device	Manufacturer	Supports	Connects to	Price
DVAP -2M	Internet Labs	D-STAR	USB	185
DVAP -70cm	Internet Labs	D-STAR	USB	145
DV MEGA -70cm	Dooren Elect.	D-STAR+DMR+YSF	RaspPi GPIO	130
DV MEGA -dual	Dooren Elect.	D-STAR+DMR+YSF	Arduino UNO	125
DV MEGA -dual	Dooren Elect.	D-STAR+DMR+YSF	RaspPi GPIO	170
DV4Mini -2M	Wireless Holdings	All	USB	149
DV4Mini -70cm	Wireless Holdings	All	USB	129
openSPOT	Shark RF	D-STAR+DMR+YSF	standalone	228



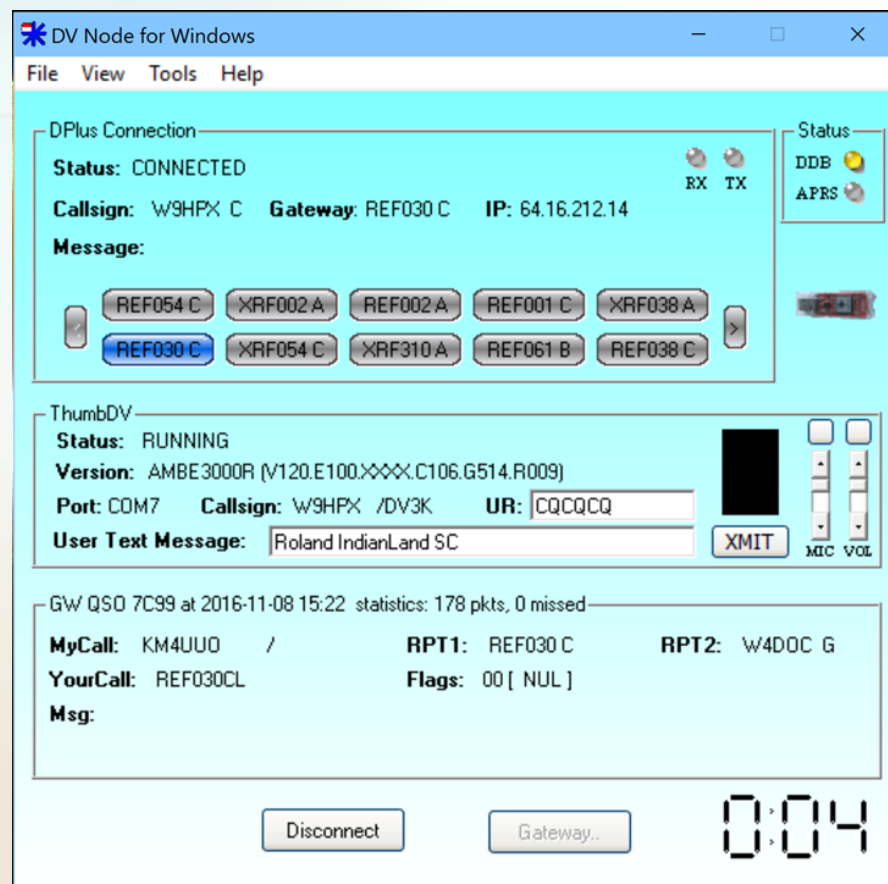
D-RATS by Dan Smith KK4DS



Download from <http://www.d-rats.com/download/tmp/>

WinDV by Fred van Kempen PA4YBR

- Only for Windows
- Only for D-STAR
- Supports
 - DV dongle
 - DVAP
 - ThumbDV
 - DVRPTR modem
 - Node adapter



Download from <http://www.dutch-star.eu/products/windv/>
Must create an account and log in to download.

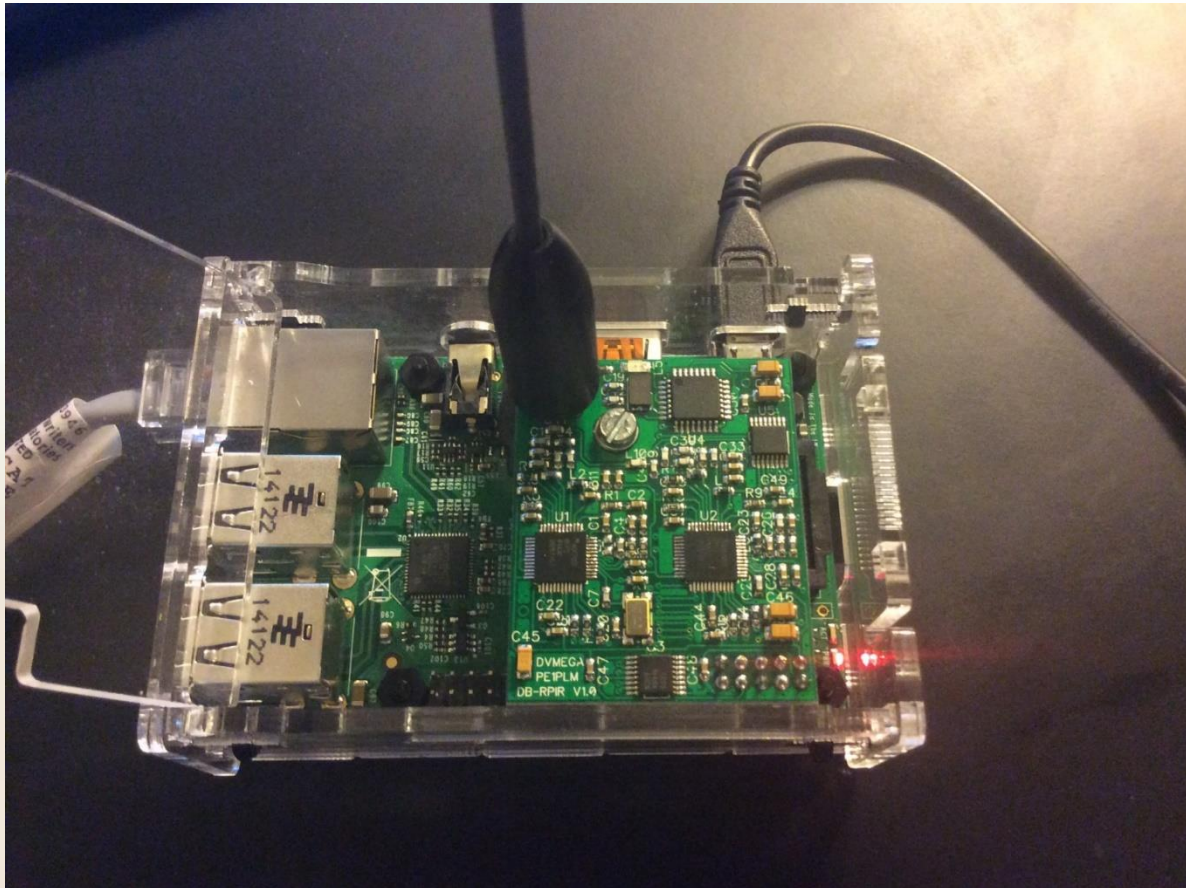
Current Active Experimentation

- Multi-mode hotspots with auto-mode select
 - DVMega / Raspberry Pi running G4KLX MMDVMHost software making a 3 mode hotspot
- Multi-mode repeater with auto-mode select
 - KI6ZUM v2 board on Arduino DUE / Raspberry Pi running G4KLX MMDVM software making a 4 mode hotspot or repeater
 - DR-1X Yaesu System Fusion repeater / UDRC on a Raspberry Pi running G4KLX D-STAR software making a 3 mode repeater

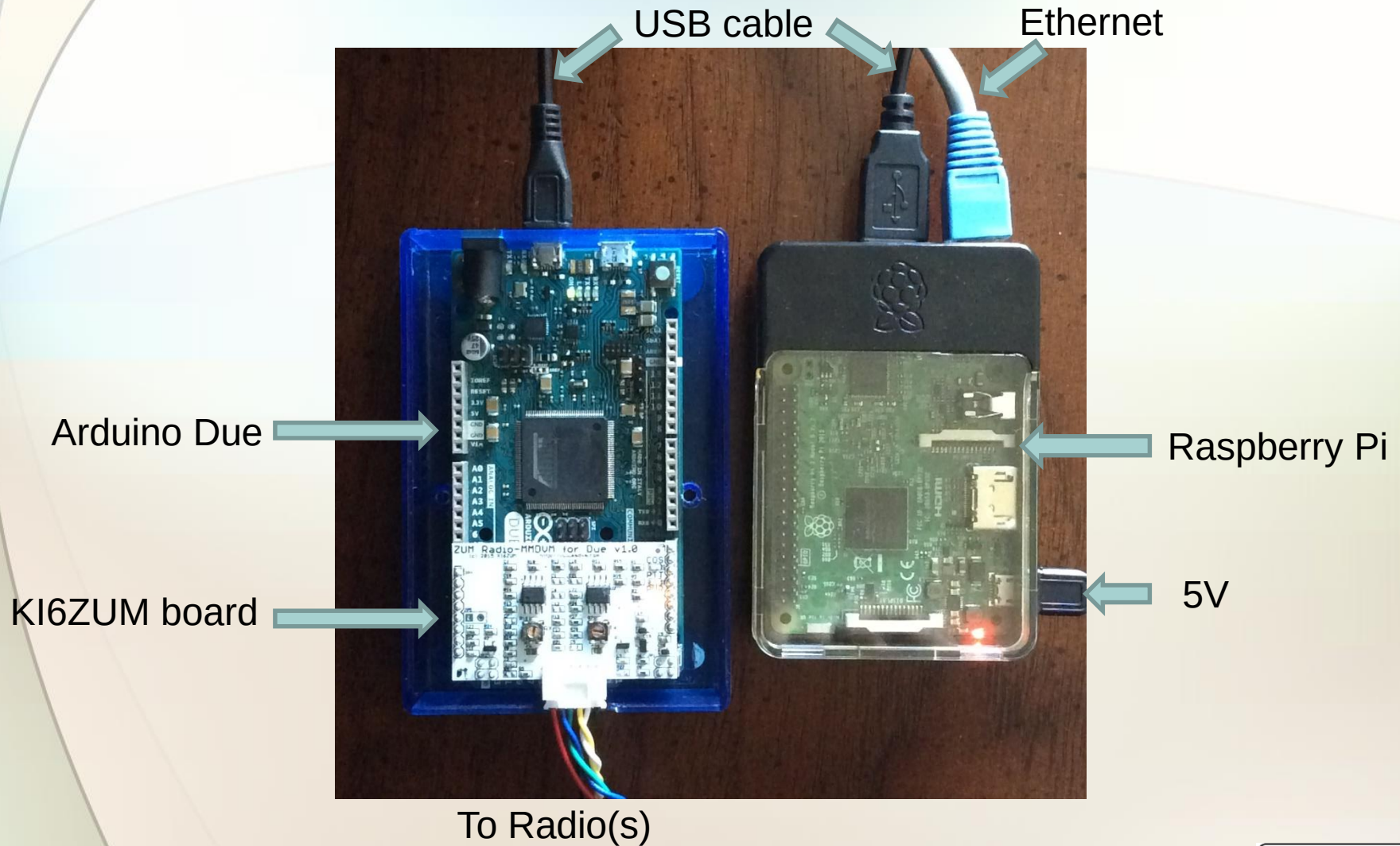


DVMega / Raspberry Pi Access Point

D-STAR, DMR, and System Fusion



Multi-Mode Digital Voice Modem



DVMega/BlueStack/BlueDV

- BlueDV software runs on Android phone. (There is also a Windows version.)
- Connect BlueStack via Bluetooth or USB
- Access internet via 4G, 3G or WiFi
- Makes great compact mobile access point



Information on the Internet

- www.charlottedstar.org – This is our site. Use Quick Registration to register for D-STAR if you live in the Carolinas.
- groups.yahoo.com/neo/groups/clt-dstar/info – This is our Yahoo group. Please join. There are many more Yahoo groups for D-STAR, Fusion, WIRES-X, DMR, mmdvm, and even for specific radios. Just search for them.
- www.dstar101.com – good beginner's site to learn about D-STAR.
- www.dstarinfo.com – download repeater lists for D-STAR radios to import into your radio.
- www.dstarusers.org – D-STAR repeater directory
- www.maryland-dstar.org – for Raspberry Pi D-STAR hotspot image
- kdj.metro-uhf.org/dvap/ - easy to use command line Raspberry Pi image for D-STAR and DMR with good instructions
- www.ncprn.net – Web site for our area DMR repeaters. Area code plugs for many radios available for download.
- www.dmr-marc.net – Register for DMR here for free.
- hose.brandmeister.network – live worldwide DMR activity
- www.trbo.org/docs/Amateur_Radio_Guide_to_DMR.pdf – Basic guide.
- https://www.brandmeister.us/files/US_BM_User_Guide.pdf - Explains Brandmeister talk groups.
- www.hamoperator.com – good site to learn about System Fusion and WIRES-X. Look for the WIRES-X bible under Fusion Help.

Questions?