



D-STAR InfoCon 2014 at SARTS

Intro to D-STAR

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What is D-STAR?



- D-STAR is an open standard for digital voice and data on Amateur Radio
- One of several digital modes in Amateur Radio
- Developed by Japan Amateur Radio League (JARL)
- Uses AMBE vocoder chip from DVSI
- Icom is first manufacturer with base, mobile, handhelds and repeater equipment
- Connect Systems planning D-STAR handheld for 2014
- Other vendors offering other products



How does D-STAR work?



- Voice is converted to digital modulation and transmitted at 4800 bps
 - 2400 bits for voice
 - 1200 bits for Forward Error Correction on voice
 - 1200 bits for data (error correction usually in applications)
- True narrowband digital signal
 - Voice and data occupy one 6.25 KHz signal (versus 12.5 KHz FM voice, P25 and MotoTRBO)
- Can operate simplex, repeater or linked to other repeater(s)



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What can D-STAR Do?



- Transmit or receive voice and 1200 baud data simultaneously on 2m, 440 and 1.2 GHz (no TNC required)
- 128 Kb data transmission on 1.2 GHz with Internet connectivity (Ethernet bridge to Internet with IP address)
- D-PRS (digital APRS) automatic position reporting simultaneous with voice with GPS
- D*Rats, D*Chat message passing and file transfer etc.
- Flexible repeater linking with Gateway and Internet connection
- Reflectors act as conference bridge for linking multiple repeaters (60+ DPLUS Reflectors now in operation worldwide)
- DV Dongle, DV Access Point (DVAP) and DV Node Adapters allow voice and data access to D-STAR via Internet connection (similar to EchoLink)



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D-STAR Equipment



- D-STAR radios (mobiles, handhels, repeaters) commercially produced by ICOM
- D-STAR handheld by Connect Systems available in late 2014
- DV Dongle is non-radio device allowing access to repeaters and reflectors via Internet (similar to EchoLink)
- DV Access Point (DVAP) creates low power hotspot via Internet
- Node Adapters converts FM transceiver to D-STAR hotspot via Internet

Icom Radios



- Offers line of mobiles, handhelds and repeaters
- Most radios are dual band (2m, 70cm)
 - ID-31A is 70cm only
 - ID-1 is 23cm only, allows high speed data
- All radios operate standard FM and D-STAR digital modes
- All Icom radios have built-in serial port for data transmission
- All offer GPS as built-in, a part of speaker/mic or connection via serial or USB port



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Icom Mobiles

- IC-2200 and ID-800 were initial mobiles
 - D-STAR board can be added to IC-2200
- ID-880 updated ID-800 with improved user functions
 - Dual-band, single receive mobile
- IC-2820 is full featured mobile
 - Dual-band, dual receive
 - Built-in GPS with external antenna
- New ID-5100 mobile offers new features
 - Dual-Band, dual receive
 - GPS built into head unit
 - Touchscreen display
 - Optional Bluetooth interface
 - DR Mode with 1200 included memories



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Icom Handhelds

- IC-91AD was initial D-STAR handheld
 - Dual-band, dual receive
- IC-92AD dual-band, dual receive
 - Slightly larger frame with more heat sink
 - Waterproof
 - GPS spkr/mic optional accessory
- IC-80 introduced as lower cost handheld
 - Dual-band, single receive
 - GPS spkr/mic accessory available
- ID-31A is 70cm handheld
 - Waterproof
 - SD card for memory storage, update memory from download
 - Built-in GPS
 - User friendly DR Mode, locate closest repeater
- ID-51A is latest dual band handheld
 - All features of ID-31A, but dual band, dual receive



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ID-1 for 1.2 GHz Voice and Data

- Operates FM, Digital Voice (DV), low speed data and high speed data (DV)
- High speed data connection is Ethernet compatible
- Acts as Ethernet bridge



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DV Dongle

- Produced by Internet Labs, available at major ham dealers
- Provides access to D-STAR repeaters via PC without radio
- Small module connects to PC via USB
- Uses PC sound card for mic/speaker audio
- Windows software runs efficiently on PCs, Netbooks, Windows tablet
- Coming to Android tablets, smartphones
- Java-based software for Mac, Linux
- Connect to repeaters, reflectors, send data, view history.



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DV Access Point

- Produced by Internet Labs, available at major ham dealers
- Creates instant local access point for limited area without D-STAR repeater
- Connects to PC via USB
- Includes 10mw 2m transceiver and stubby antenna
- Use HT, other D-STAR radio nearby for full network access without local repeater
- Windows software module for configuration and operation



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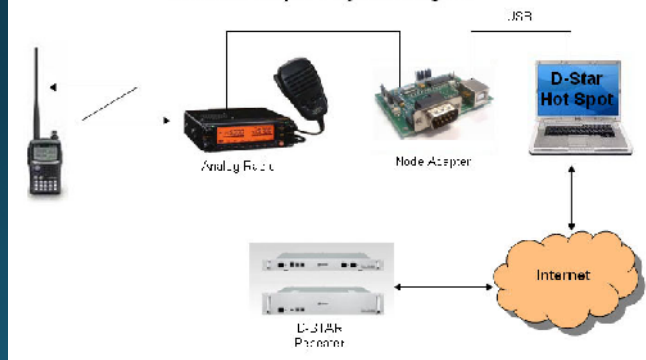
DV Node Adapters/GMSK Modems



- Provides D-STAR interface to FM radio
- Can be used to create hotspot or repeater
- Can create D-STAR compatible radio with Dongle

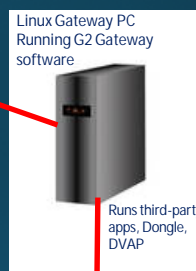


D-STAR Hot Spot - System Diagram

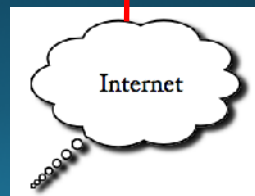


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D-STAR Repeater Architecture



Runs third-party apps, Dongle, DVAP



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Getting on the Air



- **FM Repeater**
 - Mode - FM
 - Frequency
 - Offset
 - CTCSS / TSQ
 - Tone frequency
- **D-STAR Repeater**
 - Mode - DV
 - Frequency
 - Offset
 - UR
 - RPT1
 - RPT2



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The Registration Process



- Why register?
- Registering your callsign allows access to more functions (callsign routing, linking)
- Register on your local or the closest system
- Register on **one and only one** system (local registration syncs with all systems throughout world)
- Registration is a three-step process (*all three steps must be completed*)



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Starting Registration

Step 1 – Browse to desired system and register as new user
(<https://callsign.dstargateway.org/Dstar.do>)




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Fill Out Your Info

- Fill out the info (callsign, name, email address and desired password)



Step 2 – System administrator must approve your initial registration. *You may need to send email to admin.*



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Add a Terminal

Step 3 – Add at least one terminal with a space in first word under Initial, then type a pc-name (lower case, e.g. wb4qdx-dstar)



Terminal ID	Initial	PC Name	Status
1	WB4QDX H	wb4qdx-h	OK
2	WB4QDX H	wb4qdx-h	OK
3	WB4QDX H	wb4qdx-h	OK
4	WB4QDX H	wb4qdx-h	OK
5	WB4QDX H	wb4qdx-h	OK
6	WB4QDX H	wb4qdx-h	OK
7	WB4QDX H	wb4qdx-h	OK
8	WB4QDX H	wb4qdx-h	OK

Note: You only need one terminal, a "space" for use. Adding more terminals can add confusion

Add Your Callsign to Radio



- For a radio, program your callsign (caps, no spaces) in MYCALL or MY field
 - Found in Menu under MY STATION in newer radios
- For a DVAP, DV Dongle or Hotspot, program call in callsign field exactly as entered in registration terminal
- Get on and talk!

The Big Three



- **MY** or **MYCALL** is your own callsign and is set once in radio
- **UR** or **URCALL**: Where do I want to go?
- **RPT1**: The repeater and module I am transmitting to (ex. KJ4GGV C)
- **RPT2**: Where I want my transmission to go (normally to "G", the Gateway)
 - *NOTE: It's a good practice to put the callsign and "G" in RPT2 even if talking local so other linked repeaters, DV Dongles and DV Access Points can hear your transmissions*



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RPT1, RPT2 Format



- Normal format (xxnxxx m)
 - Callsign is left justified
 - Module is always in 8th position
 - C=VHF
 - B=UHF
 - A=1.2 GHz
- Examples (" " represents a space)
 - WD4STR▪C
 - W4DOC▪▪C
 - W4GR▪▪▪C



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DPLUS adds functions



- *DPLUS is a program developed by Robin Cutshaw, AA4RC, which adds linking functions and the use of DV Dongles, DV Access Points and Hotspots to D-STAR. DPLUS is active on most gateway-equipped repeaters.*
- Characters used with DPLUS
 - G – Gateway
 - E - Echo Test
 - I – Identification
 - L – Link Repeater
 - U – Unlink Repeater

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Basic QSO



- Sample for KJ4GGV VHF/2m Repeater
145.2800 MHz +5.0 MHz Offset
- MY WB4QDX
- UR CQCQCQ
- RPT1 KJ4GGV C
- RPT2 KJ4GGV G

" " represents a space

Used for talking on local repeater. If repeater is linked, you are also heard on any of the linked repeaters

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Linking to a Repeater

- Sample for KJ4GGV VHF/2m Repeater
145.2800 MHz +5.0 MHz Offset

- MY WB4QDX
- UR WX4GPBAL (or W4DOC CL, W4GR CL)
- RPT1 KJ4GGV C
- RPT2 KJ4GGV G

" " represents a space

Key once, gateway responds with voice prompt "Remote System Linked".
Change to CQCQCQ in UR for QSO.

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Linking to a Reflector

- Sample for KJ4GGV VHF/2m Repeater
145.2800 MHz +5.0 MHz Offset

- MY WB4QDX
- UR REF002AL
- RPT1 KJ4GGV C
- RPT2 KJ4GGV G

" " represents a space

Key once, gateway responds with voice prompt "Remote System Linked".
Change to CQCQCQ in UR for QSO.

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Unlinking



- Sample for KJ4GGV VHF/2m Repeater
145.2800 MHz +5.0 MHz Offset

- MY WB4QDX
- UR ■■■■■■U
- RPT1 KJ4GGV■C
- RPT2 KJ4GGV■G

"■" represents a space

Key once, gateway responds with unlinked voice prompt. Change to CQCQCQ in UR for QSO.

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Memory Management



- Radios have different capabilities and number of memories
- First generation radios have standard memory locations for FM or DV
 - **Method 1** – Store commands in memory for favorite reflectors or repeaters
 - **Method 2** – Use UR memories for favorite reflectors or repeaters (uses fewer memory locations)
- Newer radios with DR mode simplify programming
 - **Method 3** – Use DR mode with repeater list and GPS for nearest repeater



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Radio Memory Management – Method 1

Organize blocks of channels stored in memories:

- Can be used with any D-STAR radio
- Create a group or bank of memories for each repeater
- Store commands for each function in a memory of the group

CH No	Frequency	Dup	Offset	TS	Mode	Name	Your Call Sign	RPT1 Call Sign	RPT2 Call Sign
1	145.200	DUP-	0.6	10kHz	DV	KI4SBA C	CQCQCQ	KI4SBA C	KI4SBA G
2	145.200	DUP-	0.6	10kHz	DV	UNLINK	U	KI4SBA C	KI4SBA G
3	145.200	DUP-	0.6	10kHz	DV	SBA C ID	I	KI4SBA C	KI4SBA G
4	145.200	DUP-	0.6	10kHz	DV	REF001C	REF001CL	KI4SBA C	KI4SBA G
5	145.200	DUP-	0.6	10kHz	DV	REF002A	REF002AL	KI4SBA C	KI4SBA G
6	145.200	DUP-	0.6	10kHz	DV	REF004A	REF004AL	KI4SBA C	KI4SBA G
7	145.200	DUP-	0.6	10kHz	DV	REF030A	REF030AL	KI4SBA C	KI4SBA G
8	145.200	DUP-	0.6	10kHz	DV	REF030B	REF030BL	KI4SBA C	KI4SBA G
9	145.200	DUP-	0.6	10kHz	DV	REF030C	REF030CL	KI4SBA C	KI4SBA G
10	145.200	DUP-	0.6	10kHz	DV	ECHOTEST	E	KI4SBA C	KI4SBA G

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Radio Memory Management - Talk

- Use this channel for general QSO
- No linking commands required or repeater already linked
- CQCQCQ in UR field

CH No	Frequency	Dup	Offset	TS	Mode	Name	Your Call Sign	RPT1 Call Sign	RPT2 Call Sign
1	145.200	DUP-	0.6	10kHz	DV	KI4SBA C	CQCQCQ	KI4SBA C	KI4SBA G
2	145.200	DUP-	0.6	10kHz	DV	UNLINK	U	KI4SBA C	KI4SBA G
3	145.200	DUP-	0.6	10kHz	DV	SBA C ID	I	KI4SBA C	KI4SBA G
4	145.200	DUP-	0.6	10kHz	DV	REF001C	REF001CL	KI4SBA C	KI4SBA G
5	145.200	DUP-	0.6	10kHz	DV	REF002A	REF002AL	KI4SBA C	KI4SBA G
6	145.200	DUP-	0.6	10kHz	DV	REF004A	REF004AL	KI4SBA C	KI4SBA G
7	145.200	DUP-	0.6	10kHz	DV	REF030A	REF030AL	KI4SBA C	KI4SBA G
8	145.200	DUP-	0.6	10kHz	DV	REF030B	REF030BL	KI4SBA C	KI4SBA G
9	145.200	DUP-	0.6	10kHz	DV	REF030C	REF030CL	KI4SBA C	KI4SBA G
10	145.200	DUP-	0.6	10kHz	DV	ECHOTEST	E	KI4SBA C	KI4SBA G

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Radio Memory Management - ID

- Use to see if repeater is linked or unlinked
- If linked, repeater says "Remote system linked"
- Data line will indicate where repeater or reflector linked
- Return to CQCQCQ channel to talk

CH No	Frequency	Dup	Offset	TS	Mode	Name	Your Call Sign	RPT1 Call Sign	RPT2 Call Sign
1	145.200	DUP-	0.6	10kHz	DV	KI4SBA C	CQCQCQ	KI4SBA C	KI4SBA G
2	145.200	DUP-	0.6	10kHz	DV	UNLINK	U	KI4SBA C	KI4SBA G
3	145.200	DUP-	0.6	10kHz	DV	SBA C ID	I	KI4SBA C	KI4SBA G
4	145.200	DUP-	0.6	10kHz	DV	REF001C	REF001CL	KI4SBA C	KI4SBA G
5	145.200	DUP-	0.6	10kHz	DV	REF002A	REF002AL	KI4SBA C	KI4SBA G
6	145.200	DUP-	0.6	10kHz	DV	REF004A	REF004AL	KI4SBA C	KI4SBA G
7	145.200	DUP-	0.6	10kHz	DV	REF030A	REF030AL	KI4SBA C	KI4SBA G
8	145.200	DUP-	0.6	10kHz	DV	REF030B	REF030BL	KI4SBA C	KI4SBA G
9	145.200	DUP-	0.6	10kHz	DV	REF030C	REF030CL	KI4SBA C	KI4SBA G
10	145.200	DUP-	0.6	10kHz	DV	ECHOTEST	E	KI4SBA C	KI4SBA G

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Radio Memory Management - Link

- Tune to channel and key briefly to initiate link command
- System will say "Remote system linked" if successful
- Return to CQCQCQ channel to talk

CH No	Frequency	Dup	Offset	TS	Mode	Name	Your Call Sign	RPT1 Call Sign	RPT2 Call Sign
1	145.200	DUP-	0.6	10kHz	DV	KI4SBA C	CQCQCQ	KI4SBA C	KI4SBA G
2	145.200	DUP-	0.6	10kHz	DV	UNLINK	U	KI4SBA C	KI4SBA G
3	145.200	DUP-	0.6	10kHz	DV	SBA C ID	I	KI4SBA C	KI4SBA G
4	145.200	DUP-	0.6	10kHz	DV	REF001C	REF001CL	KI4SBA C	KI4SBA G
5	145.200	DUP-	0.6	10kHz	DV	REF002A	REF002AL	KI4SBA C	KI4SBA G
6	145.200	DUP-	0.6	10kHz	DV	REF004A	REF004AL	KI4SBA C	KI4SBA G
7	145.200	DUP-	0.6	10kHz	DV	REF030A	REF030AL	KI4SBA C	KI4SBA G
8	145.200	DUP-	0.6	10kHz	DV	REF030B	REF030BL	KI4SBA C	KI4SBA G
9	145.200	DUP-	0.6	10kHz	DV	REF030C	REF030CL	KI4SBA C	KI4SBA G
10	145.200	DUP-	0.6	10kHz	DV	ECHOTEST	E	KI4SBA C	KI4SBA G

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Radio Memory Management - Unlink

- Tune to channel and key briefly to initiate link command
- System will say "Remote system unlinked" if successful
- Return to CQCQCQ channel to talk

CH No	Frequency	Dup	Offset	TS	Mode	Name	Your Call Sign	RPT1 Call Sign	RPT2 Call Sign
1	145.200	DUP-	0.6	10kHz	DV	KI4SBA C	CQCQCQ	KI4SBA C	KI4SBA G
2	145.200	DUP-	0.6	10kHz	DV	UNLINK	U	KI4SBA C	KI4SBA G
3	145.200	DUP-	0.6	10kHz	DV	SBA C ID	I	KI4SBA C	KI4SBA G
4	145.200	DUP-	0.6	10kHz	DV	REF001C	REF001CL	KI4SBA C	KI4SBA G
5	145.200	DUP-	0.6	10kHz	DV	REF002A	REF002AL	KI4SBA C	KI4SBA G
6	145.200	DUP-	0.6	10kHz	DV	REF004A	REF004AL	KI4SBA C	KI4SBA G
7	145.200	DUP-	0.6	10kHz	DV	REF030A	REF030AL	KI4SBA C	KI4SBA G
8	145.200	DUP-	0.6	10kHz	DV	REF030B	REF030BL	KI4SBA C	KI4SBA G
9	145.200	DUP-	0.6	10kHz	DV	REF030C	REF030CL	KI4SBA C	KI4SBA G
10	145.200	DUP-	0.6	10kHz	DV	ECHOTEST	E	KI4SBA C	KI4SBA G

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Radio Memory Management - Echotest

- Tune to channel, key and speak
- System will echo back your transmission
- Return to CQCQCQ channel to talk

CH No	Frequency	Dup	Offset	TS	Mode	Name	Your Call Sign	RPT1 Call Sign	RPT2 Call Sign
1	145.200	DUP-	0.6	10kHz	DV	KI4SBA C	CQCQCQ	KI4SBA C	KI4SBA G
2	145.200	DUP-	0.6	10kHz	DV	UNLINK	U	KI4SBA C	KI4SBA G
3	145.200	DUP-	0.6	10kHz	DV	SBA C ID	I	KI4SBA C	KI4SBA G
4	145.200	DUP-	0.6	10kHz	DV	REF001C	REF001CL	KI4SBA C	KI4SBA G
5	145.200	DUP-	0.6	10kHz	DV	REF002A	REF002AL	KI4SBA C	KI4SBA G
6	145.200	DUP-	0.6	10kHz	DV	REF004A	REF004AL	KI4SBA C	KI4SBA G
7	145.200	DUP-	0.6	10kHz	DV	REF030A	REF030AL	KI4SBA C	KI4SBA G
8	145.200	DUP-	0.6	10kHz	DV	REF030B	REF030BL	KI4SBA C	KI4SBA G
9	145.200	DUP-	0.6	10kHz	DV	REF030C	REF030CL	KI4SBA C	KI4SBA G
10	145.200	DUP-	0.6	10kHz	DV	ECHOTEST	E	KI4SBA C	KI4SBA G

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Memory Management – Method 2



- Can be used with any D-STAR radio
- Program one memory location per repeater with CQCQCQ in UR field
- Utilize “Your Call Sign” memories for UR field

Call Sign	U22	K4WAK B_	U52
My Call Sign	U23	K4D50 CL	U53
Your Call Sign	U24	K4D50 BL	U54
Received Call Record	U26	K4D50 AL	U56
VFC Call Sign			

- Select Memory location and change UR field for favorite linking command



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Memory Management – Method 3 (DR Mode)



- Available on ID-31, ID51, IC-7100, ID-5100
- Radios have regular memories usually used for FM
- Geocoded Repeater List / DR memories used for D-STAR
- ID-5100 Repeater List may be used for FM or D-STAR
- DR Mode introduces TO/FROM screen for easy use

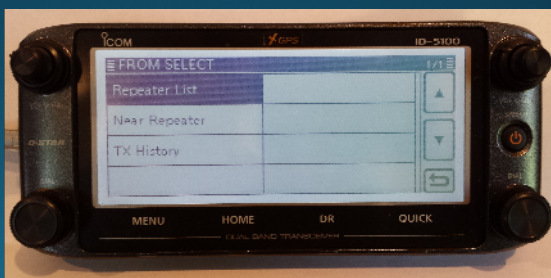


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Using DR Mode



- Select FROM to pick a repeater
- Utilizes internal GPS to know where you are
- Repeater List has geocoded repeaters
- Selecting Nearest Repeater finds closest repeaters
- Select desired repeater

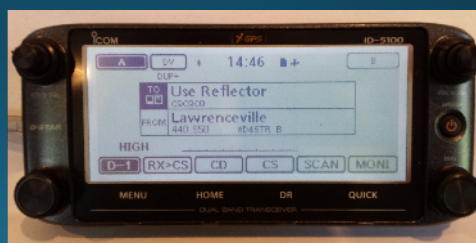
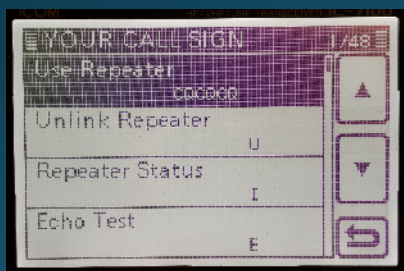


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Using DR Mode



- Select TO on screen
- Select “Your Call Sign” (“Reflector” on ID-5100)
- Select “Use Repeater” (“Link to Reflector” on ID-5100) to talk (like CQCQCQ)

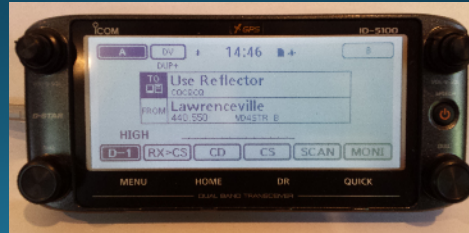


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DR Mode



- Link to a repeater or reflector while in TO field by rotating knob (*ID-5100 select Gateway CQ for repeater list or Repeater List>Link to Reflector for list of reflectors*)
- Return to Use Repeater/Reflector for CQCQCQ for talking



Programming for the DVAP



• Standard Memories

Receive Frequency	Transmit Frequency	Offset Frequency	Offset Direction	Operating Mode	Memory Name	Memory Collision	Rpt 1 Call Sign	Rpt 2 Call Sign
45.79000	145.73000		Simplex	DV	DVAP	CQCQCQ		
45.70000	145.70000		Simplex	DV	Unlink		DIRECT	
45.79000	145.73000		Simplex	DV	DVAP D	DVAP D	DIRECT	
45.79000	145.73000		Simplex	DV	DIRECT	REFLECT	DIRECT	
45.79000	145.73000		Simplex	DV	REFLECT	ILLUMIN	DIRECT	

• Repeater List

Name	Sub Name	Repeater Call Sign	Gateway Call Sign	Operating Freq	DUP	Offset Freq	USE (FROM)
D DVAP VHF				145.730000		0.000000	Yes
D DVAP UHF				441.000000		5.000000	Yes
VHF DV Simplex				145.870000		0.000000	Yes
VHF DV Simplex				445.870000		5.000000	Yes
DVAP Default VHF				145.830000		0.000000	Yes
DVAP Default UHF				445.830000		5.000000	Yes



Using a DVAP



- Normal connection to DVAP is a PC, Laptop or Netbook (bulky) with Internet connection



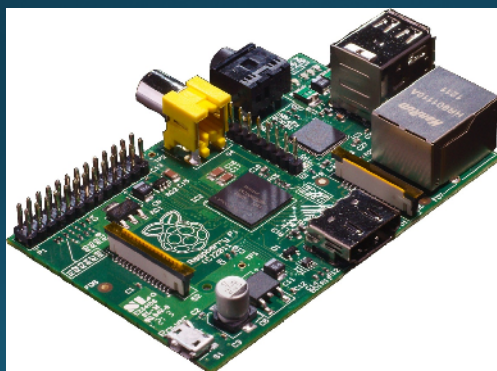
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Add a Raspberry Pi?



- Credit card sized Linux computer with SD Card slot, 2 USB, Ethernet and HDMI ports powered by 5VDC micro-USB adapter



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DVAP / Pi Configuration



- DVAP connects to Pi through USB
- Wi-Fi adapter on 2nd USB (external Internet source required)
- SD card with OS and DVAP software
- Micro USB power to AC or DC source



Homebrew DVAP Package



Pelican 1050 or 1060 Case

USB Charger/5VDC Supply
Anker 10,000 mAh or
equivalent

USB Adapter
(120VAC to 5V USB)

Micro-USB Cable

Raspberry Pi Model B

DV Access Point

USB CLA (12V to 5V USB)



9V1TT Pi Gateway



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Making It Work



- Download image file and instructions
 - DVAPtool version:
<https://www.dropbox.com/sh/mfyw3i6dwkpmriz/V56pE5JqTL>
 - ircDDB version:
<http://www.westernstar.co.uk/Downloads/DVAP+ircDDB+VNC.rar>
- Install OS image to SD card using Win32DiskImager
- Power up Pi with SD card installed, HDMI monitor, keyboard, mouse and Internet connection (Ethernet or Wi-Fi)
- Configure DVAPtool or DVAPnode and ircDDB per instructions
- Configure WiFi sources (Mobile Hotspots, home WiFi, etc)
- Can run "headless" after that...just power up, finds defined WiFi sources



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DHAP



- Commercially available from Hardened Power Systems
<http://www.portableuniversalpower.com/DHAP.htm>
- User supplies DVAP (2m or 70cm)



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D-STAR on HF



- Icom IC-7100 and IC-9100 are both DV capable on HF
- Operates at similar bandwidth to AM
- D-STAR HF nets now operating several nights a week
- Net info at
<http://www.dstarinfo.com/DSTARHFNet.aspx>



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Demo

