



D-STAR Basics & other Digital Voice

Rob Dean W4VRD

Some info from:

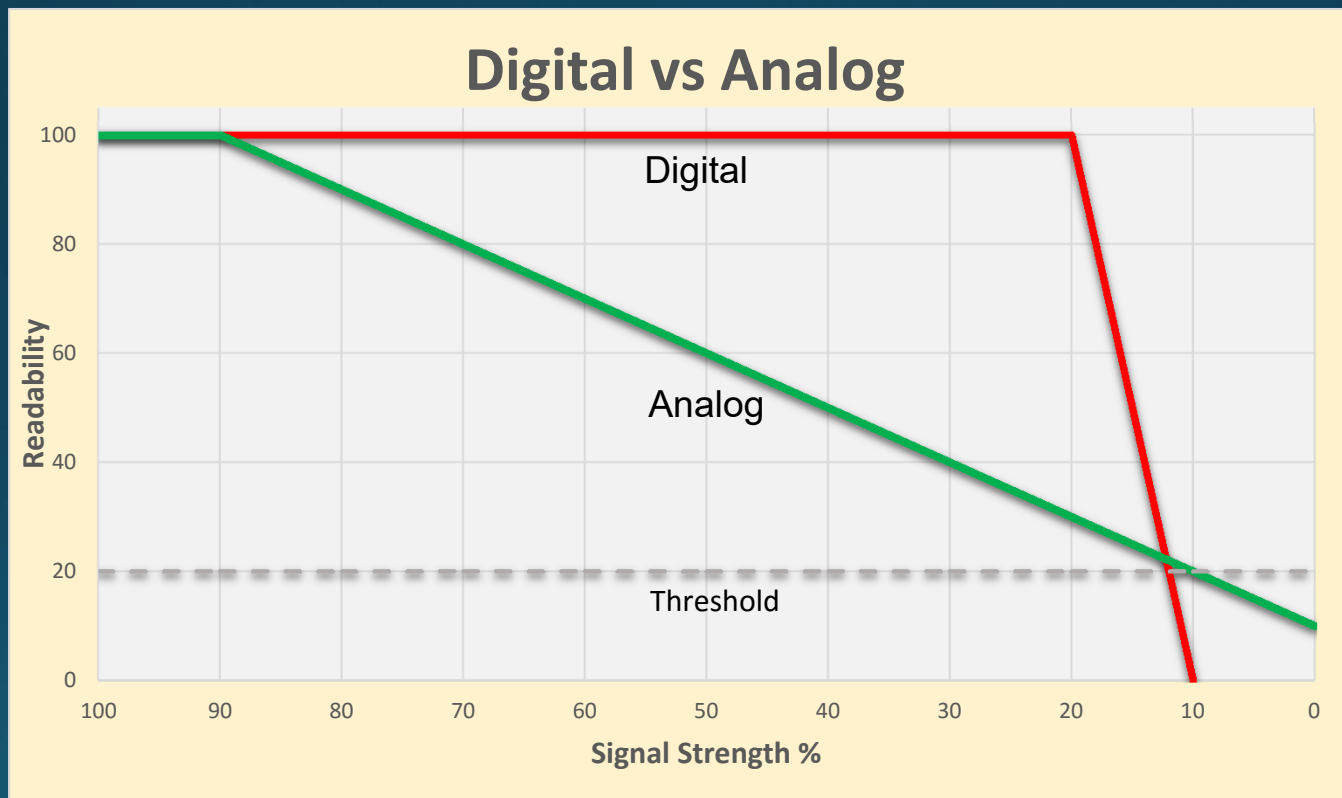


What is D-STAR?

- D-STAR is an open standard for digital voice and data designed specifically for Amateur Radio
- One of several digital modes used in Amateur Radio
- Developed by Japan Amateur Radio League (JARL)
- Uses AMBE vocoder chip from DVSI to convert analog speech to data and vice versa
- NO PL tone to enter, like traditional FM repeater
- Technician license or higher to reach world-wide

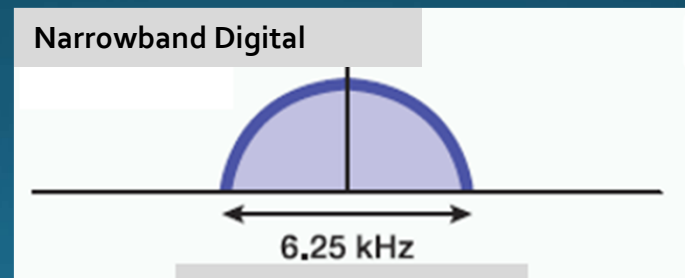
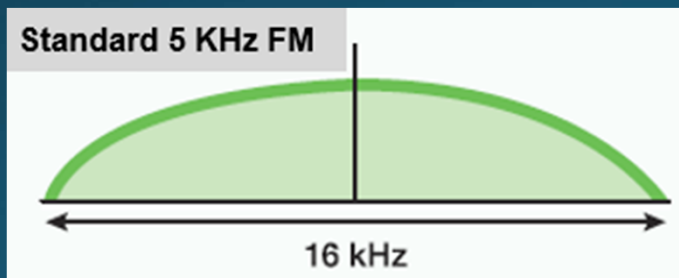
Digital Basics

- Digital voice does not gradually degrade in quality as signal level decreases



Digital Basics

- Voice (analog) is converted to data
- Data may be added to voice to produce a single data stream containing voice and data
- Radio is modulated as a data carrier
- Occupied bandwidth is determined by data bit rate and type of modulation
- Generally, digital voice and data occupies less spectrum than analog FM



Digital Mode Comparison

	D-STAR	DMR/MotoTRBO	System Fusion
Number of users	>41,000	10,282	>1,000
Repeaters	3,190	1,235	>1,000 (most operating in mixed or FM modes)
Bandwidth	6.25 KHz	7.6 KHz	7.6-9 KHz
Channel spacing	10, 12.5 KHz pairs	12.5 KHz pairs	20, 25 KHz pairs
Repeater Linking	Open via Internet (DPLUS or ircDDB)	Proprietary (Motorola IPSC) or Hytera, via Internet	Not yet available Wires-X nodes connect to radio
Linking / routing control	Determined by user, sent from radio	Defined by admin, sent from radio	Not yet available for repeater (Repeater firmware upgrade required)
Data	1200, 3600 bps 128 kbps (1.2 GHz)	SMS only implemented in Amateur Radio version	4800, 9600 bps
Radio Programming	Front panel, software	Licensed software	Front panel, software
Other user devices	Multiple vendors (Dongle, DVAP, GMSK modems, hotspot adapters)	Multiple radio vendors, proprietary networking adapters	Not yet

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 wider bandwidth for FM voice, P25 and MotoTRBO)
- Can operate simplex, repeater or linked to other repeater(s)

What can D-STAR Do?

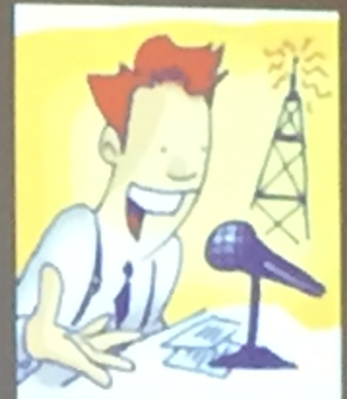
- Transmit or receive voice and 1200 baud data simultaneously on 2m, 440 and 1.2 GHz (no TNC required)
- 128 Kb data transmission on 1.2 GHz with Internet connectivity (Ethernet bridge to Internet with IP address)
- D-PRS (digital APRS) automatic position reporting simultaneous with voice with GPS
- Flexible repeater linking with Gateway and Internet connection
- Reflectors act as conference bridge for linking multiple repeaters (70+ DPLUS Reflectors, DCS and XRF 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)

The Many Facets of D-STAR

- ▶ Voice Communication
- ▶ Emergency Services
- ▶ Using D-STAR Features
- ▶ Data
- ▶ GMSK Modems
- ▶ AMBE Devices
- ▶ Hot Spots
- ▶ HF

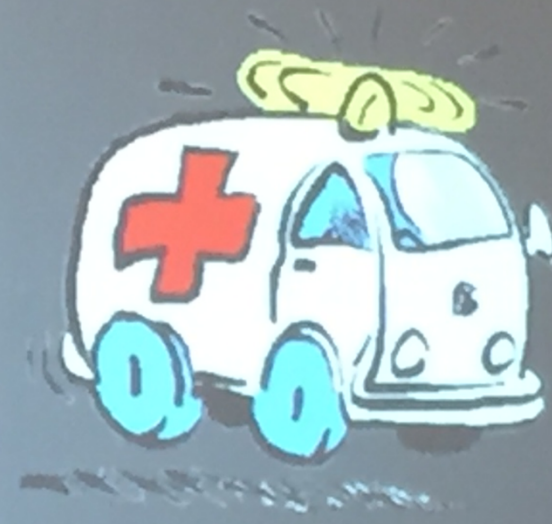
Voice Communication

- ▶ To many, an often under looked opportunity
- ▶ 43+ Countries have D-STAR Repeaters
- ▶ 48+ States have D-STAR Repeaters
- ▶ More states and countries have users with Internet access to D-STAR
- ▶ 75+ Nets
- ▶ Hundreds of Reflectors linking
 - ▶ Groups
 - ▶ Areas
 - ▶ Interests



Emergency Services

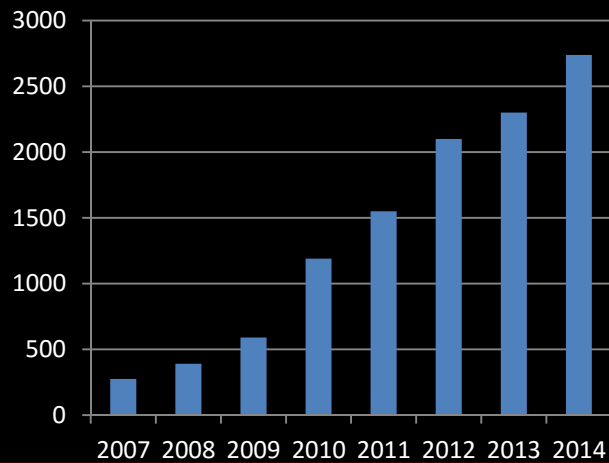
- ▶ Adopted by many ARES organizations
- ▶ Supports
 - ▶ Voice
 - ▶ Call Sign Display
 - ▶ GPS Position
- ▶ Data Connectivity
 - ▶ Single Cable
 - ▶ Forms
 - ▶ Files
 - ▶ Messages
 - ▶ Keyboard to Keyboard
- ▶ Ad-Hoc network creation
 - ▶ Any 2 or more users or repeaters worldwide



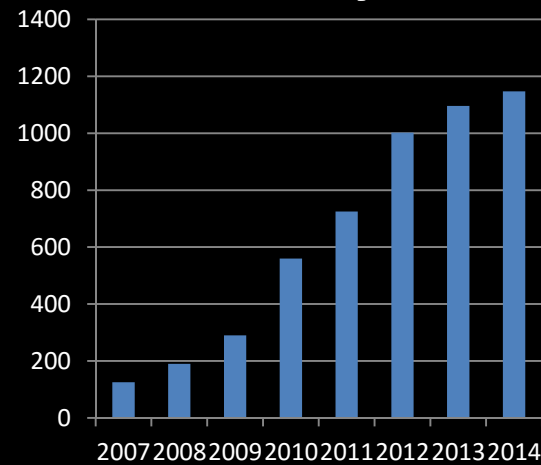
D-STAR Growth Continues

- *As of May 1, 2015 – 1,817 DPlus Gateways, over 3,190 Voice Repeaters, 222 Data Modules and 41,310 registered users on US Trust Server.*
- *Over 1,100 repeaters in US*
- *Additional ircDDB repeaters and users*

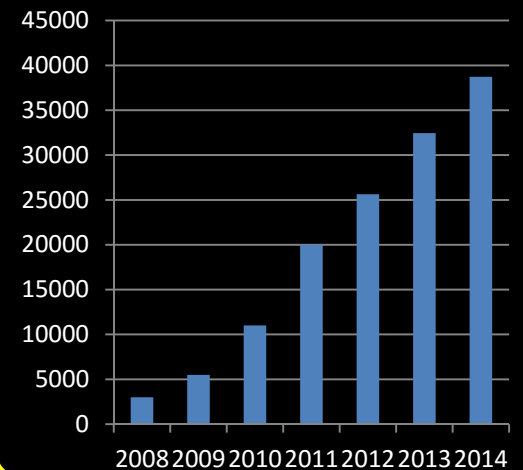
Repeaters



Gateways



Users



D-STAR Equipment

- D-STAR radios (mobiles, handhelds, repeaters) commercially produced by ICOM & soon Kenwood
- 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
- DV Mega creates low power access point with Raspberry Pi
- Node Adapters converts FM transceiver to D-STAR hotspots and repeaters

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

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 geocoded memories



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 downloads
 - Built-in GPS
 - User friendly DR Mode, locate closest repeater
- ID-51A Plus is latest dual band handheld
 - All features of ID-31A, but dual band, dual receive
 - Anniversary Edition/Plus model includes nearest FM repeater location
 - 3X data rate with other 51A/5100 radios



Other Digital Voice Suppliers

DV Dongle

- Internet Labs
- D-STAR on your PC
- \$200 new



Thumb DV



- Northwest Digital Radio
- D-STAR on your PC
- Uses AMBE 3000
- Other modes?
- \$120 new



Other Digital Voice Devices

DV Access Point

- Internet Labs
- Hotspot repeater
- Single band
- 2M \$240 new
70 cm \$260 new



DV Mega

- Guus van Dooren PE1PLM
- Hotspot repeater
- Dual band
- \$180 new



Not near a D-STAR Repeater? Make your own - with this...



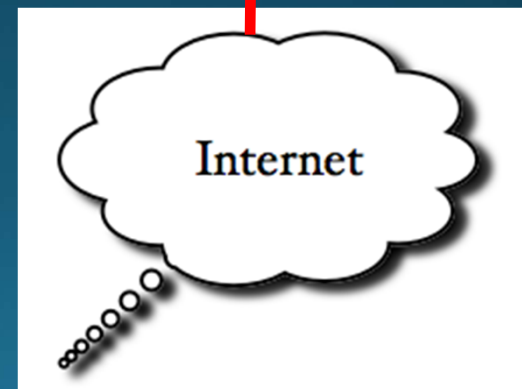
D-STAR Repeater Architecture



Linux Gateway PC
Running G2 Gateway
software



Runs third-party
apps, Dongle,
DVAP



Local D-STAR Repeaters:

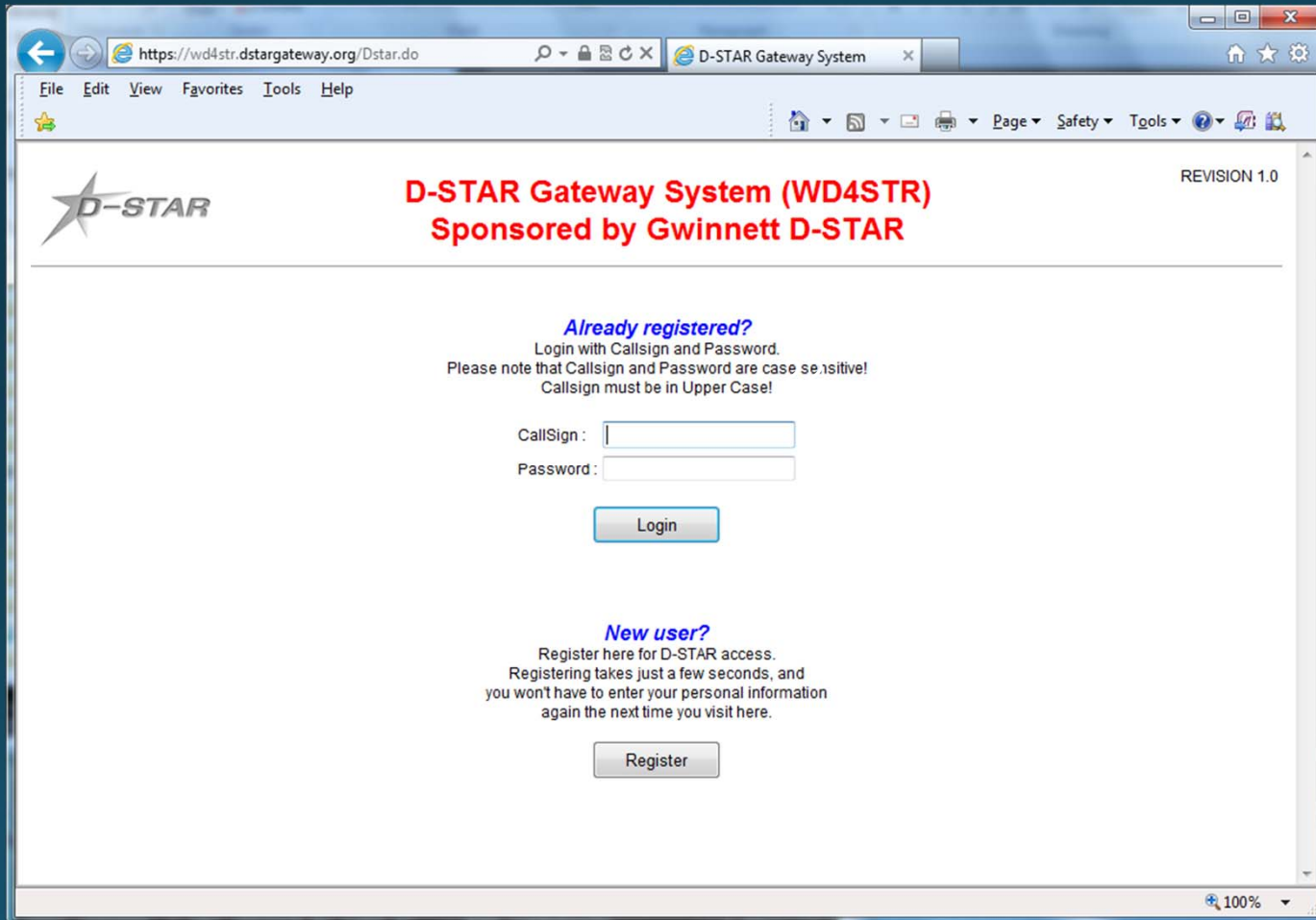
<u>N4USI</u>	Haymarket	VA	145.45000MHz - 0.600	442.41250M Hz +5.000		
<u>NV4FM</u>	Tysons Corner (Fairfax)	VA	145.34000MHz - 0.600	448.03500M Hz -5.000	1282.80000MHz -12.000	1254.20000MHz
<u>W4HFH</u>	Alexandria	VA	145.38000MHz - 0.600	442.06000M Hz +5.000	1284.60000MHz -12.000	1253.60000MHz
<u>W4OVH</u>	Manassas	VA	(offline, relocation almost completed)			
<u>WS4VA</u>	Stafford	VA	145.32000MHz - 0.600	447.27500MHz - 5.000	1282.20000MHz - 12.000	1298.40000MHz
<u>KB3YBH</u>	Frederick	MD	145.17000MHz - 0.600	444.80000M Hz +5.000		

The Registration Process

- Why register?
- Registering your callsign allows access to more functions on DPLUS repeaters (not required for ircDDB repeaters)
- Register on your local or the closest system, if possible
- 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*)

Starting Registration

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



The screenshot shows a web browser window with the URL <https://wd4str.dstargateway.org/Dstar.do>. The page title is "D-STAR Gateway System (WD4STR) Sponsored by Gwinnett D-STAR" and it is labeled as "REVISION 1.0". The D-STAR logo is visible in the top left. The page content is centered and includes two main sections:

Already registered?
Login with Callsign and Password.
Please note that Callsign and Password are case sensitive!
Callsign must be in Upper Case!

CallSign:
Password:

New user?
Register here for D-STAR access.
Registering takes just a few seconds, and you won't have to enter your personal information again the next time you visit here.

Fill Out Your Info

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

The screenshot shows a web browser window with the URL <https://wd4str.dstargateway.org/TopMenu.do?jsessionid=>. The page title is "D-STAR Gateway System (WD4STR) Sponsored by Gwinnett D-STAR" and it is labeled "REVISION 1.0". The D-STAR logo is visible in the top left. The main content area contains the following text:

The agreement document

I certify that I hold a valid Amateur Radio license. I also agree to abide by all rules and regulations of Gwinnett D-STAR and Part 97 of the FCC Rules and Regulations. I understand that non-compliance may result in removal from the D-STAR gateway network without warning.

When filling in the form below, enter both your first and last name in the Name field. Upon submitting the form, please send an email info@dstarinfo.com to provide notification of your request and prompt approval. After approval, you will need to return and login to complete the registration process.

Do you agree?
YES: NO:

Enter your personal information!

CallSign : Equal to or less than 7 characters.
Name :
E-mail : Make sure you use a valid e-mail address.
Password : 8 to 16 characters.
Password confirm :

At the bottom of the form are "OK" and "Cancel" buttons. The browser's status bar shows "100%".

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

Add a Terminal

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

Please, edit after making a left check box on.

Name : John Davis

E-mail : jdavis@gtworks.com

Password :

Password Confirm :

If the station has multiple radios, Target CS are distinguished by initial(last character) of a space or a capital english letter.
Definition character as follows..... (G)is a gateway. (S)is a local server.
Usually RPT(Repeater) isn't checked, initial AreaRPT CS is the port A of ZoneRPT CS.
If RPT is checked, AreaRPT CS is the same as Target CS.

	Initial	RPT	local IP	pcname	Del
<input checked="" type="checkbox"/>	1: WB4QDX		10.210.206.240	wb4qdx	<input type="checkbox"/>
<input checked="" type="checkbox"/>	2: WB4QDX N		10.210.206.241	wb4qdx-node	<input type="checkbox"/>
<input type="checkbox"/>	3: WB4QDX	<input type="checkbox"/>	10.210.206.242		
<input type="checkbox"/>	4: WB4QDX	<input type="checkbox"/>	10.210.206.243		
<input type="checkbox"/>	5: WB4QDX	<input type="checkbox"/>	10.210.206.244		
<input type="checkbox"/>	6: WB4QDX	<input type="checkbox"/>	10.210.206.245		
<input type="checkbox"/>	7: WB4QDX	<input type="checkbox"/>	10.210.206.246		
<input type="checkbox"/>	8: WB4QDX	<input type="checkbox"/>	10.210.206.247		

Check item and change a set value.
Click the Update button.

Update

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!

Reflectors (like conf rooms)

apps.dstarinfo.com/reflectors.aspx

Reflector	Usage	Location	Links	Speed
REF001A		London, England	Status	100 Mbps
REF001B	Illinois D-STAR repeaters	London, England	Status	100 Mbps
REF001C	D-STAR's MegaRepeater	London, England	Status	100 Mbps
REF002A	Southeastern US D-STAR Weather Net	NE, United States	Status	100 Mbps
REF002B	Southern Arizona Linked Repeater Network	NE, United States	Status	100 Mbps
REF002C	Some Nets	NE, United States	Status	100 Mbps
REF003A	Ad-hock & Emergency Use - Australia	Australia	Status	
REF003B	Permalink for Repeaters, including all WIA Port B Repeaters - Australia	Australia	Status	
REF003C	Australian Nets	Australia	Status	
REF004A	Alternate for Southeastern US D-STAR Weather Net	United States	Status	1 Gbps
REF004B	Texas Permalink Repeaters	United States	Status	1 Gbps
REF004C	General Rag Chew (English only please)	United States	Status	1 Gbps
REF005A	UK Nets, Permalink Repeaters	London, England	Status Usage Guide Information	100 Mbps
REF005B	Kent Net (UK Repeaters around Kent)	London, England	Status Usage Guide Information	100 Mbps
REF005C		London, England	Status Usage Guide Information	100 Mbps
REF005D	UKFMGW Net (North West UK Repeaters)	London, England	Status Usage Guide Information	100 Mbps
REF006A	Scottish Net	London, England	Status Usage Guide Information	100 Mbps
REF006B		London, England	Status Usage Guide Information	100 Mbps
REF006C	German Net	London, England	Status Usage Guide Information	100 Mbps
REF007A	Florida	Orlando, FL, United States	Status	100 Mbps
REF007B	Florida	Orlando, FL, United States	Status	100 Mbps
REF007C	Florida	Orlando, FL, United States	Status	100 Mbps
REF008A	Japan G2 repeaters, DVDongles and DVAPs	Japan	Status	
REF008B	Japan G2 repeaters, DVDongles and DVAPs	Japan	Status	
REF008C	Japan G2 repeaters, DVDongles and DVAPs	Japan	Status	
REF008D	Japan G2 repeaters, DVDongles and DVAPs	Japan	Status	
REF009A		AZ, United States	Status	
REF009B		AZ, United States	Status	
REF009C	Arizona Permalink Repeaters	AZ, United States	Status	
REF010A	Emergency Communications	New England, United States	Status	100 Mbps
REF010B	Open	New England, United States	Status	100 Mbps
REF010C	New England Repeaters	New England, United States	Status	100 Mbps
REF011A		Italy	Status	
REF011B		Italy	Status	
REF011C		Italy	Status	
REF012A	Permalink Repeaters	Southern CA, United States	Status	100 Mbps
REF012B	Papa System	Southern CA, United States	Status	100 Mbps
REF012C	Papa System	Southern CA, United States	Status	100 Mbps
REF013A		London, England	Status	100 Mbps
REF013B		London, England	Status	100 Mbps
REF013C		London, England	Status	100 Mbps
REF014A	US west coast repeater linking	NE, United States	Status	
REF014B	US west coast repeater linking	NE, United States	Status	
REF014C	US west coast repeater linking	NE, United States	Status	
REF015A	Multimedia (non-DSTAR)	London, England	Status	
REF015B	Multimedia (non-DSTAR)	London, England	Status	
REF015C	Data Only - Worldwide use	London, England	Status	
REF016A	Ottawa Link	British Columbia, Canada	Status	100 Mbps
REF016B	Alberta Nets	British Columbia, Canada	Status	100 Mbps
REF016C	General Amateur Use	British Columbia, Canada	Status	100 Mbps
REF017A	Netherlands (Dutch Speaking repeaters, hotspots and dongles)	Amsterdam, the Netherlands	Status	100 Mbps
REF017B		Amsterdam, the Netherlands	Status	100 Mbps
REF017C		Amsterdam, the Netherlands	Status	100 Mbps
REF018A	Brazil	United States	Status	

D-STAR Nets (lots per day)

← | apps.dstarinfo.com/nets.aspx

For Net additions and changes, send updates to Info@DSTARINFO.com

Name	Description	Day	Local Time	TimeZone	UTC	Location
DVPI	Raspberry Pi Net	Mon	22:00:00	Eastern Daylight Time	02:00:00	REF038C
QCWA1	Quarter Century Wireless Association (QCWA) (2nd Monday)	Mon	21:00:00	Eastern Daylight Time	01:00:00	REF026A
QCWA2	Quarter Century Wireless Association (QCWA) (4th Monday)	Mon	21:00:00	Eastern Daylight Time	01:00:00	REF026A
TALARC1	American Legion (TALARC) (1st Monday)	Mon	21:00:00	Eastern Daylight Time	01:00:00	REF026A
TALARC2	American Legion (TALARC) (3rd Monday)	Mon	21:00:00	Eastern Daylight Time	01:00:00	REF026A
PDRA	Philadelphia Digital Radio Net	Mon	20:00:00	Eastern Daylight Time	00:00:00	REF020A
NEADS	New England Amateur D-STAR Net	Tue	20:00:00	Eastern Daylight Time	00:00:00	REF069C
QUEBEC1	Réseau D-STAR du Québec	Tue	20:00:00	Eastern Daylight Time	00:00:00	VE2VPSC
ROCKET	Huntsville D-STAR Net	Tue	19:30:00	Central Daylight Time	00:30:00	KI4PPFC
TRI1C	Tri-State Amateur D-STAR Net	Tue	20:30:00	Eastern Daylight Time	00:30:00	REF001C
WCFDS	West Central Florida D-STAR Club	Tue	21:00:00	Eastern Daylight Time	01:00:00	KJ4ACN B
TEXAS	Texas D-STAR Net	Tue	20:00:00	Central Daylight Time	01:00:00	REF004B
NCDS1	North Carolina D-STAR Net	Tue	21:00:00	Eastern Daylight Time	01:00:00	REF054C
ALADS	Alabama D-STAR Net	Tue	20:30:00	Central Daylight Time	01:30:00	REF058B
CODS	Colorado D-STAR Net	Tue	20:00:00	Mountain Daylight Time	02:00:00	REF035B
IRCN	Independent Radio Club Net	Tue	20:00:00	Pacific Daylight Time	03:00:00	WA6IRCC
SDTECH	PAPA System D-Star Net	Tue	20:00:00	Pacific Daylight Time	03:00:00	REF012A
ALTDNS	Ark-La-Tex D-STAR Net	Tue	19:30:00	Central Daylight Time	00:30:00	REF048B
BCNDSN	Barcelona D-STAR Net	Tue	22:30:00	Central Europe Daylight Time	20:30:00	ED3YAK C
TORXRF	Toronto ARES D-STAR Net	Tue	20:30:00	Eastern Daylight Time	00:30:00	XRFO05B
R3DNET	Region III Auxiliary Communications Service	Tue	19:30:00	Eastern Daylight Time	23:30:00	REF062B
HFTUE	D-STAR HF Net	Tue	20:30:00	Eastern Daylight Time	00:30:00	HF Freq & REF030C
LONDON	London D-STAR Net	Wed	20:00:00	GMT Daylight Time	19:00:00	GB7OK
NCRN	National Capital Region Net (Washington DC)	Wed	21:00:00	Eastern Daylight Time	01:00:00	REF062A
FLDS	Florida State-Wide D-STAR DV Net	Wed	21:00:00	Eastern Daylight Time	01:00:00	REF004B
WWDVAP	Worldwide DVAP Net	Wed	18:00:00	Pacific Daylight Time	01:00:00	REF014C
HNRN	Ham Nation After Show D-STAR Net	Wed	22:00:00	Eastern Daylight Time	02:00:00	REF014C
ILLDS	Illinois State D-STAR Net	Wed	21:00:00	Central Daylight Time	02:00:00	REF001B
PUGET	The Puget Sound D-STAR Roundtable	Wed	20:00:00	Pacific Daylight Time	03:00:00	WD7STRB
PUGETS	Puget Sound D-STAR Social Net	Wed	20:00:00	Pacific Daylight Time	03:00:00	REF035C
WIDN	Wisconsin D-STAR Net	Wed	19:00:00	Central Daylight Time	00:00:00	REF019B
MDACS	Mid-Atlantic Auxiliary Communications Service	Wed	20:00:00	Eastern Daylight Time	00:00:00	REF062A
HFWE	D-STAR HF Net	Wed	20:00:00	Eastern Daylight Time	00:00:00	HF Freq & REF030C
CERT	CERT DSTAR Net	Thu	20:30:00	Central Daylight Time	01:30:00	REF067B
NEBRDS	Nebraska D-STAR Net (1st and 3rd Wednesdays)	Wed	21:00:00	Central Daylight Time	02:00:00	REF002C
INDS	Indiana State D-STAR Net (First and Third Thursday Only)	Thu	19:30:00	Eastern Daylight Time	23:30:00	REF024B
STAFFORD	Stafford Amateur Radio Association	Thu	19:30:00	Eastern Daylight Time	23:30:00	WS4VAC N4USI C
MJARC	Malfunction Junction ARC SC DSTAR	Thu	19:45:00	Eastern Daylight Time	23:45:00	KJ4BWK
QUEBEC2	Réseau D-STAR du Québec	Thu	20:00:00	Eastern Daylight Time	00:00:00	VE2VPSC
PDAN	Pacific Division D-Star ARES Net	Thu	18:30:00	Pacific Daylight Time	01:30:00	REF014B
GVN	W6DHS Global Village Net	Thu	19:00:00	Pacific Daylight Time	02:00:00	REF001C
PAPART	PAPA D-STAR Round Table Net	Thu	20:00:00	Pacific Daylight Time	03:00:00	REF012A
KVDSTAR	Kentucky D-STAR Net	Thu	19:00:00	Eastern Daylight Time	23:00:00	REF056B
FDSN	Florida D-STAR Net	Thu	21:00:00	Eastern Daylight Time	01:00:00	REF046C
NMEX	New Mexico D-STAR Net	Thu	20:00:00	Mountain Daylight Time	02:00:00	REF055A
GAHLTH	Georgia Public Health Net	Thu	08:30:00	Eastern Daylight Time	12:30:00	REF030B
HFTHU	D-STAR HF Net	Fri	20:30:00	Eastern Daylight Time	00:30:00	HF Freq & REF030C
QSONET	Round-the-World QSO Net	Thu	21:30:00	Eastern Daylight Time	01:30:00	XRFO38D
EMDRC	Australian D-Star Net	Thu	20:00:00	AUS Eastern Standard Time	10:00:00	REF003C
CANADA	Canadian D-STAR Net	Fri	21:00:00	Eastern Daylight Time	01:00:00	XRFO21B
KIAR	Kids in Amateur Radio	Fri	21:00:00	Eastern Daylight Time	01:00:00	REF012C
MEMPHIS	Memphis D-Star Net	Fri	20:30:00	Central Daylight Time	01:30:00	REF067B
CNCRN	National Capitol Region Net (Ottawa)	Sat	08:30:00	Eastern Daylight Time	12:30:00	REF016B
QUIBEC3	Réseau International D-STAR Francophone	Sat	10:00:00	Eastern Daylight Time	14:00:00	VE2VPSC

For More Information

- <http://www.dstar101.com/>
- <http://www.dstarinfo.com/>
- <http://dstarusers.org/>
- http://www.dstargateway.org/D-Star_Registration.html (D-STAR Registration info)
- <http://www.dstarusers.org/repeaters.php> (D-STAR Repeater list)
- <http://www.maryland-dstar.org/> Maryland D-Star organization

Questions ?

Rob Dean, W4VRD

first licensed Nov 2015 (on D-STAR since Feb)

robdean2@gmail.com