D-STAR InfoCon 2015

at Dayton Hamvention

Part 1 – D-STAR Basics
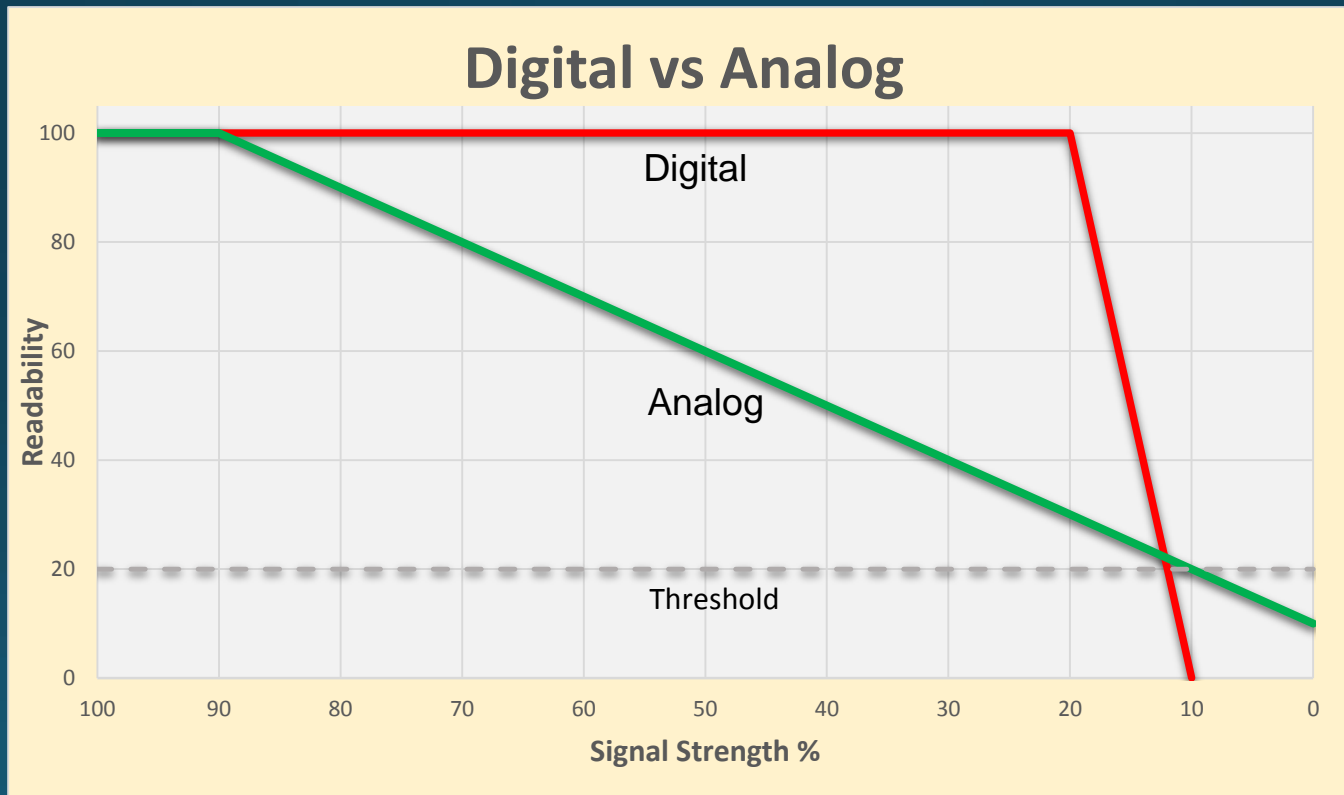
John Davis WB4QDX

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What is D-STAR?

- D-STAR is an <u>open</u> 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
- D-STAR is the only digital voice mode allowing and encouraging experimentation and open development
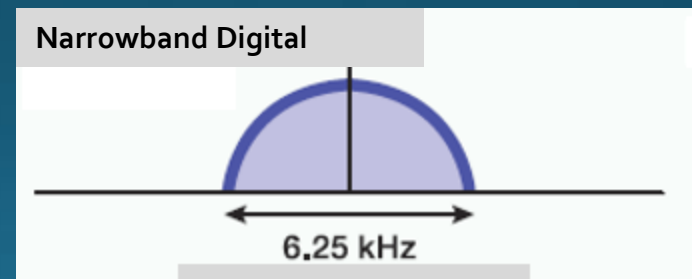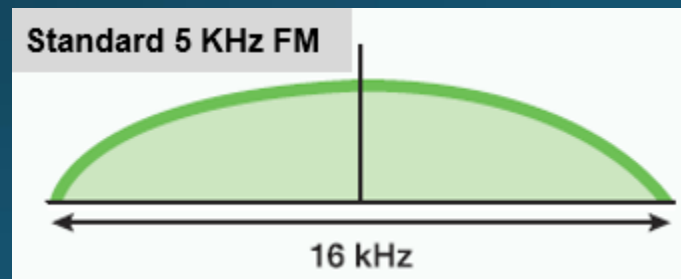
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Digital Basics

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

Digital vs Analog

Readability (y-axis): 0, 20, 40, 60, 80, 100
Signal Strength % (x-axis): 100, 90, 80, 70, 60, 50, 40, 30, 20, 10, 0

Digital
Analog
Threshold

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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

Standard 5 KHz FM

16 kHz

Narrowband Digital

6.25 kHz

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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	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)
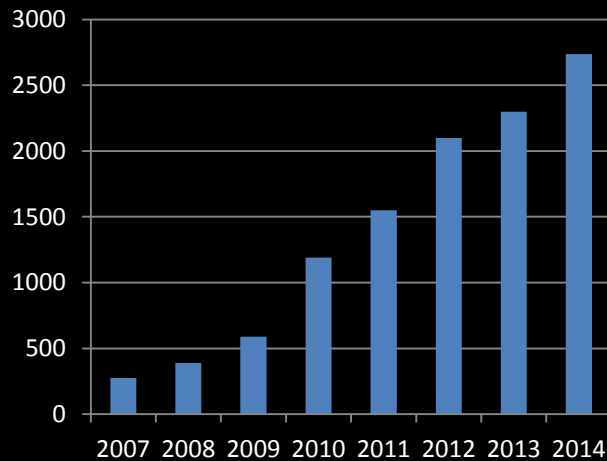- Can operate simplex, repeater or linked to other repeater(s)

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 <u>simultaneous</u> 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)

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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*
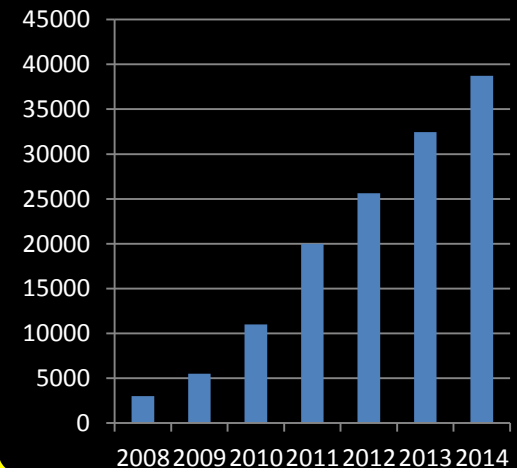- *Additional ircDDB repeaters and users*

Repeaters bar chart (2007–2014), y-axis 0–3000

Gateways bar chart (2007–2014), y-axis 0–1400

Users bar chart (2008–2014), y-axis 0–45000
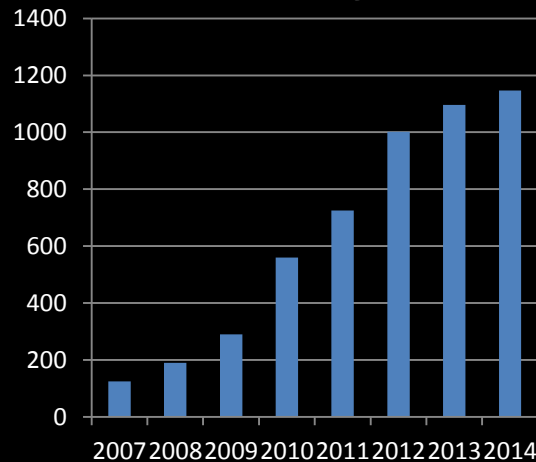
D-STAR Equipment

- D-STAR radios (mobiles, handhelds, repeaters) commercially produced by ICOM
- 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 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

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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

D-STAR Repeater Architecture

ID-RP2C
ID-RP2D 23cm
ID-RP2V 23cm
ID-RP2000V 2m
ID-RP4000V 70cm

Linux Gateway PC Running G2 Gateway software

Runs third-party apps, Dongle, DVAP

Internet
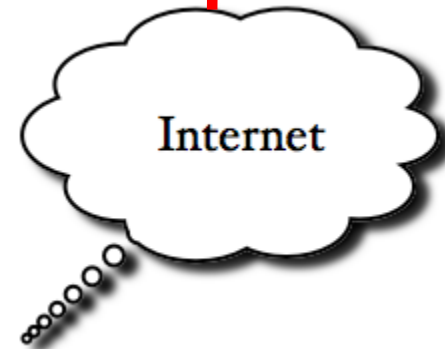
The Registration Process

- 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)

Fill Out Your Info

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

D-STAR Gateway System (WD4STR)
Sponsored by Gwinnett D-STAR

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	:	

[OK]   [Cancel]

◎ **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)

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!