PRACTICAL D-STAR

Digital Smart Technologies For Amateur Radio

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The Japan Amateur Radio League (JARL) began development of D-STAR in 1999. The first full implementation became available in 2001.

It was released as an Open Standard. However, the AMBE (Advanced Multi-Band Excitation) chip which is part of the implementation is a proprietary component.

Basically, when you speak into a radio operating in D-STAR mode, your voice and any data which is to be included with it is sent to the AMBE chip, where it is compressed, combined and encoded. The resulting digital representation is forwarded to a GSM (Global System for Mobile Communications) chip. This is the same technology used in cellular systems. The GSM chip takes the digital data and wraps it in an envelope (packet). This packet is what is transmitted.

Due to the compression, the digital transmission has the bandwidth of a Narrow FM signal, but it is a packet containing digital information.

At the receiving end, the packet is received, passed through a GSM which unwraps the packet, sending the data to the AMBE. The AMBE then splits and uncompresses the data, sending the resulting analog voice information to the appropriate circuits, and the remaining data to other portions of the system for processing.

In other words, D-STAR transmissions contain both digital voice and other textual data.

Because of the narrower bandwidth, D-STAR transmissions generally travel roughly 30% farther than normal FM signals. This is not purely theoretical. We have seen it in practice. The bandwidth is half that of a standard FM signal. In addition, because the information is sent in packets, the received signal is clean and clear.

Like other digital technologies, however, when you approach the edge of the range of a D-STAR signal, it will simply drop out. We know this as the "cliffing effect" and it is familiar to everyone using digital television (DTV), for example.

The AMBE chip used by D-STAR is not the latest implementation. For this reason, critics say that DMR and other newer modes have caused D-STAR to become outdated.

Nevertheless, D-STAR is still active and growing. It was the first "Amateur-Centric" of the digital voice modes, and remains popular.

I enjoy all of the digital voice modes; my order of preference is: D-STAR, C4FM/Fusion and then DMR.

Getting Started

While considering your equipment decisions, you should go ahead and register for Gateway access as well as obtain your CCS7 (Call Connection Service) I.D.

All registrations can now be completed from the following page:

https://register.ham-digital.org/

If you have a DMR I.D. this is also your CCS7 I.D. This is also used in D-STAR for DCS reflectors and most hotspots also require that you have a CCS7 I.D. Gateway access is what enables you to access the D-STAR network. Without Gateway access, you can only use local repeaters or operate simplex with other D-STAR radios.

In terms of equipment, you will either need a D-STAR-capable radio or a dongle connected to a computer in order to operate. If you use a radio, you may also decide to purchase a hotspot or you may simply connect through a repeater.

Our W9ALQ 2-meter repeater is equipped with a D-STAR module which supports local communications. We do not currently have it connected to the Internet, so it does not have worldwide access. The W9NTP repeater in Shelbyville is the closest D-STAR system which is on the Gateway. I am able to reach it from my home QTH.

With, or without repeater access, a hotspot is a worthwhile investment for D-STAR operation. A hotspot is essentially a personal micro-repeater. The device I am using for this presentation is a DV4Mini. It connects to a computer via a USB port. It contains a 20MW transmitter and a receiver. It is powered through the USB connection. An antenna is also connected to the unit. A software program provides the Internet networking and data communications.

Other hotspots utilize the Raspberry Pi with a small transceiver connected as a top hat. There is a small operating system called Pi-Star, designed specifically for this system.

Other hotspots are standalone self-contained devices requiring only a connection to the Internet.

For those interested in accessing D-STAR without a radio, there are a few USB devices which connect to a computer and utilize the sound card for voice input and output.

Some hotspots operate on the 2M band, but these days, the majority operate on the 70CM band.

D-STAR Protocol Setup

There are four main fields used in defining connections to D-STAR resources, as follows:

MYCALL: your FCC call sign (static field).

RPT1: the FROM repeater.

RPT2: the TO repeater.

URCALL: the action to be taken.

You enter your call sign once and leave it unchanged after that.

All of the three remaining fields are eight characters in length. This is very important!

The RPT1 (FROM) field typically contains the call sign of your local repeater, with a band designation character in the eighth position (C=2M, B=70CM).

Example1: W9ALQ C (insert spaces to properly position the band designation)

Example2: W9NTP B (70CM repeater)

The RPT2 (TO) field typically contains your repeater with a "G" in the eighth position indicating that you want to send your transmissions out to the Gateway.

Example1: W9ALQ G

Example2: W9NTP G

Once again, insert the correct number of spaces to place the "G" in the eighth position.

The URCALL field can contain a number of different values.

For a standard QSO, it will look like:

CQCQCQ

There are other commands which you will use to:

- link to a reflector
- unlink from a reflector
- request information
- Echo test your connection

Before we elaborate on URCALL commands, it is worth noting that to operate D-STAR in Simplex, all you need is to put CQCQCQ in URCALL and leave RPT1 and RPT2 blank.

This is because the only settings which have any affect in this case are the mode, frequency and URCALL since no repeaters are involved.

What about the Mode? There are two modes used for D-STAR, DV (digital voice) mode for Simplex work and DR (digital repeater) mode for operating through repeaters.

Some hotspots (like the DV4Mini) use DV mode, while others (like the Zumspot) use DR mode. When DR mode is used, you usually place your call in the RPT1 and RPT2 fields.

Once again, the URCALL commands rely on the eighth position of the field. These are the main commands you will use:

Link: ref030cl

Unlink: ....u (. Means a space here)

Echo-test: ....e

Info: i

When you set up memories for a repeater or hotspot, you will usually have several memories which look alike except that the URCALL field will vary as shown above. For example you may have several memories with link commands, so you can include links for all of your favorite reflectors.

There are four types of reflectors. Each type has a numeric value followed by a port (letter):

The DCS reflectors are newer and have "rooms" rather than ports and can use letters A-Z (allowing 26 rooms).

The REF reflectors are the first generation but still widely used in English-speaking countries.

The XRF reflectors are the second generation and less used, but remain active.

The XLX reflectors are multimode reflectors.

Visit my digital page http://www.joeleah.com/dgtlvoic.html for links to reflector lists.

Some popular reflectors are:

Ref030c -- located in Georgia and widely used worldwide

Ref001c -- located in London and also very active

Ref024b -- our Indiana reflector

Some hotspot options are:

The Zumspot - https://www.hamradio.com/detail.cfm?pid=H0-015993

The Openspot2 (coming soon) - https://www.sharkrf.com/products/openspot2/

The Nano-Spot - http://micro-node.com/

The ThumbDV (uses your PC sound card) - http://nwdigitalradio.com/thumbdv-clearance-sale/

The DV4Mini - http://wirelesshold.com/modems.aspx