MARC D-STAR Presentation

January 7

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WA3SWJ
Credits

• John Davis – WB4QDX
• Maryland D-Star
• TAPR – Digital Communications Conference – John Hays (K7VE)
• Mark Holmes – KJ4VO
• Jim Moen – K6JM
• Fred Van Kempen – PA4YBR
• Jim McClellan – N5MIJ
• Guy, Larry, & Ray
• Ron Milione Ph.D. W2TAP
Topics

• D-STAR – What is it?
• What Can I do with it?
• The Repeater / Gateway System
• D-STAR User Equipment
• D-STAR User Registration
• Your First D-STAR Call - The Four Call Signs
• D-STAR Routing
Topics

• D-STAR – What is it?
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• D-STAR Routing
D-Star – What is it?

D-STAR (Digital Smart Technologies for Amateur Radio) is a digital voice and data protocol specification (published in 2001) developed as the result of research by the Japan Amateur Radio League to investigate digital technologies for amateur radio. ICOM provided the equipment used for development and testing.

• **D-STAR is an open protocol** – although it is published by JARL, it is available to be implemented by anyone. While ICOM is the only company to date that manufactures D-STAR-compatible radios, any equipment or software that supports the D-STAR protocol will work with a D-STAR system. D-STAR systems can be built using both commercial and homebrew equipment and software.

• In a D-STAR system, the **air link portion of the protocol applies to signals travelling between radios or between a radio and a repeater.** D-STAR radios can talk directly to each other without any intermediate equipment or through a repeater using D-STAR voice or data transceivers. **The Gateway portion of the protocol applies to the digital interface between D-STAR repeaters.**

• **D-STAR also specifies how a voice signal is converted to and from streams of digital data**, a function called a codec.
  • The D-STAR codec is known as **AMBE (Advanced Multi-Band Excitation)** from Digital Voice Systems, Inc (DVSI) ([www.dvsinc.com](http://www.dvsinc.com))
  • The voice signal is transmitted in the D-STAR system at 3,600 bps (3.6kbps)
AMBE-2020™ Vocoder Chip

Now Available! PC Decoder Software for AMBE-2000™ and AMBE-2020™ Applications

For OEM customers purchasing DVSIs AMBE-2000™ or AMBE-2020™ vocoder chips, DVSIs can provide PC-based decoder software that is able to decode speech from the encoded bit stream by the vocoder chip. This decoder software, which operates at select bit rates, is available under DVSIs license. It enables a PC to playback speech from an encoded bit stream produced by AMBE-2000™ or AMBE-2020™ vocoder chips, and can be used in a wide range of applications.

This PC-based decoder software (executable code) is offered through a standard software license agreement. Please contact DVSIs for more details.
Analogue FM Transmitter Block Diagram
Look inside the D-STAR radio

Analog Speech → 2.4kbps digitized voice + FEC → AMBE → Controller

Controller → 4.8kbps (3.6 voice + 1.2 data) → Modem

Modem → GMSK Signal

Diagram includes analog speech, AMBE, controller, modem, and GMSK signal visualization with header and data fields.
Digital Voice Encoder
Some Protocol Specification Terminology

• Digital Voice (DV)
  • 3600 bps data stream real time encoded with
    • 2400 bps voice (AMBE encoded)
    • 1200 bps Forward Error Correction (FEC) for voice
  • 1200 bps data (text messages, GPS, telemetry, etc.)
    • About 900 bps available for transmission of “user data”
  • 6.25 kHz. Bandwidth using GMSK

• Digital Data (DD) (23cm only - ID-1 Radios)
  • 128 kbps data stream
  • 150 kHz. Bandwidth
  • Possible extensions to other rates and bandwidths
D-STAR Radio Frame Structure in DV mode
-- The work of the “Controller”
The DV Protocol
Common Air Protocol – Techie Stuff

Radio Header — Data

Bit Synchronization
64 bits

Frame Sync
15 bits

Flag 1
8 bits

Flag 2
8 bits

Flag 3
8 bits

Radio ID

P_FCS

Destination Repeater Call
64 bits/8 char
K7LWH B

Local Repeater Call
64 bits/8 char
K7LWH C

Destination Station Call
64 bits/8 char
CQ CQ CQ

This Station Call
64 bits/8 char
K7VE

This Station Comment
32 bits/4 char
JOHN

Digital Communications Conference XXIX
Vancouver, WA, USA 24-26 September 2010
The DV Protocol
Common Air Protocol – Techie Stuff

- Radio Header
- Data
- Audio Frame 72 bits
- Data Frame 24 bits
- Final Data Frame 48 bits

Alternating Audio/Data
FEC on Audio but not on Data
D-STAR Radio Frame Structure Notes

1) The preamble of radio frame according [shogen] consists of 64 bits (alternating 1 and 0). Based on the fact, that conventional amateur transmitter needs more time to lock its PLL after the PTT was activated, the preamble is transmitted up to 550bits (and longer), before the "frame sync" will be started. The "frame sync" is following bit pattern: \{1,1,1,0,1,0,0,1,0,0,0,0\}. 

2) The "sync flag" consists of following bit pattern: \{1,0,1,0,1,0,1,0,1,0,1,0\} + \{1,1,0,1,0,0,0\} + \{1,1,0,1,0,0,0\}. The "sync flag" is transmitted in the 1st and than in each 21th data time slot. The "sync flag" is used in the receiver for correction of time synchronization to the transmitter as well it is used as preamble in case if the receiver was switched on during an ongoing transmission and missed the regular header.

3) The "terminating flag" is send at the end of the ongoing transmission in order to indicate a regular end of it. The "terminating flag" consists of \{1,0,1,0,...,1,0,1,0\}32 Bit+ \{0,0,0,1,0,0,1,1,0,1,0,1,1,1,1,0\} 16Bit. After that approximately 20 Zeros or Ones are send. The Transmitter is switched off (PTT deactivation) after 10th such Zero or One.
Look inside the D-STAR radio

Analog Speech → AMBE → Controller → Modem → GMSK Signal

- 2.4kbps digitized voice + FEC
- 4.8kbps (3.6 voice + 1.2 data)

GMSK Signal

Analog Speech

Signal

Modem
In digital communication, Gaussian minimum shift keying or GMSK is a continuous-phase frequency-shift keying modulation scheme. It is similar to standard minimum-shift keying (MSK); however the digital data stream is first shaped with a Gaussian filter before being applied to a frequency modulator. This has the advantage of reducing sideband power, which in turn reduces out-of-band interference between signal carriers in adjacent frequency channels. However, the Gaussian filter increases the modulation memory in the system and causes intersymbol interference, making it more difficult to differentiate between different transmitted data values and requiring more complex channel equalization algorithms such as an adaptive equalizer at the receiver. GMSK has high spectral efficiency, but it needs a higher power level than QPSK, for instance, in order to reliably transmit the same amount of data.
GMSK basics

GMSK modulation is based on MSK, which is itself a form of continuous-phase frequency-shift keying. One of the problems with standard forms of PSK is that sidebands extend out from the carrier. To overcome this, MSK and its derivative GMSK can be used.

MSK and also GMSK modulation are what is known as a continuous phase scheme. Here there are no phase discontinuities because the frequency changes occur at the carrier zero crossing points. This arises as a result of the unique factor of MSK that the frequency difference between the logical one and logical zero states is always equal to half the data rate. This can be expressed in terms of the modulation index, and it is always equal to 0.5.
Generating GMSK using a Gaussian filter and VCO

A second method is more widely used. Here what is known as a quadrature modulator is used. The term quadrature means that the phase of a signal is in quadrature or 90 degrees to another one. The quadrature modulator uses one signal that is said to be in-phase and another that is in quadrature to this. In view of the in-phase and quadrature elements this type of modulator is often said to be an I-Q modulator. Using this type of modulator the modulation index can be maintained at exactly 0.5 without the need for any settings or adjustments. This makes it much easier to use, and capable of providing the required level of performance without the need for adjustments. For demodulation the technique can be used in reverse.

Block diagram of I-Q modulator used to create GMSK
T-MARC – getting a 2M or 440 repeater frequency pair – is a huge challenge

The D-STAR voice and low speed data signal offers a significant improvement in spectrum efficiency, requiring only a 6 Khz channel instead of the 20,25, or even 30Khz of analog wide-band FM.

D-Star repeaters could be “interleaved” between existing analogue 2M / 440 channels.
D-STAR
Spectral Efficiency
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• D-STAR Routing
What Can I do with it ...

D-Star Network – Interconnects the “gateways” - Infrastructure to enable moving voice packets encoded by the AMBE vocoder, locally, regionally, or globally.

Simplex Operation

Local Repeater

Germantown, MD

San Francisco, CA

London

Add an Internet “gateway function” to the Repeater
Application 1: Digital voice (DV mode)
Analog audio is modulated to a digital signal and transmitted in the digital mode signal by the D-STAR radio.

Voice is crisp and clear!

Application 2: Short data message (DV mode)
Call sign identification and short data messages are available.

HELLO

Application 3: GPS tracking (DV mode)
With a GPS receiver, you can send your current position information to another radio.

Application 4: Internet access (DD mode)*
In DD mode operation, you can access to the Internet via a D-STAR Internet gateway. Connect a PC with the ID-1 and you can browse web sites or check e-mail.

Application 5: IP camera (DD mode)
You can transmit live images in DD mode and watch real-time images from a remote location.

Internet connection*
The Internet gateway allows linking of D-STAR repeater sites over the Internet. You can uplink to your local repeater and downlink from a remote repeater, even from a foreign country!

GPS satellite

Some restrictions may apply depending on specific countries’ regulations.
http://aprs.fi/info/DSTAR

Position reported via APRS (144.390 Mhz)

Position reported via D-STAR (any D-StAR repeater)
<table>
<thead>
<tr>
<th>Gateway Name</th>
<th>Status</th>
<th>Type</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gateway 1</td>
<td>Online</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gateway 2</td>
<td>Offline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gateway 3</td>
<td>Online</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gateway 4</td>
<td>Offline</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

388 (75%) Gateways Up To Date, 126 with errors - Thu, 30 Dec 14 04:57:59 +0000

http://dsync.dstarusers.org/
Reflector Operation

Internet (D-Star Network)

- REF025B
- REF001C
- REF068A

Germantown, MD
Frederick, MD
London
Alexandria, VA
Naples, Italy
Rome, Italy
# D-STAR - Reflectors

<table>
<thead>
<tr>
<th>Reflectors</th>
<th>Usage</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-STARb</td>
<td>D-STARa MacroRepeater</td>
<td>London, England</td>
</tr>
<tr>
<td>D-STARc</td>
<td>Southeast US D-STAR Weather Nat</td>
<td>NE, United States</td>
</tr>
<tr>
<td>D-STARd</td>
<td>Suncoats</td>
<td>NE, United States</td>
</tr>
<tr>
<td>D-STARe</td>
<td>Suncoats</td>
<td>NE, United States</td>
</tr>
<tr>
<td>D-STARf</td>
<td>Antenna &amp; Emergency Use - Australia</td>
<td>Australia</td>
</tr>
<tr>
<td>D-STARg</td>
<td>Permalink for Reflectors, Including all VHF Port &amp; Repeaters - Australia</td>
<td>Australia</td>
</tr>
<tr>
<td>D-STARh</td>
<td>Australian Nets</td>
<td>Australia</td>
</tr>
<tr>
<td>D-STARi</td>
<td>Antennas for SouthEast US D-STAR Weather Nat</td>
<td>United States</td>
</tr>
<tr>
<td>D-STARj</td>
<td>Texas Permalink Repeaters</td>
<td>United States</td>
</tr>
<tr>
<td>D-STARk</td>
<td>General Req Chev (Given only please)</td>
<td>United States</td>
</tr>
<tr>
<td>D-STARl</td>
<td>UK Nets, Permalink Repeaters</td>
<td>London, England</td>
</tr>
<tr>
<td>D-STARm</td>
<td>French Language - Swiss and French users</td>
<td>London, England</td>
</tr>
<tr>
<td>D-STARn</td>
<td>Scottish Net</td>
<td>London, England</td>
</tr>
<tr>
<td>D-STARo</td>
<td>Irish Net</td>
<td>London, England</td>
</tr>
<tr>
<td>D-STARp</td>
<td>German Net</td>
<td>London, England</td>
</tr>
<tr>
<td>D-STARq</td>
<td>Florida</td>
<td>Orlando, FL, United States</td>
</tr>
<tr>
<td>D-STARr</td>
<td>Florida</td>
<td>Orlando, FL, United States</td>
</tr>
<tr>
<td>D-STARs</td>
<td>Florida</td>
<td>Orlando, FL, United States</td>
</tr>
<tr>
<td>D-STARt</td>
<td>Japan G2 repeaters, DVBsingles and DVBs</td>
<td>Japan</td>
</tr>
<tr>
<td>D-STARu</td>
<td>Japan G2 repeaters, DVBsingles and DVBs</td>
<td>Japan</td>
</tr>
<tr>
<td>D-STARv</td>
<td>Japan G2 repeaters, DVBsingles and DVBs</td>
<td>Japan</td>
</tr>
<tr>
<td>D-STARw</td>
<td>AZ, United States</td>
<td>AZ, United States</td>
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<td>D-STARx</td>
<td>AZ, United States</td>
<td>AZ, United States</td>
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<tr>
<td>D-STARy</td>
<td>Arizona Permalink Repeaters</td>
<td>AZ, United States</td>
</tr>
<tr>
<td>D-STARz</td>
<td>Emergency Communications</td>
<td>New England, United States</td>
</tr>
<tr>
<td>D-STARaa</td>
<td>New England Repeaters</td>
<td>New England, United States</td>
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<tr>
<td>D-STARab</td>
<td>Italy</td>
<td>Italy</td>
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<tr>
<td>D-STARac</td>
<td>Italy</td>
<td>Italy</td>
</tr>
<tr>
<td>D-STARad</td>
<td>Italy</td>
<td>Italy</td>
</tr>
<tr>
<td>D-STARae</td>
<td>Southern California, United States</td>
<td>Southern California, United States</td>
</tr>
<tr>
<td>D-STARaf</td>
<td>Southern California, United States</td>
<td>Southern California, United States</td>
</tr>
<tr>
<td>D-STARag</td>
<td>Public Service, Skywarn &amp; Emergency Use</td>
<td>Washington, DC, United States</td>
</tr>
<tr>
<td>D-STARah</td>
<td>National Capital Region Association Permalink</td>
<td>Washington, DC, United States</td>
</tr>
<tr>
<td>D-STARai</td>
<td>General Usage &amp; Sunday Night NCR Nat</td>
<td>Washington, DC, United States</td>
</tr>
</tbody>
</table>
D-STAR Growth Continues

- As of May 1, 2014 – 1,111 DPLUS Gateways, over 2,575 Voice Repeaters, 218 Data Modules and 34,298 registered users on US Trust Server and 62+ DPLUS reflectors in operation
- Other users, repeaters and reflectors on DCS and XREF systems

- D-STAR has largest base of users and repeaters of all digital modes
From D-STARUSERS.ORG – Watch D-Star Grow
(snap shot taken on 01/02/2015)
Topics

• D-STAR – What is it?
• What Can I do with it?
• The Repeater / Gateway System
• D-STAR User Equipment
• D-STAR User Registration
• Your First D-STAR Call - The Four Call Signs
• D-STAR Routing
D-STAR OV-1  (From ICOM – New Concept Sheet)

Features of the D-STAR System

- Digitally-modulated voice and data communication
- High-speed 64–128 kbps data access
- Complies with IP connection
- Repeaters can handle both digital and analog voice
- System operates on multi-site and backbone connection
Many D-Star repeater installations have more than one repeater. Each repeater is on a different amateur radio band. By convention:

- The “C” module is on the “2m” band (144-148 MHz).
- The “B” module is on the “70cm” band (440-450 MHz).
- The “A” module is on the “23cm” band (1.2 GHz).
Provision for an “Alternate Backbone”
ICOM -- D-STAR Controller – and 70cm RF deck
ICOM Repeater Controller
ICOM Repeater Controller – Block Diagram
We are one node in the D-Star Network

Germantown, MD

San Francisco, CA

London
<table>
<thead>
<tr>
<th>Gateway</th>
<th>Status</th>
<th>IP Address</th>
<th>Location</th>
<th>Type</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gateway1</td>
<td>Up</td>
<td>192.168.1.1</td>
<td>North</td>
<td>Data</td>
<td>Normal</td>
</tr>
<tr>
<td>Gateway2</td>
<td>Down</td>
<td>192.168.2.1</td>
<td>South</td>
<td>Data</td>
<td>Failed</td>
</tr>
<tr>
<td>Gateway3</td>
<td>Up</td>
<td>192.168.3.1</td>
<td>East</td>
<td>Data</td>
<td>Normal</td>
</tr>
</tbody>
</table>

*Note: The table above shows the status of various gateways, their IP addresses, locations, types, and any remarks about their status.*
### KV3B Gateway – Detailed Status

<table>
<thead>
<tr>
<th>Date/Status Tag</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Registration Status:</strong></td>
<td>Registered with US Root.</td>
</tr>
<tr>
<td><strong>Last Synchronization:</strong></td>
<td>2014-12-30 04:56:49 (3 minutes ago)</td>
</tr>
<tr>
<td><strong>Required Update Status:</strong></td>
<td>No recent updates!</td>
</tr>
<tr>
<td><strong>Latest Checksum Reported:</strong></td>
<td>Checksums: All up to date (2014-12-30 05:00:34)</td>
</tr>
<tr>
<td><strong>Previous Checksum Reported:</strong></td>
<td>Checksums: All up to date (2014-12-30 04:45:35)</td>
</tr>
<tr>
<td><strong>Gateway Software</strong></td>
<td>Icom G2</td>
</tr>
<tr>
<td><strong>System Clock</strong></td>
<td>Okay</td>
</tr>
<tr>
<td><strong>Last Status Reported:</strong></td>
<td>dsipsvd (root:19192) dsgwd (root:19150) postgres (postgres:19055) httpd (root:19084) java (root:2437) dplus (root:10611) named (named:1915) DSM 3.0.4b02 Running, PID = 2437 Mem: 455MB Free, 2534MB Total GW_VER=2.1</td>
</tr>
<tr>
<td><strong>Last Version Reported:</strong></td>
<td>/dstar/scripts/gw_schedule 2.1b Linux version 2.6.18-398.el5</td>
</tr>
<tr>
<td><strong>Unique IPs in 48 hours</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>trust Server Info Reported:</strong></td>
<td>Valid Trust Server Entry usroot.dstarusers.org 10.0.0.1 (2014-12-30 04:45:35)</td>
</tr>
<tr>
<td><strong>Registration Page</strong></td>
<td>Registration Page Okay</td>
</tr>
<tr>
<td><strong>Dplus Page</strong></td>
<td>DPLUS Page Okay</td>
</tr>
</tbody>
</table>
KV3B Gateway – DPLUS Dashboard

https://kv3b.dstargateway.org/

--- or ---

https://dstar-mc.marcclub.org/

DPLUS Dashboard | Gateway Status and Control

Registration | KV3B Repeater System | DPLUS version 3.2v

Linked Gateways / Reflectors

<table>
<thead>
<tr>
<th>Module</th>
<th>Linked to</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>unlinked</td>
</tr>
<tr>
<td>B</td>
<td>REF025 B</td>
</tr>
<tr>
<td>C</td>
<td>unlinked</td>
</tr>
<tr>
<td>D</td>
<td>unlinked</td>
</tr>
<tr>
<td>E</td>
<td>unlinked</td>
</tr>
</tbody>
</table>

Remote Users

<table>
<thead>
<tr>
<th>Callsign</th>
<th>User Message</th>
<th>Last TX</th>
<th>Type</th>
</tr>
</thead>
</table>

Last Heard

<table>
<thead>
<tr>
<th>Callsign</th>
<th>User Message</th>
<th>Last TX</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>N3OXA</td>
<td>Randy QTH Ellridge,</td>
<td>B</td>
<td>2015/01/04 17:06:47</td>
</tr>
</tbody>
</table>

Status as of 2015/01/05 13:55:29
Topics

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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
• Used by MED team during MCM to provide TCP/IP connectivity
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
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
DV Dongle -- $199.95

• 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.
DV Dongle – Connectivity

NOTE: No Radio Present!
DV Access Point (DVAP) -- $250

- 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
DVAP Connectivity

Must be a D-STAR enabled HT

Typical range:
Several hundred feet
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**

Must be a D-STAR enabled HT
New MARC D-STAR RaspberryPi based HotSpot

- RaspberryPi
  - Running Maryland D-Star Image (loaded on Memory card – visible)
  - (powered 5v - via USB cable/PS)

- DVRPTR
  - DVRPTR_V1 9600 GMSK Modem
    - (connects to radio – audio in, audio out, PTT)
    - (USB serial connection to Pi)
    - (powered 12v - by wall wart)

- Motorola GM300 Radio
  - 446.050Mhz, 25 Watts (Analogue)

Plugs into LAN Switch
For Dongle, DVAP, Hotspot – Need to “punch holes” in your home Firewall for Digital Voice Audio Streams

![Port Range Forward settings in Linksys Wireless-G Broadband router](image)
D-Star Hardware Review

- No D-Star Radio Required
  - DV Dongle
- D-Star Radio Required
  - DVAP (DV Access Point)
  - D-Star Hot Spot
  - D-Star Repeater
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Why Registration Required?

NOT REQUIRED

NOT REQUIRED

REQUIRED

D-STAR Network
Registration Document Available

• We have a nice 7 page document (with screen shots) listing the 12 simple steps

• Overview
  • Submit a “registration request” to the KV3B Gateway
    • Send an email to WA3SWJ@arrl.net to poke him about a registration that needs to be approved!
  • D-STAR Sys Admin verifies (1) active FCC license and that (2) you are not already registered at another gateway.
    • You only need to be registered at one of the Gateway’s in the D-STAR system
  • Sys Administrator notifies you that your registration has been completed
  • You log into your account on the Gateway and configure your personnel information
    • Register your D-STAR Device(s) (HT, Hotspot, mobile, etc)
KV3B Registration Page
https://dstar-mc.marcclub.org/LogoutAction.do

D-STAR Gateway System (KV3B)

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

CallSign: 
Password: 

Login

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.

Register

D-STAR is a digital protocol developed by the Japan Amateur Radio League (the JARL)
and stands for Digital Smart Technology for Amateur Radio.
Registration Request

D-STAR Gateway System (KV3B)

The agreement document

I agree to abide by all rules and regulations of The Montgomery [Maryland] Amateur Radio Club (MARC) and FCC regulations Part 97. I understand that should I not comply, I may be removed permanently from the D-Star network without warning. For more information, visit www.marcclub.org

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
After notification by Sys Admin – Complete Personnal Information

D-STAR Gateway System (KV3B)

<table>
<thead>
<tr>
<th>User Information</th>
<th>GW Information</th>
<th>Terminal Information</th>
<th>Personal Information</th>
</tr>
</thead>
</table>

Please, edit after making a left check box on.
- Name: Fred Baker
- Email: k3csk@qmail.net
- Password: [Hidden]
- Password Confirm: [Hidden]

If the station has multiple radios, Target CS are distinguished by initial (or character) of a space or a capital English letter.
Definition character as follows: (G) Gateway, (L) Local server.
Usually RPT (Repeater) left checked. Initial AareaRPT CS is the part of AreaRPT CS.
If RPT is checked AreaRPT CS is the same as Target CS.

<table>
<thead>
<tr>
<th>Initial</th>
<th>RPT</th>
<th>local IP</th>
<th>CS Name</th>
<th>Del</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>10.166.07.252</td>
<td>k3csk donor</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>10.166.07.253</td>
<td>k3csk donor</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>10.166.07.254</td>
<td>k3csk donor</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>10.166.07.255</td>
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<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>10.166.07.256</td>
<td>k3csk donor</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>10.166.07.257</td>
<td>k3csk donor</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>10.166.07.258</td>
<td>k3csk donor</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>10.166.07.259</td>
<td>k3csk donor</td>
<td></td>
</tr>
</tbody>
</table>

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

• D-STAR – What is it?
• What Can I do with it?
• The Repeater / Gateway System
• D-STAR User Equipment
• D-STAR User Registration
• Your First D-STAR Call - The Four Call Signs
• D-STAR Routing
The Four call signs -- terminology

- The terminology is from the viewpoint of the communication link!
  - “MyCall” is really YOUR call sign; that is, you, the guy or gal holding the radio or microphone.
  - “YourCall” (also called “UrCall”) is really the call sign of the OTHER person, that is, the person you want to talk to (you only set this when you use the D-Star gateway system).
  - “Rpt1Call” (also called “R1Call”) is the call sign of the local repeater.
  - “Rpt2Call” (also called “R2Call”) is the call sign of the local gateway computer.
D-STAR CALLSIGN Fields

---- For Local simplex Operation

**FOUR CALLSIGNS**

- **THE ORIGINATION**  MYCALL    W2TAP
- **THE DESTINATION**  URCALL    CQCQCQ
- **THE FIRST ROUTING**  RPTC1    not used
- **THE NEXT ROUTING**  RPTC2    not used
**D-STAR CALLSIGN Fields – the Magical 8th Character**

- **CALLSIGNS**
  - The station’s call is up to **7 Characters** long
    - By definition the MYCALL must be the legal callsign of the originating station. Additional ID on the MYCALL of 4 characters
      - The MYCALL will look like “W2TAP ___ / Ron_”
      - The “/Ron_” portion is not used for routing
  - The 8th Character of a callsign is the PORT of a D-Star Repeater
    - The Ports are by convention
      - A is 1200 Mhz or BLANK is routed as an “A”
      - B is 440 Mhz
      - C is 144 Mhz
      - G is the GATEWAY COMPUTER  *use only in RPTC2*
<table>
<thead>
<tr>
<th>Receive Frequency</th>
<th>Transmit Frequency</th>
<th>Offset Frequency</th>
<th>Offset Direction</th>
<th>Operating Mode</th>
<th>Name</th>
<th>Your Callsign</th>
<th>Rpt-1 CallSign</th>
<th>Rpt-2 CallSign</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>KV3B ID</td>
<td>KV3B B</td>
<td>KV3B G</td>
</tr>
<tr>
<td>1</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>KV3B B</td>
<td>CQC QCQC</td>
<td>KV3B B</td>
</tr>
<tr>
<td>2</td>
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<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>ECHO</td>
<td>KV3B E</td>
<td>KV3B B</td>
</tr>
<tr>
<td>3</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>UNLINK</td>
<td>U</td>
<td>KV3B B</td>
</tr>
<tr>
<td>4</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>REF020A</td>
<td>REF020AL</td>
<td>KV3B B</td>
</tr>
<tr>
<td>5</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>REF025B</td>
<td>REF025BL</td>
<td>KV3B B</td>
</tr>
<tr>
<td>6</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>REF001C</td>
<td>REF001CL</td>
<td>KV3B B</td>
</tr>
<tr>
<td>7</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>REF030C</td>
<td>REF030CL</td>
<td>KV3B B</td>
</tr>
<tr>
<td>8</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>REF030D</td>
<td>REF030DL</td>
<td>KV3B B</td>
</tr>
<tr>
<td>9</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>REF DATA</td>
<td>REF015CL</td>
<td>KV3B B</td>
</tr>
<tr>
<td>10</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>REC</td>
<td>KV3B S0</td>
<td>KV3B B</td>
</tr>
<tr>
<td>11</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>PLAY</td>
<td>KV3B R0</td>
<td>KV3B B</td>
</tr>
</tbody>
</table>

7 spaces an the letter “I” in the 8th position
Reflector Operation

Internet (D-Star Network)

- REF025B
- REF001C
- REF068A

Locations:
- Germantown, MD
- Frederick, MD
- Alexandria, VA
- London
- Naples, Italy
- Rome, Italy

Connecting the dots with communication symbols.
Topics

- D-STAR – What is it?
- What Can I do with it?
- The Repeater / Gateway System
- D-STAR User Equipment
- D-STAR User Registration
- Your First D-STAR Call - The Four Call Signs
- D-STAR Routing
How is Traffic routed over the Internet

• **Gateway system**
  • *Associates* the user’s callsign with a discrete IP number within the gateway system
    • Accomplished by user registration
  • *Associates* distant repeater callsigns with discrete IP number within the system
    • Assigned when the gateway system is commissioned
    • *The IP numbers used in routing are NEVER needed beyond the inner workings of the gateway system*
    • *All that is needed are the CALLSIGNS which are available to the user’s “front panel”*
  • **Tracks** each user’s callsign last location
  • **Routes** traffic for that user to the last known repeater and port
What is Routing?

• Two Routing Methods
  • Site Routing
    • Where you want to talk
      • Specific *System/Gateways* and *Port*
  
• User Routing
  • Who you want to talk
    • Specific *User*
Site Routing (you specify the target Gateway/Repeater System)
User Routing (the D-Star Network “finds” the user for you)
Site Routing

- **Given this information**
  - W2TAP: Huntington, NY
  - W2KPQ: Selden, NY
  - W4DOC: Atlanta, GA
  - K6MDD: Mt. Diablo, CA
  - N7IH: Bellevue, WA (ICOM America HQ)
  - G7ICM: ICOM UK
  - VK8RAD: Darwin, Australia

- **And I programmed my Radio**
  - MYCALL = W2TAP
  - RPT 1 = W2KPQ--B
  - RPT 2 = W2KPQ--G
  - URCALL = /VK8RADB

**Results**

- My call would be routed from the W2KPQ repeater, over the gateway, and come out on the UHF module in Darwin Australia.

Note: The “/” as the first character to indicate repeater or site routing.
User Routing

- Given this same information
  - W2TAP: Batavia, IL
  - K5TIT: Dallas, TX
  - W4DOC: Atlanta, GA
  - K6MDD: Mt. Diablo, CA
  - N7IH: Bellevue, WA (ICOM America HQ)
  - G7ICM: ICOM UK
  - VK8RAD: Darwin, Australia

- And I programmed my radio
  - MYCALL = W2TAP
  - RPT 1 = W9CEQ---B
  - RPT 2 = W9CEQ---G
  - URCALL = N5MIJ

• Results
  - W2TAP’s voice and data communications would be routed from the W9CEQ repeater, over the gateway, and come out on the last RF module N5MIJ used anywhere in the world!
  - Pretty Cool!
Basic Callsign Routing – Another Example

Instructs the N7IH repeater to use its registry to find the repeater on which N9JA last operated and route the packets there via the gateway.
142 Unique call signs heard in the last 24 hours

### [Click here to disable refresh]

Current Time is 08/23/2007 15:18:37 UTC

<table>
<thead>
<tr>
<th>Call sign</th>
<th>Time Heard</th>
<th>Reporting Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>VE3EI</td>
<td>08/23/07 15:17:25 UTC</td>
<td>VE3YYZ C 2 Meters Toronto, Cn</td>
</tr>
<tr>
<td>K8IXA</td>
<td>08/23/07 15:12:08 UTC</td>
<td>W6HHH A 1.2GHz Atwater, Ca</td>
</tr>
<tr>
<td>WA6YTD</td>
<td>08/23/07 15:11:55 UTC</td>
<td>K6ADD C 2 Meters Mt. Diablo, Ca</td>
</tr>
<tr>
<td>G4TKR</td>
<td>08/23/07 15:04:40 UTC</td>
<td>GB7IC B 440 MHz ICOA UK</td>
</tr>
<tr>
<td>K9SGK</td>
<td>08/23/07 15:03:12 UTC</td>
<td>W9ICE B 440 MHz Indianapolis, In</td>
</tr>
<tr>
<td>WA4HZE</td>
<td>08/23/07 14:58:59 UTC</td>
<td>KI4SAZ C 2 Meters Magnolia Springs, Al</td>
</tr>
<tr>
<td>N9FNX</td>
<td>08/23/07 14:49:06 UTC</td>
<td>W9CEQ B 440 MHz Batavia, Il</td>
</tr>
<tr>
<td>NJ6N2</td>
<td>08/23/07 14:43:42 UTC</td>
<td>K6SOA A 1.2GHz Laguna Beach, Ca</td>
</tr>
<tr>
<td>KH4PB</td>
<td>08/23/07 14:43:19 UTC</td>
<td>KI4SAZ C 2 Meters Magnolia Springs, Al</td>
</tr>
<tr>
<td>W4MD</td>
<td>08/23/07 14:41:33 UTC</td>
<td>W4KCQ C 2 Meters Tuscaloosa, Al</td>
</tr>
<tr>
<td>WA4SYI</td>
<td>08/23/07 14:41:10 UTC</td>
<td>KI4PF C 2 Meters Huntsville, Al</td>
</tr>
<tr>
<td>KE4ROC 5</td>
<td>08/23/07 14:33:24 UTC</td>
<td>KI4PF C 2 Meters Huntsville, Al</td>
</tr>
<tr>
<td>K6W1L</td>
<td>08/23/07 14:31:51 UTC</td>
<td>K6ADD B 440 MHz Mt. Diablo, Ca</td>
</tr>
<tr>
<td>K6PR</td>
<td>08/23/07 14:24:24 UTC</td>
<td>W6HHH C 2 Meters Atwater, Ca</td>
</tr>
<tr>
<td>W9GF</td>
<td>08/23/07 14:18:56 UTC</td>
<td>KST1T C 2 Meters Dallas, Tx</td>
</tr>
<tr>
<td>W2XAB</td>
<td>08/23/07 14:17:28 UTC</td>
<td>W4DOC C 2 Meters Atlanta, Ga</td>
</tr>
<tr>
<td>KG4AYV</td>
<td>08/23/07 14:16:28 UTC</td>
<td>KST1T B 440 MHz Dallas, Tx</td>
</tr>
<tr>
<td>GB4FFQ</td>
<td>08/23/07 14:15:14 UTC</td>
<td>GB7IC B 440 MHz ICOA UK</td>
</tr>
<tr>
<td>K6FQR</td>
<td>08/23/07 14:08:54 UTC</td>
<td>K6ADD B 440 MHz Mt. Diablo, Ca</td>
</tr>
</tbody>
</table>
www.jfindu.net/DStarActivity.aspx

**K8BIG Repeaters**

**Locate K8BIG Repeaters**

- B Range: 50nm 440 Voice 444.000 +5.00 MHz
- C Range: 45nm 2m Voice 145.350 -0.600 MHz

**DV stations last heard on K8BIG**

<table>
<thead>
<tr>
<th>Station</th>
<th>Last Heard</th>
<th>Repeater</th>
</tr>
</thead>
<tbody>
<tr>
<td>KD8G1K</td>
<td>36s</td>
<td>K8BIG_C</td>
</tr>
<tr>
<td>K8BIG</td>
<td>3h32m37s</td>
<td>K8BIG_C</td>
</tr>
<tr>
<td>KD8BNS</td>
<td>10h42m3s</td>
<td>K8BIG_C</td>
</tr>
<tr>
<td>W4CVG</td>
<td>14h32m21s</td>
<td>K8BIG_C</td>
</tr>
</tbody>
</table>
Cross Band Operations

• System Configuration
  – 23cm DV       Port A
  – 23cm DD       Port A
  – 70cm DV       Port B
  – 2m DV         Port C

• Goal
  – To talk to friends on another band, same system.

• Callsign Programming
  • MYCALL = W2TAP
  • RPT 1 = NS9RC---B
  • RPT 2 = NS9RC---A
  • URCALL = CQCQCQ

• Result
  – Both Voice and Data Communications routed to NS9RC Port A, which is 1200 Mhz!
D-Star Routing

• There are four ways to communicate with other users on other D-Star repeaters, using the D-Star network:

  1. “Repeater routing” – this is part of the original D-Star design.
  2. “Call sign routing” – this is part of the original D-Star design.
  3. Using “repeater linking” – this capability was added by “D-Plus”, a gateway software add-on. (tying two repeaters together)
  4. Using “reflector linking” – this capability was added by “D-Plus”, a gateway software add-on.

• #s 1 & 2 are slightly complex, and if both you & the other user don’t “get it right”, you will not be able to talk.

• #s 3 & 4 are much simpler to setup & use, and often the repeater is already set in that mode.
D-Star “network routing” overview

- **Advantages of call sign routing:**
  1. You can call another user without knowing which repeater that user is currently on.
  2. Only “ties up” the two repeaters involved

- **Limitations of repeater or call sign routing:**
  1. You can’t hear what is happening on the remote repeater.
  2. You usually need to initially announce that you are remote, so that the remote user(s) know to set up their radios for repeater or call sign routing.
  3. If the remote user doesn’t setup his/her radio correctly, you will be unable to have a successful two-way conversation.
D-Star “network linking” overview

• Advantages of repeater or reflector linking:
  1. You can hear what is happening on the remote repeater(s).
  2. The remote user does not need to configure his/her radio in order to respond.
  3. A repeater can be left in this configuration for new users.

• Limitations of repeater or reflector linking:
  1. You can’t call another user without knowing which repeater that user is currently on.
D-Star repeater routing: call

• For the user wanting to contact another user using repeater routing, it’s easy:
  • You set the “YourCall” field to the other repeater’s call sign:
    • The first character is a slash (“/”),
    • followed by the other repeater’s call sign,
    • followed by spaces to pad the field to seven (7) characters,
    • followed by the other repeater’s module (“A”, “B”, or “C”) in the 8th character position.
  • The gateway computer routes the call to the indicated remote repeater.
D-Star call sign routing: reply

• If other users at the remote repeater hear your call and wish to reply, they must program their radios to send their transmissions back to the caller.

• To do this, they must set “YourCall” to either:
  1. the caller’s callsign; or
  2. the call sign of the repeater that the caller is on.

• This can be done by either:
  1. Manually setting the “YourCall” field; or
  2. immediately (before anyone else transmits) pressing the “RX->CS” button (the label varies among radio models).
Call sign vs. repeater routing

• So, what’s the difference?

• Note that the radio setup to reply, appears to be the same for both call sign routing and for repeater routing!

• Both call sign routing and repeater routing accomplish the exact same thing!

• What is different, depends upon your intent:
  • If the person you are talking to, moves (eg, mobile) to another repeater, call sign routing will automatically route your transmissions to the new repeater.
  • Repeater routing is fixed until you change “YourCall”.

D-Star Network
D-Star Call Sign Routing - Challenges

• Features: common to both call sign and repeater routing:
  • All radios listening to either repeater can hear both sides of the conversation. **HOWEVER:**
  • If any other listener transmits on either repeater, only other listeners on that repeater will hear the transmission, **UNLESS** they **ALSO** program their radios for call sign or repeater routing.
  • This means if someone attempts to join the conversation, the local user should mention that call sign routing is in use.
D-Star call routing summary

• Normally, call sign routing is easier for the replying station to set (via the “Rx->CS” button), so it is normally used for remote calling.

• Repeater routing might be best if you want to talk to just anyone on the remote repeater.

• Of course, in any routing communications, some users can be using call sign routing and some can be using repeater routing.
D-Star linking - Using Reflectors

• Linking to D-Star repeaters and reflectors is made possible by the D-Star gateway software add-on by Robin Cutshaw / AA4RC.

• Linking to D-Star repeaters and reflectors was not envisioned in Icom’s design of the D-Star network:
  • You can only link two D-Star repeaters together
  • A reflector is very similar to a D-Star gateway, but without any repeater modules. You can link many D-Star repeaters to one reflector.
D-Star network commands

- These commands only work if:
  1. You have set the “Rpt2Call” field to specify your local gateway (otherwise the gateway will never see them).
  2. Your local gateway must be running:
     - “D-Plus”, the gateway software add-on (written by Robin Cutshaw / AA4RC) to Icom’s gateway software; or
     - “D-Extra” software on systems running non-Icom gateway software.

- These commands are set into the “YourCall” field of the radio. You key your radio to send the command to the gateway.
### ID 880 Programming – using RT Systems

<table>
<thead>
<tr>
<th>Receive Frequency</th>
<th>Transmit Frequency</th>
<th>Offset Frequency</th>
<th>Offset Direction</th>
<th>Operating Mode</th>
<th>Name</th>
<th>Your Callsign</th>
<th>Rpt-1 Callsign</th>
<th>Rpt-2 Callsign</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>KV3B ID</td>
<td>KV3B</td>
<td>KV3B G</td>
</tr>
<tr>
<td>1</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>KV3B B</td>
<td>CQCQC QC</td>
<td>KV3B</td>
</tr>
<tr>
<td>2</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>ECHO</td>
<td>KV3B E</td>
<td>KV3B</td>
</tr>
<tr>
<td>3</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>UNLINK</td>
<td>U</td>
<td>KV3B</td>
</tr>
<tr>
<td>4</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>REF020A</td>
<td>REF020AL</td>
<td>KV3B</td>
</tr>
<tr>
<td>5</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>REF025B</td>
<td>REF025BL</td>
<td>KV3B</td>
</tr>
<tr>
<td>6</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>REF001C</td>
<td>REF001CL</td>
<td>KV3B</td>
</tr>
<tr>
<td>7</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>REF030C</td>
<td>REF030CL</td>
<td>KV3B</td>
</tr>
<tr>
<td>8</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>REF030D</td>
<td>REF030DL</td>
<td>KV3B</td>
</tr>
<tr>
<td>9</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>REF DATA</td>
<td>REF015CL</td>
<td>KV3B</td>
</tr>
<tr>
<td>10</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>REC</td>
<td>KV3B S0</td>
<td>KV3B</td>
</tr>
<tr>
<td>11</td>
<td>444.20000</td>
<td>449.20000</td>
<td>5.00 MHz</td>
<td>+DUP</td>
<td>DV</td>
<td>PLAY</td>
<td>KV3B R0</td>
<td>KV3B</td>
</tr>
</tbody>
</table>

7 spaces an the letter “I” in the 8\(^{th}\) position
“Can you hear me now?”

- (with apologies to Verizon’s advertising slogan).

- Ever want a **truly objective** signal report? Use the “echo” command:
  - Program a “**YourCall**” value of seven (7) spaces, followed by an “E” in the 8th (module) position.
  - Key your radio & speak a short test message of your choice (I recommend using the words “echo test” in it).
  - When you unkey your radio, the gateway will play back (“echo”) your transmission.
  - Remember to change your “**YourCall**” value back!
D-Star repeater linking

- To link to another repeater (running “D-Plus” or “D-Extra”), you set the “YourCall” field to the other repeater’s call sign:
  - Enter the other repeater’s call sign,
  - followed by spaces to pad the field to six (6) characters,
  - followed by the other repeater’s module (“A”, “B”, or “C”) in the 7th character position,
  - followed by the “link” command (“L”) in the 8th character position.
- Key the radio briefly ONCE to set the link; you will hear a voice message announcing the result.
- Remember to change your “YourCall” value back!
After the link ...

• Once the link to a D-Star repeater or reflector has been established:
  • All repeaters linked together act as one repeater, with one caveat:
  • All users must insure that the “Rpt2Call” field is set to their local repeater’s gateway, or their transmissions will not be heard on the other repeater(s).
  • Users should set the “YourCall” field to “CQCQCQ” or “/” (the latter is required on D-star radios using the “DR” (“D-Star Repeater”) mode.)
D-Star unlinking

• Program a “YourCall” value of seven (7) spaces, followed by an “U” in the 8th (module) position.
• Key your radio
• When you unkey your radio, the gateway will play “say” UNLINKED
• Remember to change your “YourCall” value back!
D-Star tip: The new “DR” mode

- Icom’s new “D-Star Repeater” mode separates the “YourCall” memories from the “Rpt1Call”/“Rpt2Call” memories.
- In “DR” mode, you can select the “YourCall” value, and then scroll through the “Rpt1Call”/“Rpt2Call” memories without changing the “YourCall” value.
- Tip: Enter the “DR” mode first, before selecting a “YourCall” value.
- Tip: Save & use “/” as a “YourCall” value in place of “CQCQCQ”. When “YourCall” contains “CQCQCQ”, the “DR” mode will blank out the “Rpt2Call” field, and your transmissions will not be routed to the gateway (or a linked repeater or reflector).
## The DD Protocol

**Common Air Protocol – Techie Stuff**

<table>
<thead>
<tr>
<th>Radio Header</th>
<th>Length 16 bits</th>
<th>Ethernet Packet</th>
</tr>
</thead>
</table>

### Bit Synchronization
- 64 bits

<table>
<thead>
<tr>
<th>Frame Sync</th>
<th>Flag 1</th>
<th>Flag 2</th>
<th>Flag 3</th>
<th>Radio ID</th>
<th>P_FCS</th>
</tr>
</thead>
</table>
- 15 bits   | 8 bits | 8 bits | 8 bits |          |       |

### Destination
- Repeater Call: 64 bits/8 char
- Station Call: 64 bits/8 char

<table>
<thead>
<tr>
<th>Destination</th>
<th>Local Repeater Call</th>
<th>Destination Station Call</th>
<th>This Station Call</th>
<th>This Station Comment</th>
</tr>
</thead>
</table>
- K7LWH G    | K7LWH A             | CQCQCQC                  | K7VE              | JOHN                |

---

**Digital Communications Conference XXIX**
Vancouver, WA, USA 24-26 September 2010
The DD Protocol
Common Air Protocol – Techie Stuff

<table>
<thead>
<tr>
<th>Radio Header</th>
<th>Length 16 bits</th>
<th>Ethernet Packet</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC Src Addr 48 bits</td>
<td>MAC Dest Addr 48 bits</td>
<td>Type 16 bits</td>
</tr>
<tr>
<td>Data Frame 128 – 12000 bits</td>
<td>FCS 32 bits</td>
<td>TCP/IP or Other</td>
</tr>
</tbody>
</table>

Digital Communications Conference XXIX
Vancouver, WA, USA 24-26 September 2010
D-Star network information

- This could be a whole session, so I will just list a few:
  - www.DstarDB.com (my site: tracks D-Star usage)
  - www.dstarinfo.com (D-Star programming calculator)
  - www.dstarusers.org (D-Star repeater list)
  - www.jfindu.net (and other APRS stuff)
  - www.aprs-is.net/DPRSCalc.aspx (D-PRS calculator)
Resources

- http://dstarinfo.com
- http://dstarusers.org
- http://www.moencomm.com
  - http://www.k6jm.com/hs-setup.htm
- http://groups.yahoo.com
  - dstar_digital
  - gmsk_dv_node
  - DStar-Gateway
- http://dutch-star.eu
- http://www.k5tit.org
- http://ok-dstar.blogspot.com
Questions