



D-Star Update

Presentation to Hornsea Amateur Radio Society
by Andy Russell, G0VRM

30th Jan 2013

D-Star Update

- What is D-Star
- D-Star Repeaters
- Call Sign Routing
- Linking to Reflectors
- Programming Software
- Gateway Demonstration
- Digital Voice and Data
- GPS Tracking
- Low Speed Data
- Application Software



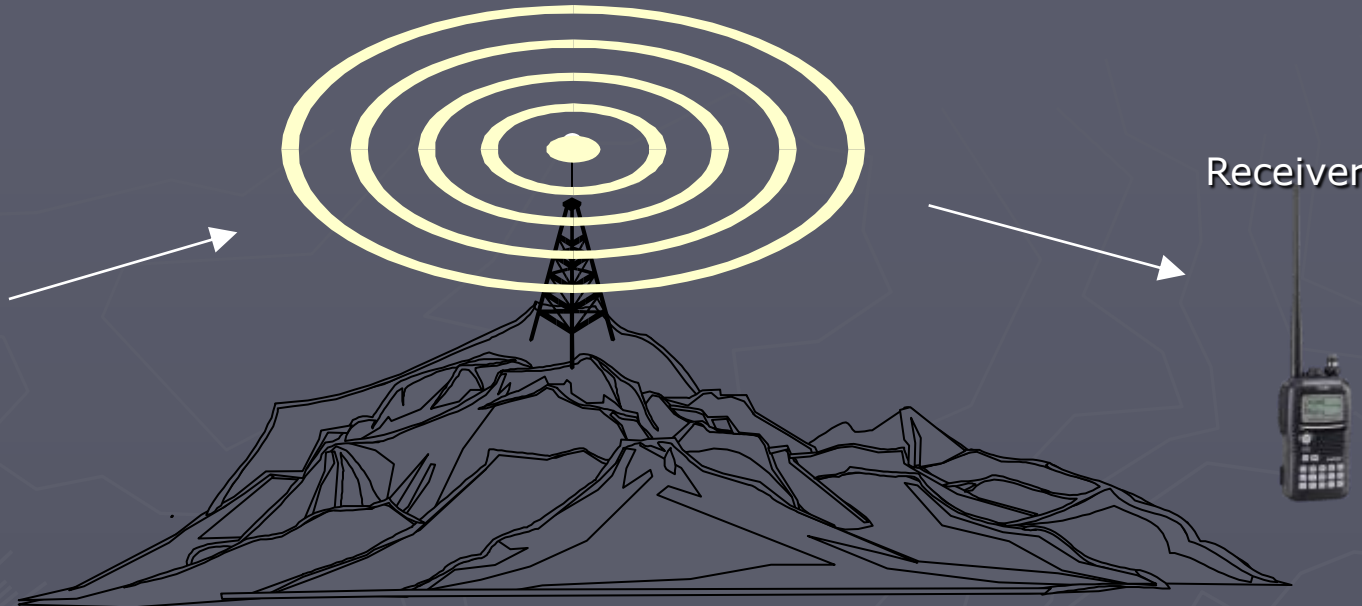
What is D-Star ?

- D-STAR is a Digital Voice protocol developed specifically for amateur radio use by the Japan Amateur Radio League funded by Japanese Government
- The D-Star protocol supports both over the air transmissions and Internet connectivity in a way that is completely transparent to the user
- D-Star users can communicate locally or globally via Internet linked repeaters with the result that you have a QSO with a station across town or across the globe at any time of day with no loss of quality
- Icom are the only manufacturer to offer D-Star compatible radios – although there are many third-party add-ons such repeaters / nodes and software

D-Star Repeaters

Transmitter

Receiver



- D-Star Repeaters work in the same way to traditional FM Repeaters, they receive on one frequency and retransmit on another in the same band
- D-Star Repeaters also include an Internet Gateway often requiring a broadband Internet connection to a remote site – ours is via a 5GHz link over an 8km path supplied by Clive G3GJA

D-Star Repeaters

D-Star uses special callsigns embedded within each transmission instead of CTCSS tones for Identification, access and routing through the system

Your Call:

C	Q	C	Q	C	Q		
---	---	---	---	---	---	--	--

 The general callsign

RPT1:

G	B	7	H	U			B
---	---	---	---	---	--	--	---

The D-Star Repeater's callsigns

RPT2:

G	B	7	H	U			G
---	---	---	---	---	--	--	---

My Call:

G	O	V	R	M			
---	---	---	---	---	--	--	--

 My callsign!



*The **Your Call** callsign is used to send various commands to the repeater*

*The **RPT1** callsign is handled by the repeater controller itself*

*The **RPT2** callsign signals that the data should be passed to the Gateway PC*

*The **My Call** callsign never changes*

Call Sign Routing

- GB7HU has been upgraded to Jonathan Naylor G4KLX's ircDDB Gateway software running under Windows 7. It still provides features of the original Icom G2 System and a lot more besides - and is more supportable...
 - *D-Star has the ability to call another user anywhere on the network (either locally or globally) using their callsign*
 - *The system must therefore keep track of where every user is on the network and distribute this information to every D-Star repeater as users move around*
 - *The Icom G2 System does not record and distribute this information quickly enough, and an alternative method was devised that provides these updates in real-time using internet relay chat.*

Enter the ircDDB – internet relay chat Digital Data Base!

Call Sign Routing

To link to a particular user anywhere on the D-Star Network!

Your Call:	V	K	5	Z	E	A			Michael's callsign
RPT1:	G	B	7	H	U			B	} <i>Stays the same</i>
RPT2:	G	B	7	H	U			G	
My Call:	G	O	V	R	M				

Set **Your Call** to the callsign of the person you want to route your transmission to...

Your local repeater will look up the callsign within its internal database and route the transmission to the repeater the station last transmitted on ...



Call Sign Routing



Michael VK5ZEA demonstrates the ircDDB system by transmitting into the 2m and 70cms ports of his local repeater in turn, showing how the system remembers where he was last heard...



Call Sign Routing

ircDDB - Network

ircddb.net/live.htm

ircDDB Live

home docu status **live** sources support download register site notice

21:09:08	DL2GKH	E880	CQCQCQ	HB9HD_C	HB9HD_G	-	HDRMANN * KUESSABERG	7.6s S:0% E:0.2%	00 00 00
21:09:10	NN1D	2820	CQCQCQ	K1RFI_A	K1RFI_G	-	NN1D - Mobile	62.4s S:0% E:0.0%	00 00 00
21:09:23	DO4DSW	E880	CQCQCQ	DB0HFT_B	DB0HFT_G	DCS001_D	SVEN IN BREMEN-NORD	52.6s S:0% E:0.0%	00 00 00
21:09:17	KC9USH	STU	CQCQCQ	NE9RD_B	NE9RD_G	DCS006_V	-	3.0s S:0% E:7.9%	00 00 00
21:09:19	IK6IMZ	E880	IR6UCC	STN071	IR6UCC_G	-	ROBERTO - ORTONA	55.6s S:0% E:0.0%	00 00 00
21:09:24	*****		CQCQCQ	DM0HMB_B	DM0HMB_G	DCS001_O	-	0.3s S:92% E:0.0%	00 00 00
21:09:27	DL2GKH	E880	CQCQCQ	HB9HD_C	HB9HD_G	-	HERMANN * KUESS@BERG	4.6s S:0% E:0.3%	00 00 00
21:09:42	G1SCQ			MB6HU_C	MB6HU_G	-	Kevin/Norfolk	0.3s S:92% E:0.0%	00 00 00
21:09:28	KC9USH	STU	CQCQCQ	NE9RD_B	NE9RD_G	DCS006_V	-	5.0s S:0% E:1.2%	00 00 00
21:09:31	WA9EIC	80AD	CQCQCQ	NE9RD_B	NE9RD_G	DCS006_V	DON DANVILLE, IL	48.1s S:0% E:0.0%	00 00 00
21:09:35	DL2GKA	E80D	CQCQCQ	HB9HD_C	HB9HD_G	-	ALBERT * ERZINGEN BW	5.7s S:0% E:0.0%	00 00 00
21:09:40	*****		-	WB1GOF_B	-	-	-	-	-
21:09:40	OE1KDA		CQCQCQ	OE1XDS_B	OE1XDS_G	-	Krzysztof Wien JN88	18.7s S:0% E:0.0%	00 00 00
21:09:41	KB2ITR		CQCQCQ	KB3TEM_B	KB3TEM_G	-	E-STROUDSBURG PA	1.2s S:100% E:0.0%	00 00 00
21:09:45	VE3X2T		CQCQCQ	VE3ENH_B	VE3ENH_G	XRF018_B	DALE IN ALMONTE	5.4s S:0% E:0.0%	00 00 00
21:09:45	DL2GKH	E880	CQCQCQ	HB9HD_C	HB9HD_G	-	HERMANN * KUESSABERG	13.8s S:0% E:0.2%	00 00 00
21:09:47	KB2ITR		CQCQCQ	KB3TEM_B	KB3TEM_G	-	E-STROUDSBURG PA	1.1s S:100% E:0.0%	00 00 00
21:09:48	*****		CQCQCQ	IR1UBR_B	IR1UBR_G	XRF033_A	-	1.8s S:79% E:0.3%	00 00 00
21:09:51	KB2ITR		CQCQCQ	KB3TEM_B	KB3TEM_G	-	E-STROUDSBURG PA	1.2s S:100% E:0.0%	00 00 00
21:09:56	SM0RUX	E92D	CQCQCQ	SM0R_C	SM0R_G	DCS010_I	Pontus Stockholm Swe	2.7s S:0% E:0.0%	00 00 00
21:09:56	PT2AST	BASE	CQCQCQ	PT2MTD_C	PT2MTD_G	-	MARCOS/GAMA-DF, DPRS!	5.4s S:7% E:0.0%	00 00 00
21:09:54	N1KXJ	880H	CQCQCQ	KB1YAC_B	KB1YAC_G	-	RAY / MOBILE	1.7s S:0% E:8.0%	00 00 00
21:10:03	DL2GKA	E80D	CQCQCQ	HB9HD_C	HB9HD_G	-	ALBERT * ERZINGEN BW	TX on	00 00 00
21:09:58	*****		CQCQCQ	SR9UVM_B	SR9UVM_G	-	-	TX on	00 00 00
21:10:05	SM0RUX	E92D	CQCQCQ	SM0R_C	SM0R_G	-	Pontus Stockholm Swe	2.8s S:0% E:0.0%	00 00 00
21:08:48	DH4HAN	HANS	CQCQCQ	DB0CHV_B	DB0CHV_G	DCS001_D	www.vfdb-cuxhaven.de	TX on	00 00 00
21:10:12	*****		*****	SR7UVL_B	SR7UVL_G	DB0BS_B	-	1.8s S:100% E:0.0%	00 00 00
21:10:14	*****		REF030CL	IROMA_B	IROMA_G	-	-	0.3s S:6% E:0.0%	00 00 00
21:10:15	N1HSW	880H	CQCQCQ	K1RFI_C	K1RFI_G	-	JOHN-FALL RIVER, MA.	TX on	00 00 00
21:10:18	IW6PQB	2820	STN071	IR6UDD_B	IR6UDD_G	-	ANTONIO DE IW6PQB 73	0.2s S:33% E:0.0%	00 00 00
21:10:13	N1KXJ	880H	DCS006BL	KB1YAC_B	KB1YAC_G	-	-	2.0s S:0% E:0.0%	00 00 00
UTC	MYCALL	880H	URCALL	RPT1	RPT2	DEST	TX MSG	TX STATS	Flags

To see the live callsign updates visit the ircDDB Live web page – <http://www.ircddb.net/live>

Call Sign Routing

To link to a particular repeater anywhere on the D-Star Network!

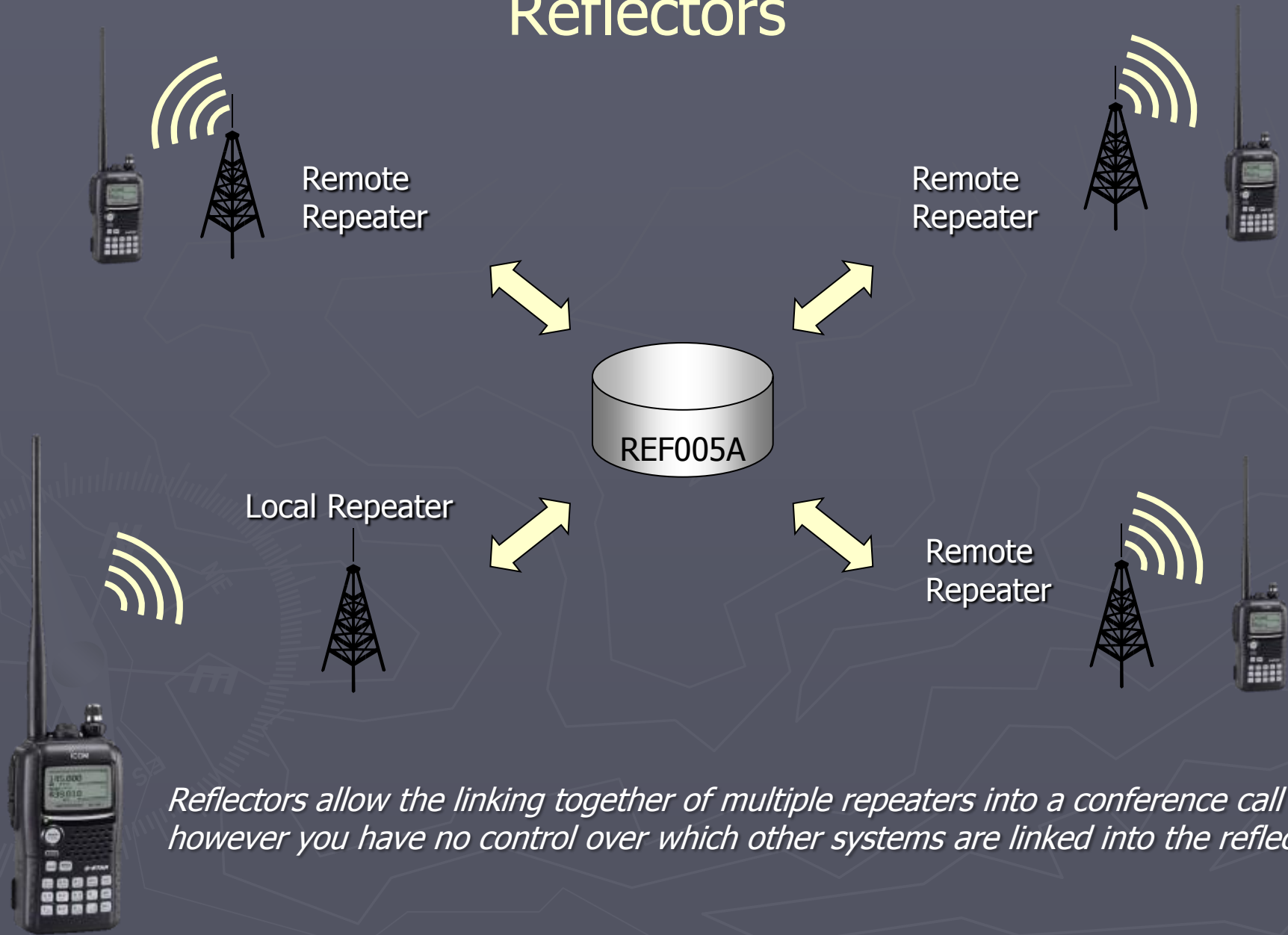


Your Call:	/	V	K	5	R	E	X	B	VK5REX Port B (70cms)
RPT1:	G	B	7	H	U			B	} <i>Stays the same</i>
RPT2:	G	B	7	H	U			G	
My Call:	G	O	V	R	M				

*Set **Your Call** to the callsign of the repeater and port you want to route your transmission to – the "/" tells the system this is a repeater's callsign*

However callsign routing to either an individual station or a repeater is seldom used!

Reflectors



Reflectors allow the linking together of multiple repeaters into a conference call however you have no control over which other systems are linked into the reflector...

Reflectors

- The G4KLX ircDDB Gateway Software still provides access to the D-Plus Reflector System - you can still access REF001C (US) and REF005A (UK) using the ***Your Call*** commands to link and unlink as before...
- It also provides access to the new Digital Conference Server (DCS) reflectors which offer a much improved network protocol that eliminates most of the problems of lost transmissions – the D-Star Black Hole
 - *All of the DCS Reflectors have 26 modules - one for each letter of the alphabet*
 - *Module "A" of every DCS Reflector is linked together so operates worldwide*
 - *Module "Z" of every DCS Reflector is an Echo function...*
- The G4KLX ircDDB Gateway Software now offers a new way of linking and unlinking to Reflectors – via DTMF your DTMF keypad

Linking to Reflectors

Either transmit once with the Your Call command to link to DCS005B...

Your Call:

D	C	S	0	0	5	B	L
---	---	---	---	---	---	---	---

*Or transmit with Your Call set to the default and type **D5B** on the keypad*

Your Call:

C	Q	C	Q	C	Q		
---	---	---	---	---	---	--	--

*The system will respond with a Voice Announcement "**Linked to DCS005B**"*

*Because there aren't 26 letters on your DTMF keypad the module letter is exchanged with a number – for example to link to the UK Midlands DCS reflector DCS005M type **D513**.*



Unlinking from Reflectors

When you've done with the reflector send the "Unlink" command

Your Call:

							U
--	--	--	--	--	--	--	---

Or transmit with Your Call set to the default and type # on the keypad

Your Call:

C	Q	C	Q	C	Q		
---	---	---	---	---	---	--	--

Or if you are lazy, you can just issue another link command and the software will automatically unlink and then link up with the new reflector...

After a period of inactivity, GB7HU and most other UK D-Star repeaters running the G4KLX ircDDB Gateway Software will automatically switch back to the UK DCS Reflector - DCS005B



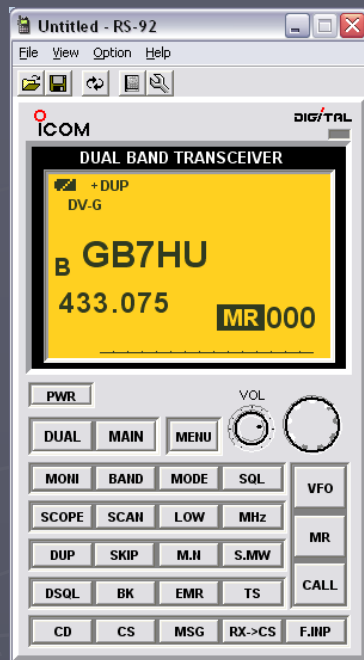
Linking to Reflectors

Repeater Function	Your Call	DTMF Shortcut
Talk on the local repeater, or via a linked reflector	CQCQCQ	
Talk to a specific station anywhere on the system	G0XYZ	
Talk via a specific repeater on the system	/GB7AB	
Link to US D-Plus Reflector REF001C	REF001CL	*1C
Link to Australian D-Plus Reflector REF003B	REF003BL	*3B
Link to UK D-Plus Reflector REF005A	REF005AL	*5A
Link to Data D-Plus Reflector REF015C	REF015CL	*15C
Link to MidStar D-Plus Reflector REF036A	REF036AL	*36A
Link to Worldwide DCS Reflector DCS002B	DCS002BL	D2B or D202
Link to UK DCS Reflector DCS005B	DCS005BL	D5B or D502
Link to US DCS Reflector DCS006B	DCS006BL	D6B or D602
Link to Australian DCS Reflector DCS014B	DCS014BL	D14B or D1402
Link to Canadian DCS Reflector DCS017B	DCS017BL	D17B or D1702
Link to UK D-Extra Reflector XRF001B	XRF001BL	1B
Link to Canadian D-Extra Reflector XRF005B	XRF005BL	5B
Unlink from any reflector	U	#
Echo your transmission back to you	E	
Request status from repeater	I	0 or 00

For an up to date listing of all the REF and DCS reflectors see the Wyre Forest Repeater Group's website – <http://www.wfrg.net>



Programming Software Demonstration



OPC 1799 Serial Cable
RS-92 Programming Software

Name

Your Call

*GB7HU **

CQCQCQ

REF 1C

REF001CL

REF 5A

REF005AL

REF 36A

REF036AL

DCS 2B

DCS002BL

DCS 5B

DCS005BL

DCS 6B

DCS006BL

DCS 14B

DCS014BL

DCS 17B

DCS017BL

Unlink

U

Info

I

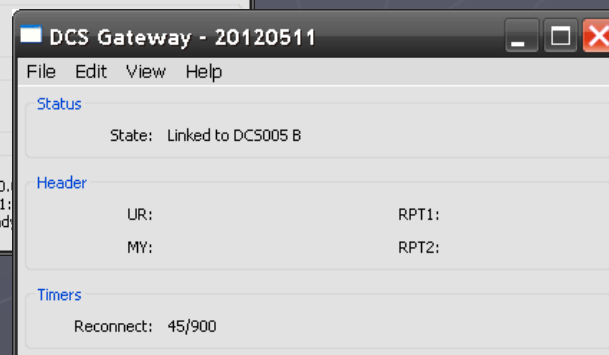
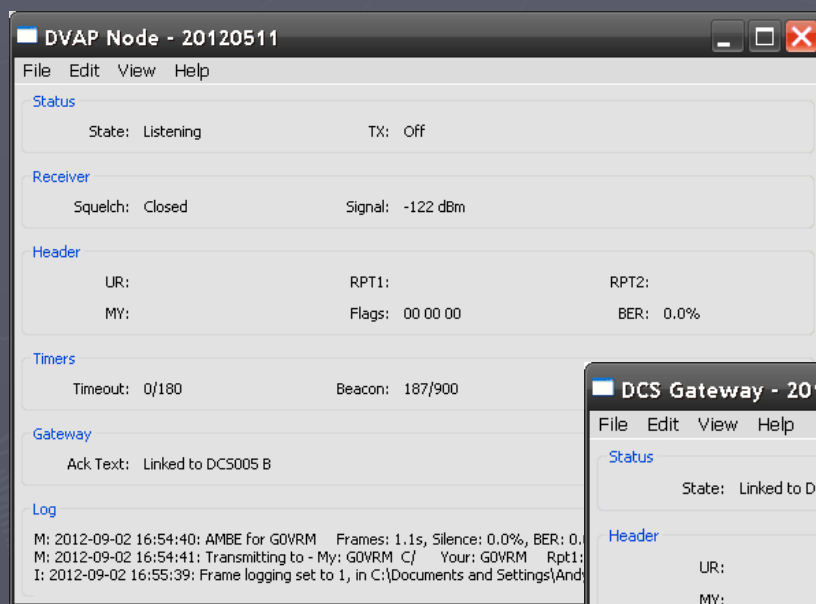
Echo

E

Most people program in the commands they frequently use into memories with "sensible" names – you can then use the dial to select the command you want rather than going into the menu settings!

G4KLX Software Demonstration

The G4KLX ircDDB Gateway software is intended for repeaters only – I am going to demonstrate a cut-down version intended for end-users...



The G4KLX Repeater software provides the building blocks for making your own analogue (FM) and D-Star repeater systems – this is gateway onto the DCS reflector system using a DV Access Point Dongle...

Application 1

Digital Voice

Digital Voice is sent with a call sign ID and a short status message

HELLO



Digital Voice and Data

D-Star digital voice and data communications can operate directly between radios, via a local repeater or via a group of repeaters linked together over the internet to cover a wide area.



Presentation

Digital Voice and Data

Controller uses Digital Voice, Messaging and can see the location of key assets



Application 2

GPS Tracking

Live position updates are sent simultaneously with Digital Voice



Application 3

Low Speed Data

Messages, chat and small files can be sent without additional hardware



D-Star Repeater



Internet
Gateway



Presentation

Web Access

User Services only need a web browser to gain awareness of situation



Internet users can view live position information using the Automatic Position Reporting System (APRS-IS) using a web browser, and access the D-Star Digital Voice Repeater using a DV Dongle or DV Access Point.



Digital Voice and Data

- D-STAR transmissions are a continuous stream of data at 4800 bits per second (baud) using Gaussian Minimum-Shift Keying – essentially shaped FSK
 - *Each transmission begins with a "Header" which contains the callsigns used for identification and routing and a user-entered 20 character message which is scrolled across the receiver's display*
 - *This is followed by interleaved Digital Voice and Data Frames which continue as long as the PTT is pressed or there is data to send*
- The D-Star data stream consists of the following components, which are always present - even if there is no voice or data to transmit
 - *2400 bits per second for Digital Voice*
 - *1200 bits per second for Forward Error Correction of the Digital Voice Data*
 - *1200 bits per second for low speed data*

Digital Voice and Data

- D-Star Digital Voice uses a proprietary AMBE chipset to encode and decode speech, this also provides the Forward Error Correction which allows data to be reconstructed when errors occur – making Digital Voice as robust as FM
- As Low speed data is always present within the data stream, data can go where D-Star goes. It works simplex, through a repeater or an Internet Link
- A repeater can still be used within the local area if the Internet fails...
 - *The mobile environment is not ideal for data communications as the noise from mobile flutter, vehicle electrical noise and the constantly changing RF path all cause bit errors which render data unusable*
 - *The forward error correction and the high correlation between data, allow digital voice to be reconstituted when errors occur – the useful range of D-Star low speed data which has no error correction is approx 1/3 that of digital voice*

GPS Tracking

- D-Star radios can be configured to use the Low Speed Data to either transmit GPS information or to provide a “virtual serial connection” between radios – but not both at the same time!
- Two data formats are available: GPS and GPS-A
 - *GPS format is simply a pass through of several lines of raw NMEA data with individual checksums added and a comment line*
 - *GPS-A format encapsulates the data into a one line APRS format packet with a cyclic redundancy check – this is much more reliable!*
- Although it may seem desirable to set up your radio to transmit automatic beacons, it is not recommended as they can disrupt QSOs in progress...
Your position will still be sent every time you transmit on D-Star !

GPS Tracking



Optional GPS Speaker-microphone

Used with the GPS speaker-microphone, HM-175GPS, the IC-E92D shows your position data on the display and offers automatic position reporting in DV mode. The IC-E92D shows the direction to a received D-STAR station or to a stored position with a compass-like display pointer. In addition, the GPS-A mode assists in easy D-PRS system operation.

GPS application examples

Tracking with GPS
Even if you separate from your friend, the radio shows the distance and direction to help you to rejoin them.

Moving with GPS
When you find a nice viewpoint, you can save the location to your friends.

Moving with GPS
Exchanging position information with someone else helps you get together.

Examples of GPS functions

MY POSITION

MY POSITION

COMPASS INFORMATION

DISTANCE AND DIRECTION TO RX STATION

DIGITAL

GPS		DVCE ICOM	
MY 34°41'26"N		135°31'24"E	
ELEVATION: 19m		TIME: 12:08:19	
DATA	POSI	G-WR	MENU

DIRoRXSTN	401km GPS0	DV	439.010
RX 35°41'16"N		139°47'24"E	
MY 34°37'33"N		135°34'07"E	
DATA	POSI	G-WR	MENU

- GPS data can be displayed on the screens of both the IC-E92D handheld and the IC-E2820 mobile transceivers – provided GPS format is used
- GPS data is translated into APRS format by the repeater's gateway and made available via the global APRS Internet Service to web users using sites such as <http://aprs.fi>

GPS Tracking

- APRS.FI offers access to real-time APRS data with just a web browser...
 - *It is based around the familiar Google Maps interface overlaid with APRS symbols and non-ham data from AIS (shipping) and the Citizen Weather Observer Program*
 - *It stores worldwide APRS data for over a year, keeping the last 48 hours data in memory for quick access – it is hosted on dual redundant servers hosted by data centres in separate cites.*
 - *Any user can share their location using a GPS enabled iOS or Android smartphone, including non-amateurs (i.e. 4x4 response) as this data is not propagated back onto the APRS network and will not appear on RF*
 - *It allows customisation allowing lists of specific stations / filtering on object type and name / settings and views – these are saved on the server not the device*
 - *Users can measure distances and bearings and obtain routes between objects*

APRS.FI Demonstration

The screenshot displays the Google Maps APRS interface. The main map shows the Hull area, including the Humber River and surrounding roads. A red line indicates the current track, starting from the bottom left and moving towards the center. The sidebar on the right contains the following sections:

- aprs.fi - Login**
 - [Tektronix Oscilloscopes](#)
 - [uk.farnell.com/Tektronix](#)
 - We Stock Tektronix Products - Buy Online Today - Next Day Deliver AdChoices
- Track callsign:**
- Address, city or Locator:**
- Show last:**
- Track tail length:**
- GOVRM**
 - Updated: 2012-12-24 20:17:30 (34d2h)
 - Position: 53°42.22' N 0°26.98' W
- Other SSIDs:**
- Other views:**
 - [Station info](#)
 - [Raw packets](#)
 - [Status packets - Beacon packets](#)
 - [APRS/CWOP weather - Telemetry](#)
 - [Messages - Bulletin board](#)
 - [Prefix browsing](#)
 - [Google Earth KML ?](#)
 - [Data export tool](#)
 - [Preferences - My account](#)
- Information:**
 - [Stations currently moving](#)
 - [User guide](#)
 - [FAQ](#)
 - [Blog](#)
 - [Discussion group](#)
 - [Linking to aprs.fi](#)
 - [AIS sites](#)
 - [Service status](#)
 - [Database statistics](#)
 - [Advertising on aprs.fi](#)
 - [Technical details](#)
 - [API](#)
 - [Change](#)

Low Speed Data

- All D-Star radios have a built in RS-232 serial connection. Provided your PC has a serial port there is no requirement for an external interface
 - *Serial data is sent without any form of error correction – this must be handled by the application software*
 - *Only the data frames are available - the whole data stream which includes the callsigns and messages is not accessible outside the system*
 - *Some of the data frames are taken up for synchronisation purposes, leaving approximately 900 bits per second - approx the same speed as packet radio*
 - *Need to disable the GPS from within the menus to use serial data - however GPS data sent by others comes out of the serial port!*

Application Software

- D-Rats by Dan Smith KK7DS can be used to setup data communications networks between a number of stations using D-Star Low Speed Data
- It was written specifically for emergency communications use , providing the following functions:
 - *Messaging – Radio messages, forms, e-mail (which can be sent to the Internet) with attachments*
 - *Keyboard Chat – instant keyboard-to-keyboard, including multi-user and private channels*
 - *File Transfers – unattended file sharing, upload / download from common shared site*
 - *Mapping / Position Reporting – displays location of stations from GPS data using OpenStreetmap based mapping.*



D-Rats Demonstration

Email Message

Reply Forward via Print Delete

Email Message

☐ Routing Information

Source Callsign G0VRM

Destination Callsign M0GYR

Subject D-Star Presentation

Message

This is the end of the presentation please feel free to ask any questions

+ Attachments

+ Path



Questions ?



Linking Repeaters with D-Plus

Your Call:

G	B	7	A	U		B	L
---	---	---	---	---	--	---	---

Command to Link with GB7AU Port B

RPT1:

G	B	7	H	U			B
---	---	---	---	---	--	--	---

The D-Star Repeater's callsign

RPT2:

G	B	7	H	U			G
---	---	---	---	---	--	--	---

My Call:

G	O	V	R	M			
---	---	---	---	---	--	--	--

This doesn't change

Transmitting once with these settings will temporarily link our repeater with the GB7AU repeater in Amersham...

*You will hear a voice announcement "Remote System Linked"
Then switch back to the standard repeater setting.*



Linking Repeaters with D-Plus

Once linked the two repeaters will relay transmissions from either end - GB7HU or GB7AU

Local Repeater



GB7HU Port B

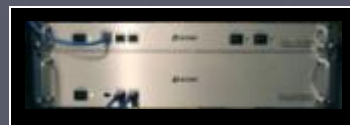
C	Q	C	Q	C	Q		
---	---	---	---	---	---	--	--

G	B	7	H	U			B
---	---	---	---	---	--	--	---

G	B	7	H	U			G
---	---	---	---	---	--	--	---

G	O	V	R	M			
---	---	---	---	---	--	--	--

Remote Repeater

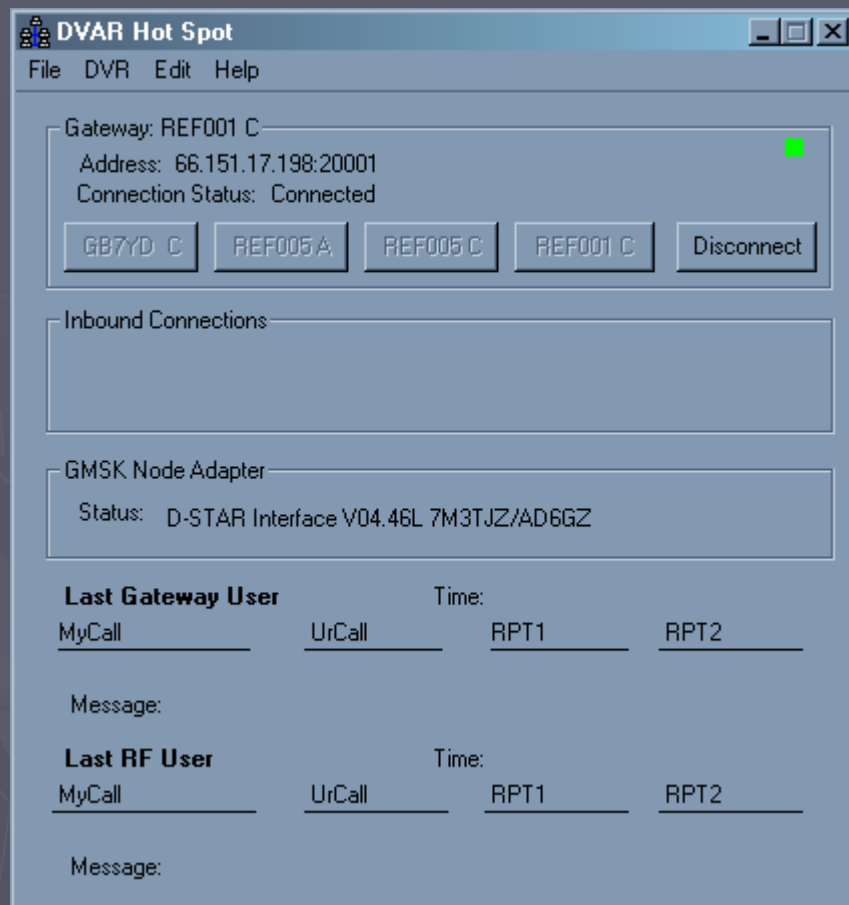


GB7AU Port B

But can I link more than two repeaters together ?



The D-Star Hotspot



KB9KHM D-Star Hotspot

The KB9KHM D-Star Hotspot is a Windows program for creating a local "access point" on to the global D-Star network...

With a D-Star Hot Spot, you can use your D-STAR radio (IC-91AD, IC-92D, etc.) to listen to, and talk on, any D-STAR repeater or reflector.

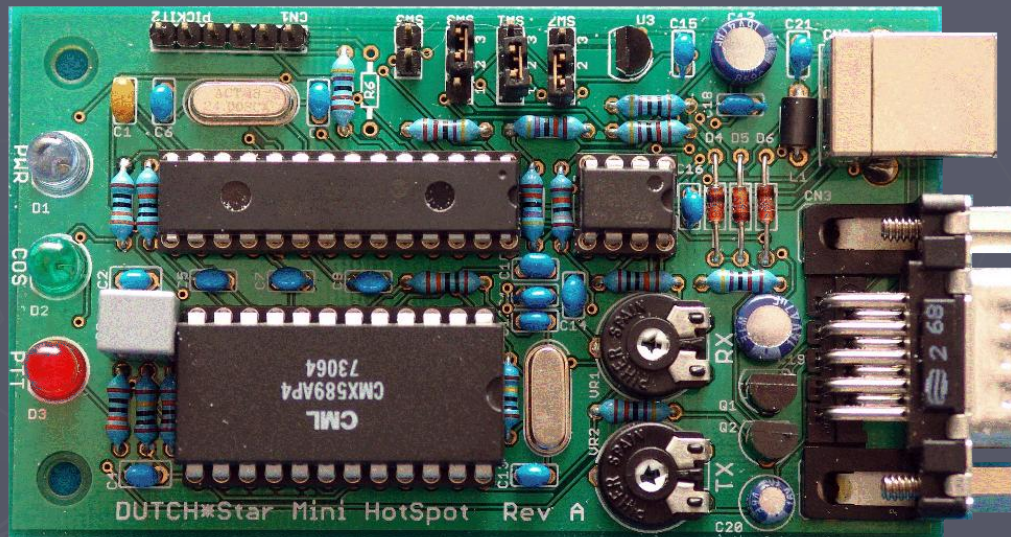
It uses the services of the PC to provide an Internet connection, and a Node Adapter Board to interface to a conventional FM Transceiver.

The D-Star Hotspot

Programming Header Option Switches

PIC Microcontroller

GMSK Modem IC



USB & Power

Radio Interface

Node Adapter Board

The original board and PIC firmware were developed by Satoshi Yasuda 7M3TJZ/AD6GZ, and can be used as either a simplex link or as a complete full duplex repeater system.

The Mini Hotspot board (demonstrated here) is a cut down version designed by Mark Phillips G7LTT and Fred Van Kempen PA4YBR, and uses the Satoshi Firmware.