Data Communications Special Interest Group

Andy Russell, G0VRM
North Humber Raynet

Objective

It is intended to form an informal group within North Humber Raynet that specialises in the provision of data communications for the voluntary radio and response groups within the local area. This group will draw upon the expertise of persons and organisations outside of North Humber Raynet in order to establish both the requirements and current practices with the aim of maximising interoperability between ourselves and other Raynet groups.

Technology Summary

This document aims to give a non-technical summary of the data modes that are currently under consideration – this is not an exhaustive list as there may be other suggestions.

APRS

The Automatic Packet Reporting System (APRS) is a system for sharing real-time tactical data; such as position reports, messages and bulletins, between a large numbers of users spread over a wide area. Information is carried locally by packet radio without the requirement for infrastructure, as each station uses its network peers to extend the network by using them to repeat the data packets they hear. Information is carried globally via the APRS Internet Service[1] and can be viewed live using a web browser[2].

Although dedicated APRS radios are available from both Kenwood and Yaesu, the capability can be added to most 2m band radios simply by plugging in a packet radio modem or a low-cost microcontroller based tracker[3] (with or without GPS) into the data port. Application software is available for most platforms (including Android and iOS smartphones).

The installation of *digipeaters* and *internet gateways* would improve the local network which is currently patchy – possibly through the East Yorkshire Repeater Group? Setting up a 4m digipeater at a later stage would possibly free up 2m for voice communications.

It is intended to produce how-to guides for the common Windows software such as UI-View[4] and APRSISCE[5] to encourage more activity and increase the *"critical mass"* of users. A suitable demonstration of vehicle tracking is required in order to raise awareness – possibly by South Humber Raynet?

Future developments are the integration of APRS connectivity into the tracking software that is currently being developed by Tony Wilk M0NIX to automatically update the location of responders from live data taken from the APRS Internet Service?

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[1]   APRS Internet Service - http://www.aprs-is.net/
[2]   APRS Web Access - http://aprs.fi
[3]   Argent Data Systems Tracker 3 - http://www.argentdata.com/products/tracker3.html
[4]   UI-View - http://www.apritch.myby.co.uk/uiview.htm
[5]   APRSISCE - http://aprsisce.wikidot.com/

## D-Star Digital Voice

D-Star is a digital voice and data protocol developed specifically for amateur radio use that supports communications both over the air, and over the internet. The system allows users to communicate worldwide using Internet-linked repeaters and gateways, simply by entering special call signs into their radio.

D-Star digital voice is encoded with a proprietary protocol developed by Digital Voice Systems Incorporated (DVSI) which includes a very effective Forward Error Correction (FEC) that allows the received audio to remain noise free over a wider range of signal levels than FM – with FM having a slight advantage at very low signal levels when the D-Star signal fall off the *digital cliff*.
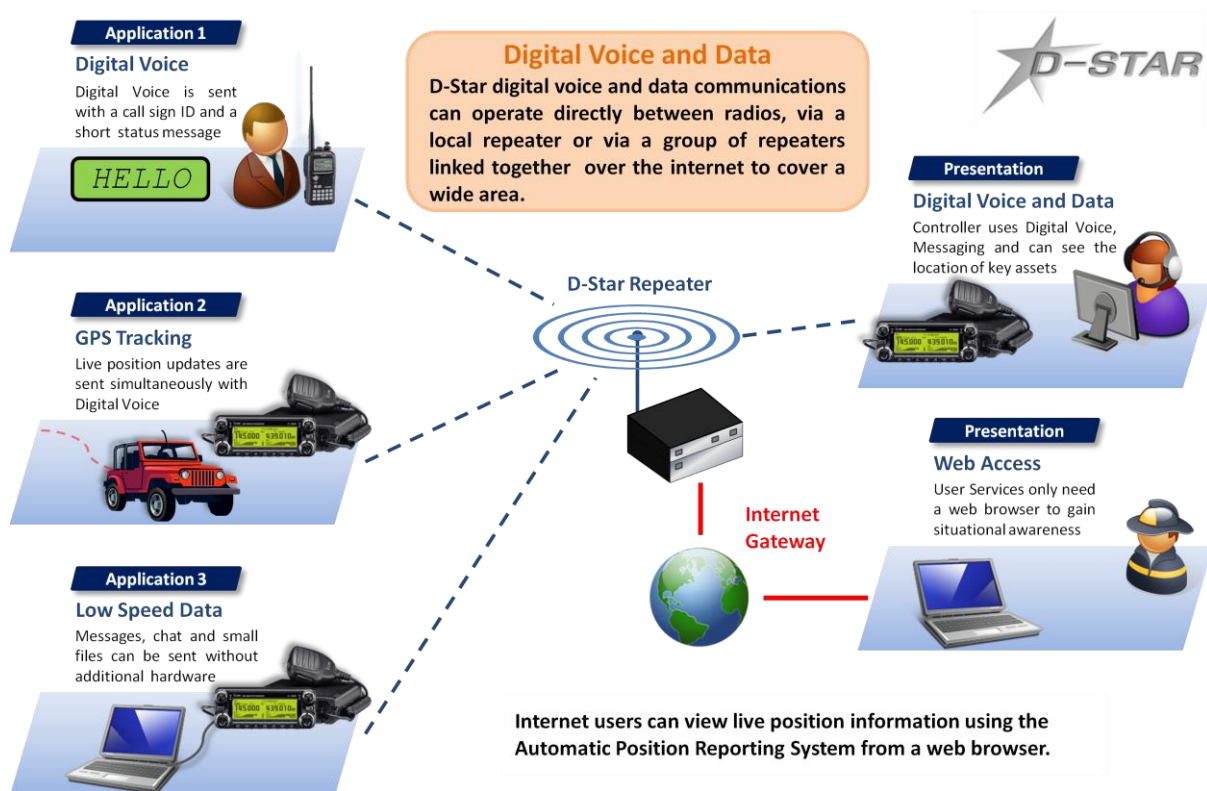
Two types of GPS data are supported: GPS mode is intended to provide a display the distance and bearing of the received station; whilst GPS-A mode sends the data in a more compact format intended for APRS tracking – although both formats are converted by the repeater software and posted as position reports on the APRS Internet Service, the latter is more reliable.

Although it may seem desirable to transmit automatic beacons similar to APRS, this practice is not recommended as they can disrupt voice traffic between linked repeaters.

D-Star Low Speed Data

D-Star Digital Voice also supports a slow speed data mode which uses the spare capacity that normally carries GPS data to provide a *virtual serial connection* between the radios – this data stream does not have any form of Forward Error Correction and this needs to be handled in the application software.

D-Rats[6] is an example of such software that can provide rudimentary e-mail, messaging and file transfers. However, transferring files using D-Rats is not advisable as the speeds achieved in practice are very low due to the lack of error correction and overheads.

It is intended to produce a User Guide for the ircDDB Gateway Software that is currently running on GB7HU and the MB6EY Simplex Gateway, together with standardised settings for the Icom IC-E2820 and IC-E92D handhelds that allow the users to get the most from the system – the document will be available via Creative Commons and allow others to modify it for their radios.

D-Star High Speed Data

Icom also offers a High Speed Digital Data mode with the Icom ID-1 radio that operates on the 23cms Amateur Radio Band – this provides dial-up speed TCP/IP connectivity using the 23cms Data Repeater. However, due to restrictions on licensing repeaters on this band from the Civil Aviation Authority this has not had a great take-up in the UK.

High Speed Multimedia Radio

High Speed Multimedia Radio (HSMM) is the implementation of wireless computer networks for emergency communications using commercial Wi-Fi equipment operating on amateur radio frequencies in the 2.4GHz and 5GHz bands which allow the use of high gain directional antennas. The objective is to build a high-speed self-discovering fault-tolerant network that is capable of carrying Voice over IP (such as Asterisk[7]) and e-mail and messaging such as WinLink[8]. Although encryption (including WEP / WPA etc.) is not allowed, the casual user can be kept out of the network by the use of MAC address filtering!

Most references on the Internet are from the United States where amateur radio operators are governed by different legislation, and use the OpenWRT[9] firmware for the Linksys WRT54G router which is not readily available in the UK.

In order to proceed, discussions are required with RSGB ETCC and Ofcom – possibly through Darren Storer G7LWT. Following this, the development and testing of an alternative platform using low-cost commodity hardware such as the Raspberry Pi[10] and/or Beaglebone Black[11] running the HSMM-PI Software[12].

HF NVIS / Data Modes

HF may provide an alternative means of communications for situations where it is not possible to cover the intended area using VHF and UHF due to the terrain. HF can provide both SSB voice and data communications over a large area by making use of a mode known as Near Vertical Incidence Skywave (NVIS).

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[6]   D-Rats - http://www.d-rats.com/
[7]   Asterisk - http://www.asterisk.org/get-started
[8]   Winlink 2000 - http://www.winlink.org/
[9]   High Speed Multimedia Radio - http://www.broadband-hamnet.org/
[10] Raspberry Pi - http://www.raspberrypi.org/
[11] Beaglebone Black - http://beagleboard.org/products/beaglebone%20black
[12] HSMM Pi - http://hsmmpi.wordpress.com/

Antennas are installed so that they direct the majority of the radiated energy vertically upwards, the signals are reflected straight back down to earth by the ionosphere and give a continuous coverage over a range of approximately 250 miles. It is intended to produce an NVIS antenna *"Go Kit"*.

PSK-31 is perhaps the obvious candidate for data communications on HF due to its widespread use and simple soundcard interface – its popularity is due to its resistance to noise that allows contacts to be made across continents on low power, often under conditions where the signal is inaudible in the receiver's speaker. The APRS Messenger[13] and Raynet Messenger[14] software developed by Chris Moulding G4HYG are capable of sending and receiving APRS position reports and formal messages using APRS on HF using PSK-63 (a faster variant of PSK-31) and when conditions allow, they can operate at speeds of up to 250 bits per second using a variety of modulation methods.

The program recommended by the Raynet HF Team is FLDIGI. It supports formal messages with the FLMSG add-on, with manual word count and a "wrapper" which contains a checksum that allow the recipient to verify that the message has arrived intact. It also supports other transmission modes, and is able to transmit a header (known as the Reed-Solomon ID after its coding) which sets the receiver to the appropriate mode and adjusts the passband of the receiver automatically – A video is available from the Raynet HF website showing how to setup and use FLDIGI[15].

Another potential requirement is the transfer of files over the air – the amateur radio version of Digital Radio Mondiale (DRM) is widely used for sending image files over the air as a digital version of slow-scan television. DRM being a broadcast mode has strong forward error correction and can cope with the fading and QRM encountered on HF, it also has a mechanism that allows the recipients to request the retransmission of any missing portions of files.

HF Digital Voice

During the past year there have been significant developments in HF Digital Voice with the release of FreeDV[16]. This offers "communications quality" speech using an open source speech codec[17] at a very low bit rate that can fit in 1.25 kHz wide channel. It can be decoded at low signal levels with long distance contacts being reported using 1-2 watts of power.

As both the encoding and modulation are free from patents it is open to experimentation and could grow into an ideal platform for emergency communications.

Next Steps

Probably APRS is the best place to start – as we have a definite requirement from the Yorkshire 4x4 Response to provide both vehicle tracking and backup communications between members of their Control Team in the event of the internet or telephone system being compromised.

If you are interested in participating in the group then please e-mail andyg0vrm (at) gmail (dot) com.

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[13] APRS Messenger - http://www.crosscountrywireless.net/aprs_messenger.htm
[14] Raynet Messenger - http://www.crosscountrywireless.net/raynet_messenger.htm
[15] Raynet HF Team - http://raynet-hf.net/about-us/operating-modes-and-protocols
[16] FreeDV - http://freedv.org/tiki-index.php
[17] Codec 2 - http://codec2.org/