DV Dongle Overview

A quick insight into the DV Dongle

V1.0

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DV Dongle

What is a DV Dongle?

The DV Dongle is a small device that plugs into a computer USB slot, and uses DV Dongle software with the computers microphone and speaker, to allow you to connect to the D-Star network via the internet.

The "DV" part of the name stands for "Digital Voice".

D-Star[1]

Let's have a closer look at the Dongle and where it fits in to the whole D-Star environment, and we'll start by understanding what D-Star is all about.

D-Star ("Digital Smart Technologies for Amateur Radio") is a protocol to encode voice into a digital data stream which is then transmitted by a radio. It therefore sits across the amateur radio interest areas of digital transmission (which is normally used to exchange text and binary information using protocols such as RTTY, PSK-31 and the like) and voice modes of RF modulation such as FM and SSB.

D-Star transceivers are similar to other amateur radio transceivers, except for a little encoder/decoder chip that converts the audio to and from the digital data stream (more on this later).

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[1] This section scratches the surface of the capabilities of the D-Star environment, and only refers to those parts that help in our present discussion. Please see the companion "D-Star Overview" document for more details.
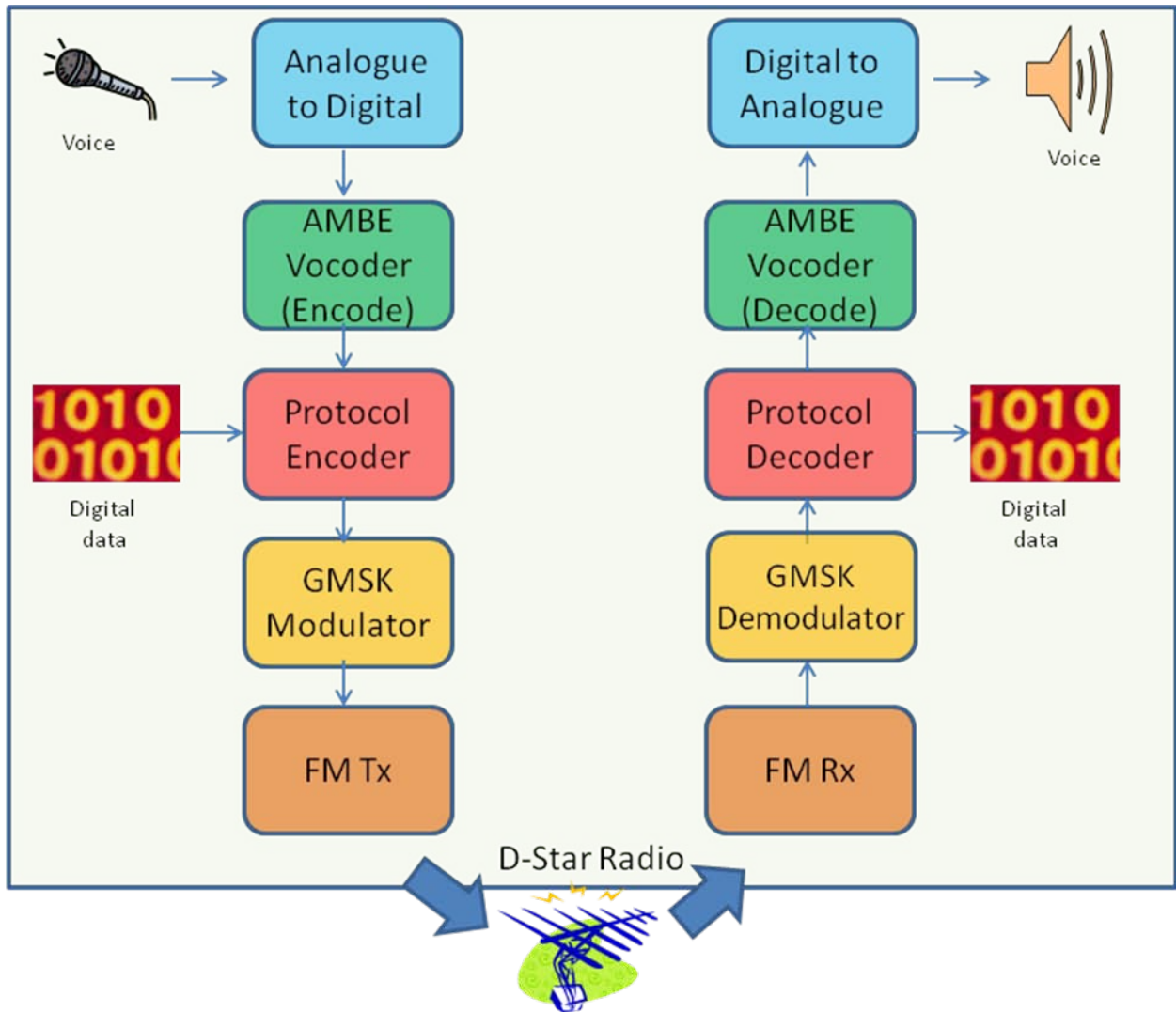
Consider the technology of IRLP nodes that use the Internet to connect two nodes together. You send a code (DTMF) to the local IRLP node that tells it which other node to connect to (or disconnect from). Once you have done this, you (and anyone else within range of either node) can communicate with each other.

Each D-Star repeater can operate as a stand alone repeater, or be connected to the Internet and hence other repeaters, via a 'gateway'. Because the signal being sent by the transceiver is in digital form already, there is no need to use any other mechanism to pass the codes to the local repeater to tell it which other repeater you wish to connect to – it's all embedded within the data stream as defined in the D-Star protocol.

This is where D-Star leaves the other protocols behind. Each time you use your D-Star transceiver to connect to a repeater, you send out your callsign information which is registered within the world wide D-Star network. This allows the D-Star network to remember the last repeater you accessed.

D-Star also lets you specify a repeater or some other *person* you wish to communicate with by giving their callsign – in the case of an individual callsign, the D-Star network will automatically route your call to the repeater where that callsign was last heard.

In the IRLP world, a connection between 2 nodes lasts for as long as you need it to (except for timeouts etc.) but each node can only connect to one other node at a time. In the D-Star network, each connection lasts for only as long as your transmission (because you send the connection information at the beginning of each "over"), but this also means that multiple connections can, in effect, be made at the same time.

D-Star repeaters can also link to other repeaters on a more permanent basis (just like the IRLP nodes) but each can connect to multiple other repeaters at the same time. Therefore you can create a whole mini-network of linked repeaters (for example, in a multi-repeater D-Star net).

D-Star connections to a repeater come at a cost and a repeater can be adversely affected if too many connections are made to it at the same time. To overcome this, there are reflectors in the D-Star network which are normally located inside significant computer centres with high quality internet connections. Reflectors can link two or many repeaters together at the same time.

And this is where the DV Dongle comes into the picture.

What does a DV Dongle do?

Because the D-Star repeaters and reflectors are connected together via the Internet, there is no reason why some other device with Internet connectivity cannot join in (so long as it complies with the D-Star protocol). This is exactly what the DV Dongle lets your Internet-connected computer do.

The DV Dongle hardware uses specific software running in your computer to encode and decode the audio signal in exactly the same way as the chip in your D-Star radio does. In fact it *IS* the same chip as in your D-Star radio.
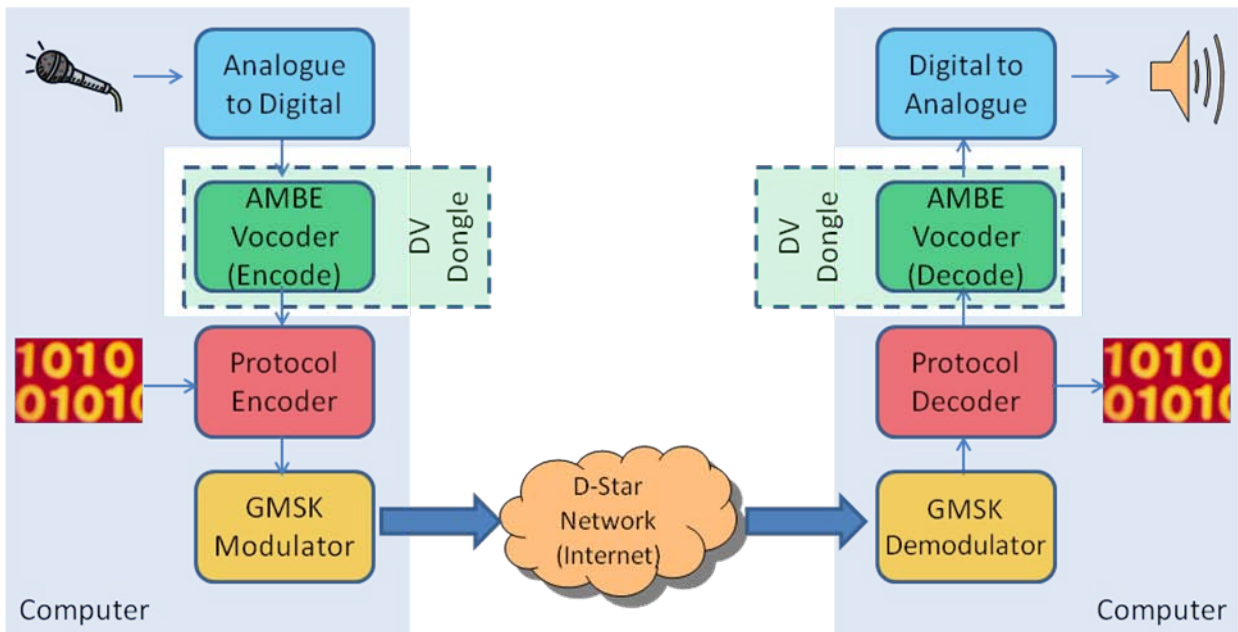
DV Dongle software

The software on your computer connects together three things: your Internet connection so it can communicate with a repeater or reflector[2], your sound card so it can receive your voice from the microphone connected to it and send the audio to the sound cards speakers, and the dongle itself which does the audio encoding and decoding.
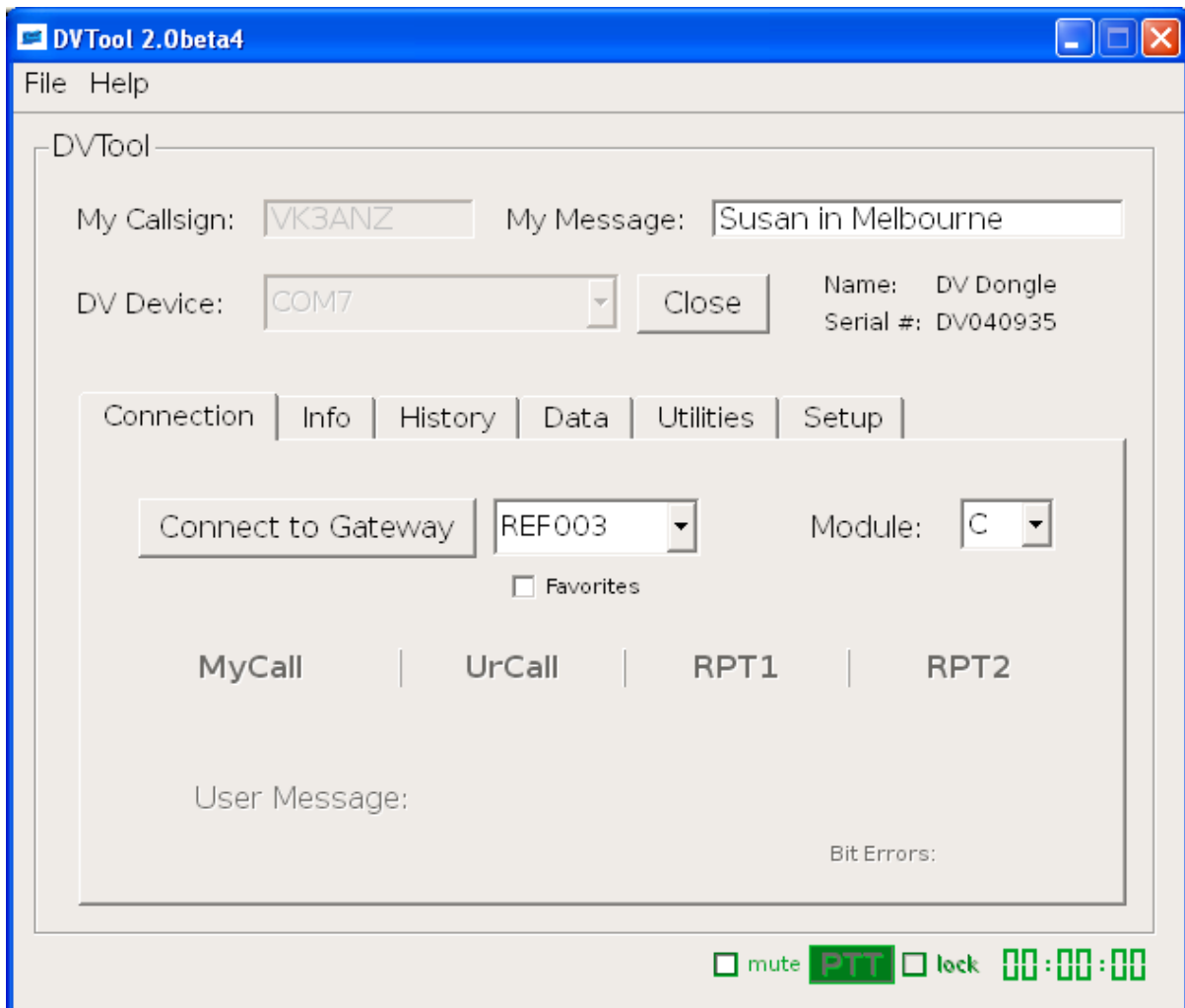
When you start up the program, it will use the D-Star protocol to connect to whatever repeater or reflector you specify. In effect, your computer becomes a node on the D-Star network just like any other[3].

When you want to say something, the audio is taken from your microphone, through the soundcard and the software then passes it on to the DV Dongle. The Dongle compressed and

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[2] From here on in I'll only talk about connecting to a reflector. While it is possible to connect to a repeater, this is not normally a good idea because of the limited Internet connection bandwidth that most repeaters have – leave that free for the RF users of the repeater.

[3] Well – almost. You can't have other nodes connect to you; you must connect to others through a repeater or, more commonly, a reflector.

encodes it before sending it back to your computer. The software then packages the signal up according to the D-Star protocol and passes this on to the reflector you are connected to through your internet connection. From there the data stream is passed on to every other connected node in the network.

When someone else starts to talk, the data stream is sent by the reflector to your computer. The software then passes this on to the DV Dongle where it is decoded into the audio stream which is passed back to the software. The audio stream is then passed on to the computers sound card and on to the attached speakers so you can hear it.

One significant advantage that software running on a computer has over the software that runs within the D-Star radio itself, is that it can provide a more comprehensive user interface. The current DV Dongle software provides:

- The ability to connect and disconnect the DV Dongle device on the computer
- The selection of the repeater or reflector, and its available ports to connect to over the Internet
- The ability to display a scrolling log of the "last heard" stations on the reflector port
- Show the 'additional information' that a station can include in its data stream, such as its "short message" text and its GPS location (RF stations with a GPS capability)
- A list of the current connections from repeaters and dongles to the selected reflector via its various ports
- An analysis of the data stream, including the number of errors and lost packets encountered (often the cause of the R2D2 signals received)
- Indications of any dropped data streams as seen by the reflector[4]
- The storage of the audio received and audio that can be sent on request

The above is a short list of some of the currently available features.

D-Star Protocol

The D-Star protocol is designed for the data stream to carry more than just a voice signal. The D-Star protocol allows the data stream to carry your call sign (which is verified against your registration), the call sign of the repeater or person you are calling, commands to connect and disconnect repeaters and reflectors, and echo test your transmitter via a repeater.

The protocol also allows for a short message (e.g. call sign and name) to be included that is transmitted with each "over" you send out.

If the transceiver is connected to a GPS it will log and transmit your position and provide a direction and distance to a similarly equipped receiving device.

The other major use of the D-Star protocol covers what is referred to as "DD" – Digital Data (to distinguish it from the Digital Voice). The protocol allows for the transmission of any binary data which means that it can be used to transfer images, files and so forth. To a limited extent,

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[4] D-Star allows only one data stream to be sent via a repeater or reflector at a time. However, it is possible for a reflector to detect when additional data streams are encountered but blocked.

you can use it to connect computers together (even over RF) in a small network. The bandwidth required for this exceeds that available in all but the 23 cm band (and above).

Uses of a DV Dongle

When discussing the DV Dongle (as opposed to D-Star) we have not mentioned anything about RF. This means that we can join in the D-Star network from anywhere that has an Internet connection, and there is no need to have a D-Star repeater within range of your transceiver.

Advantages

The 'location independence' provided by a DV Dongle is one of the more obvious advantages. You can take it with you when you travel (the computer power needed for the software is very small and a laptop or netbook computer is perfectly adequate for the task) and keep in touch at all times.

You should not need to have a licence to operate a transmitter when you are in another country as RF is not required, but check first.

If you want to (and have the necessary permissions) you can download the DV Dongle software (it's free) and install it on any computer. That way you only need to carry around the DV Dongle itself if you really need to travel light.

It uses a standard USB 2.0 connection which makes it compatible with just about any computer.

The DV Dongle software was originally written in Java which meant that it would run on any operating system that supported a Java Virtual Machine (JVM). There is a more recent version (in beta at the time of writing) that is available for the Windows and some Linux/OS X operating systems which still covers the vast majority of operating systems in use in the home environment.

Disadvantages

Well, you do have to buy the DV Dongle hardware.

The DV Dongle uses the same encoder/decoder chip as used everywhere else in the D-Star network. This is one of the major criticisms levelled against D-Star in general –that it uses a proprietary chip that can only be bought from a single supplier[5]. However the same encoder/decoder chip is used in many other commercially available devices (e.g. satellite telephones). The available DV Dongle also contains the USB interface chip and a dedicated microcontroller that handles all of the traffic to and from the computer and within the dongle itself.

Again, there is nothing stopping you from designing your own, buying the parts, writing the code for whatever controller you want to use and building it yourself.

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[5] I'm not going into that argument in this article other than to say that you CAN buy the chip if you want for about US$20 and so build your own encoder/decoder device.

Because the DV Dongle does not involve RF, it has been said that "this is not amateur **_RADIO_**". I'll leave that discussion alone, other than to say 'EchoLink'!

Other Uses

D-Star Client Software

The purpose of this application is to turn your non-D-Star transceiver into a D-Star one by using your computer and the DV Dongle.
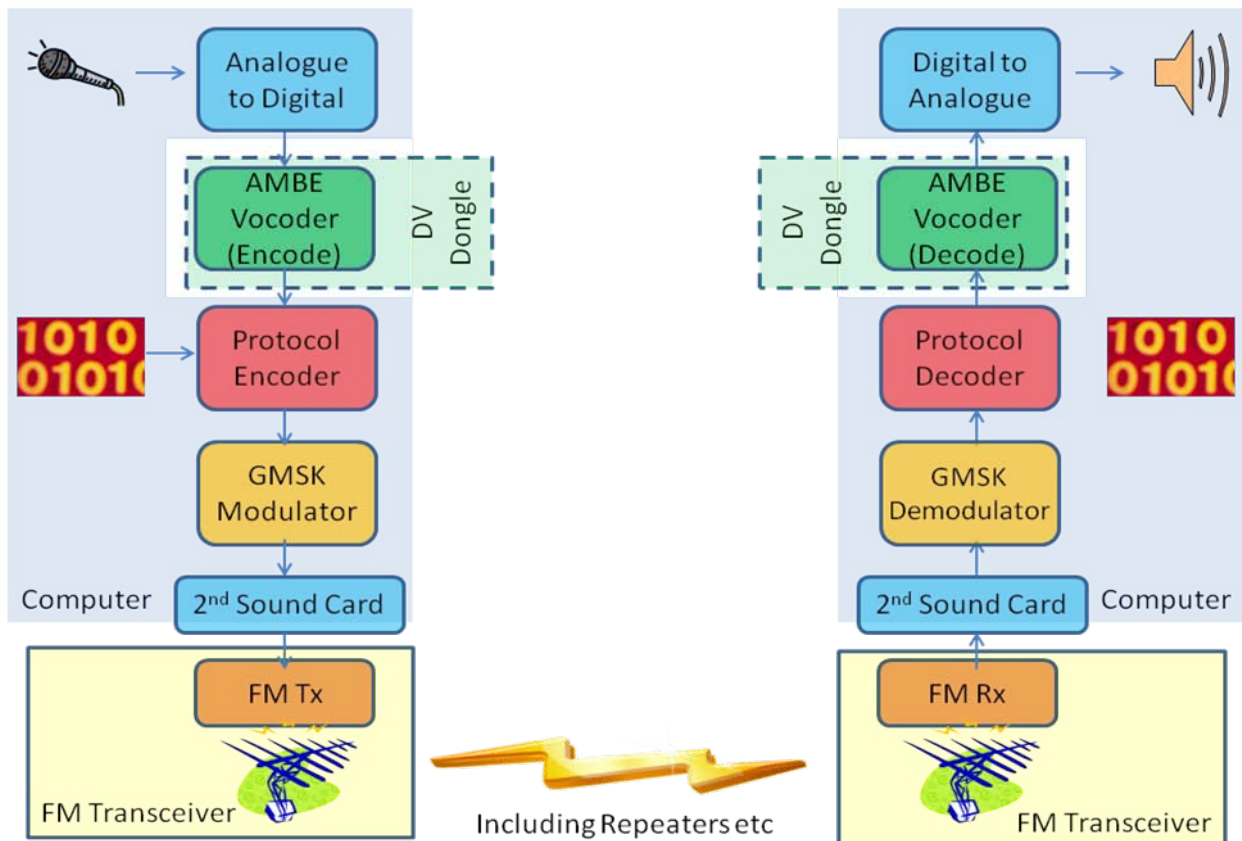
To use it, you need the software (freely available but in beta at the time of writing), the DV Dongle and 2 sound cards; the need for an internet connection disappears.

The software works in the same way as outlined for the DV dongle above as far as getting your audio signal back from the DV Dongle. From here, instead of sending it out to the Internet, the software uses the second sound card to send the (now audio but encoded signal) to any transceiver (preferably one with a VOX or some other way of automatically turning on the transmitter at the right time).
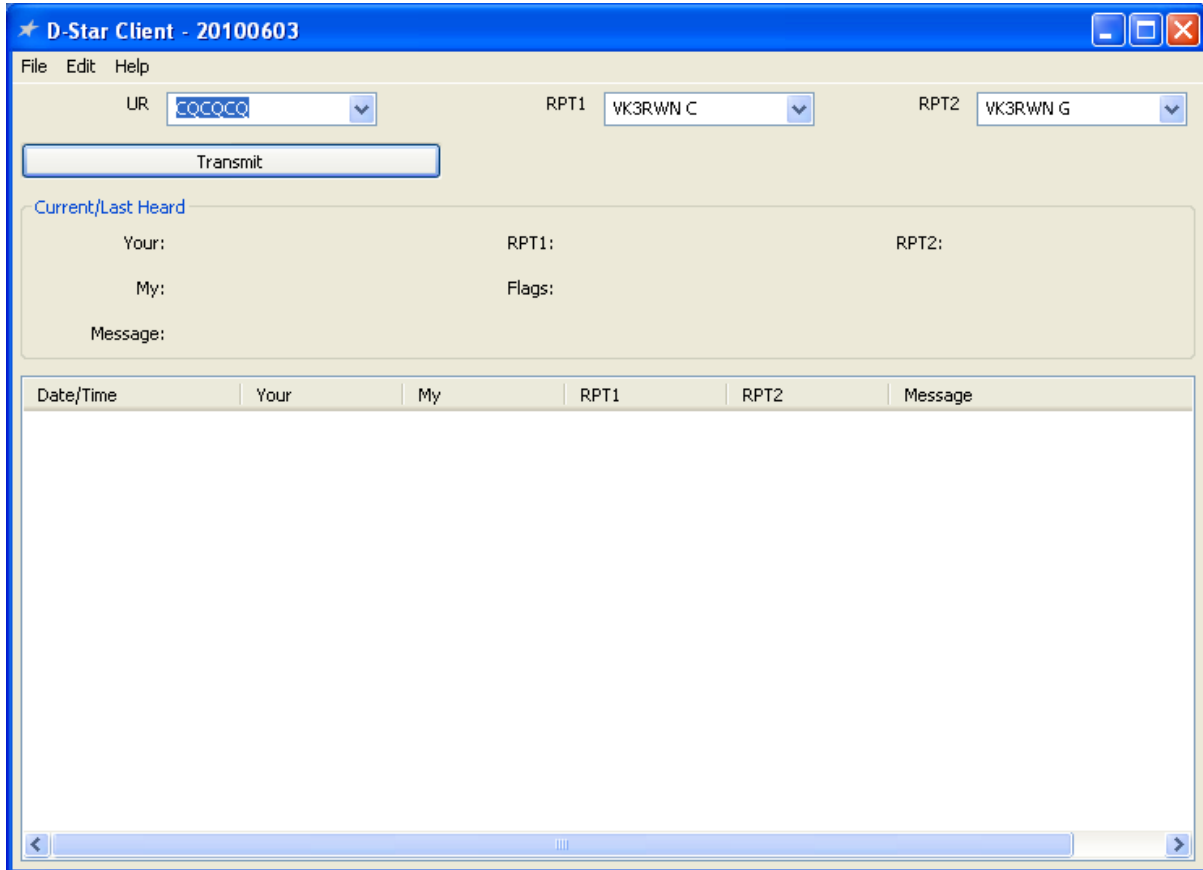
Conversely, the audio from your transceiver is fed into the microphone connection of the second sound card and then back into the decoder part of the DV Dongle. Again, from there on the process is as described above.

It works because of what we said at the very beginning of this article: a D-Star transceiver is basically just like any other transceiver except for the encoding/decoding of the audio stream. This software, and the DV Dongle does that encoding/decoding for you, uses your existing rig as it was always intended (except you could not understand the audio that comes out of it!).

Availability

The DV Dongle hardware is available from several sources that can be found on the Internet, mainly in the US, UK and Europe. You could even try eBay!!!

The DV Dongle software is also available in the Internet, but currently the primary source is at www.opendstar.org.

You will also need free drivers for the USB chip used in the DV Dongle hardware which are available from www.ftdichip.com/drivers (generally you will need the VCP drivers for your operating system).

As this section is really about getting started, I'll add in here that you will need to be registered on the D-Star network to use the DV Dongle. However, you need to be registered to use just about anything but the basics of D-Star so this should not be an issue for most.

Technical Details

The DV Dongle (in the commercially available form anyway) has 3 main parts:

- an FTDI FT232RL USB interface chip
  This handles the USB communication between the Dongle and your computer

- an Atmel AT91SAM7S256 ARM7 microcontroller chip
  This provides the control within the DV Dongle, interprets the information being passed to and from the computer and issues the required commands to the encoder/decoder chip

- a DVSI AMBE2000 or AMBE2020 Vocoder chip
  This does the voice encoding and decoding according to a proprietary algorithm

The key component is the AMBE[6] chip that compresses the incoming speech, and encodes it into a bit-encoded digital data stream. It also performs the complementary decoding/expansion processes. The algorithm used for this encoding/decoding and compression/decompression is proprietary to DVSI. However it is also the same chip as used in all D-Star devices and the D-Star protocol (which is otherwise "open") just treats it as a bit-stream. The manufacturer will sell single chips at low cost to hams.

The microcontroller chip, according to the developers, is not heavily utilised, and contains a bootloader and the FreeRTOS operating system. They openly suggest that new application code can be developed and downloaded into the microcontroller in the future.

If you want more details, that can be found at http://www.moetronix.com/dvdongle. The web site contains numerous documents and files, including the technical specifications and schematics for the device, and some of the original source code for the microcontroller. The Technical Reference document details how the device works, the protocols used to communicate with the computer and how it can be reprogrammed etc..

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[6] AMBE – **A**dvanced **M**ulti**B**and **E**xcitation; Vocoder – **Vo**ice En**coder**/decoder; DVSI – **D**igital **V**oice **S**ystems **I**nc