

Background

The Scotland AllStar Network is a network based on the open-source Asterisk PBX system. The network is predominantly an analogue network however, there are 3 bridges which support digital voice including the FreeDMR network.

The network can be accessed through TG23551 (Scotland Alba AllStar Multi).

How do we connect AllStar to FreeDMR

We use DVSwitch to connect the AllStar (ASL) system to DMR networks such as FreeDMR. DVSwitch allows you to take analogue audio, modulate and demodulate it into digital streams, similar to how DMR radios work using an AMBE vocoder chip. Where the magic happens is that DVSwitch allows you to do this using emulation software. This uses a MD380 emulator which lets you do this simply on a Raspberry Pi or similar Linux system.

The Setup

The setup is a bit long winded but we found by taking time and following each step through in order, and double checking before moving onto the next step, it should take about 30 mins from start to finish.

The end result should resemble something like this:

ASL<-> Analog_Bridge <-> MMDVM_Bridge <-> FreeDMR

<-> denotes two-way communication between the programs which is done using UDP ports

1. On ASL, you first need to go to the `rpt.conf` file to take note of the UDP ports that are being used. The example below is what you should be seeing

```
[1999]                                     ;this is usually your node number
rxchannel = USRP/127.0.0.1:34001:32001 ;Use the USRP channel driver. Must be enabled in
modules.conf

                                     ;127.0.0.1 = IP of the target application
                                     ;34001 = UDP port the target application is listening on
                                     ;32001 = UDP port ASL is listening on
```

2. Once you are finished taking note of these port numbers, you need to now enable the USRP channel driver from the modules.conf file. The line should look like this:

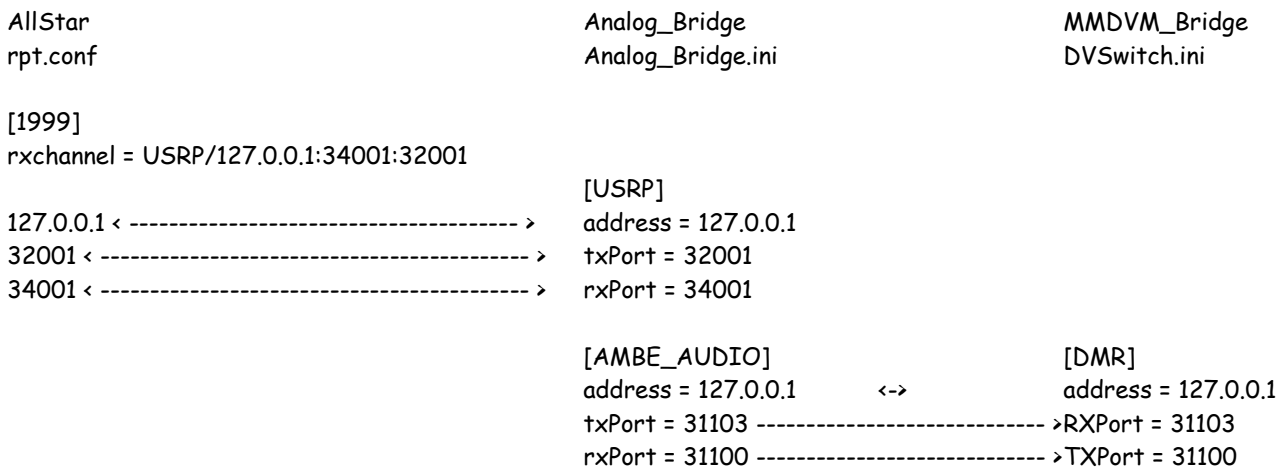
```
load => chan_usrp.so ;GNU Radio interface USRP Channel Driver
```

3. Next you need to install the DVSwitch program needed to connect ASL to FreeDMR by following these steps from your command line on your Pi or Linux system:

```
apt-get update      (this will make sure your repository list is fully up to date)
```

```
apt-get install dvswitch -y (this installs Analog_Bridge, MMDVM_Bridge and md380-emu. The scripts and datafiles are also installed. Each of the programs is set to start at boot.
```

4. Here is a diagram of what we will now be building. We will start from left to right:



From the left, the [1999] stanza is your node number and this defines how your node communicates. In this case, we will use USRP to communicate with Analog_Bridge. 127.0.0.1 is the address ASL will send data to Analog_Bridge (this IP address is used as this is a local address. Meaning that AllStar and DVSwitch are installed on the same server of the same Raspberry Pi). 34001 is the UDP port that ASL will send data on. 32001 is the port that ASL will listen for data on.

In Analog_Bridge.ini the [USRP] stanza defines how Analog_Bridge will communicate with another USRP partner. In this case, port 32001 is the port that Analog_Bridge will send data to ASL on. Port 34001 is the port that Analog_Bridge will listen for data from ASL on.

In Analog_Bridge.ini the [AMBE_AUDIO] stanza defines how Analog_Bridge will communicate with a digital partner. Port 31103 is the port that Analog_Bridge will send data to MMDVM_Bridge on. Port 31100 is the port that Analog_Bridge will listen for data from MMDVM_Bridge on.

MMDVM_Bridge is the program that will connect to FreeDMR. Think of it as a virtual Pi-Star hotspot.

Analog_Bridge and MMDVM_Bridge can be accessed by going to `cd /opt`. This should show these programs and then within them, their ini configuration files.

Next step is to setup MMDVM_Bridge with the details you need to connect to FreeDMR. You need to now edit the MMDVM_Bridge.ini file. There are two edits here you need to make. First of all is entering your callsign in the CALLSIGN field then your DMR ID in the appropriate field. It's recommended to add a 2-digit number between 01 and 99 here. This is now as your SSID.

Next you need to edit the [DMR_NETWORK] stanza with details specific to FreeDMR. These details can be found on FreeDMR's website. You should be looking at the configuration details as if you were setting up a Pi-Star or similar hotspot. The edits you would need to make here are enabling the DMR network by `Enable=1`, making sure that the address field has the details as supplied by FreeDMR and password, also supplied.

This sees the end of both sides of the bridge being set up. Next step is the final step. Using the emulator to make the necessary transcoding from analogue to digital and vice versa.

Digital to Analog and Back Again

We need to now configure the Analog Bridge so that it can pass data to the MD380 Emulator and make the necessary conversions to digital and vice versa.

1. Navigate again to `opt/Analog_Bridge/Analog_Bridge.ini`
2. In the [GENERAL] stanza change `decoderFallback = false` to `decoderFallback = true` and `useEmulator = false` to `useEmulator = true`
3. The [AMBE_AUDIO] stanza sets up the connection to MMDVM_Bridge. RXPort is the UDP port that Analog_Bridge will listen for data on from MMDVM_Bridge. Address and TXPort are where Analog_Bridge will send data to MMDVM_Bridge
4. `gatewayDmrID` is the DMR ID that all analogue traffic from ASL will appear to come from when someone is listening on DMR
5. `repeaterID` should match the ID you use to log in to FreeDMR
6. `txTg` is the talkgroup that traffic should be sent to
7. `txTs` is the timeslot the traffic from ASL will be on
8. Next we look at [USRP] stanza. This is where you tailor the audio in and out of ASL to FreeDMR. Our audio levels are left at default due to the good audio that comes from ASL. So you should leave this as `AUDIO_UNITY`

To recap what is happening here -

Analog_Bridge is sending data to MMDVM_Bridge at address 127.0.0.1 on port 31103

Analog_Bridge is listening for data from MMDVM_Bridge on port 31100

Analog_Bridge is sending analogue audio to ASL at address 127.0.0.1 on port 32001

Analog_Bridge is listening for analogue audio from ASL on port 34001

The setup looks complicated but following it through step by step and following the guides on <https://dvswitch.groups.io/g/main> was a great help to see it through from start to finish.

If you have any questions or need any of the points clarified then please contact me at

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