Using the Digital TV Framework

Introduction

One significant difference between Digital TV and Analogue TV that the unwary (like myself) should consider is that, although the component structure of DVB-T cards are substantially similar to Analogue TV cards, they function in substantially different ways.

The purpose of an Analogue TV is to receive and display an Analogue Television signal. An Analogue TV signal (otherwise known as composite video) is an analogue encoding of a sequence of image frames (25 frames per second in Europe) rasterised using an interlacing technique. Interlacing takes two fields to represent one frame. Therefore, an Analogue TV card for a PC has the following purpose:

- Tune the receiver to receive a broadcast signal
- demodulate the broadcast signal
- demultiplex the analogue video signal and analogue audio signal.

> **Note**
>
> some countries employ a digital audio signal embedded within the modulated composite analogue signal - using NICAM signaling.)

- digitize the analogue video signal and make the resulting datastream available to the data bus.

The digital datastream from an Analogue TV card is generated by circuitry on the card and is often presented uncompressed. For a PAL TV signal encoded at a resolution of 768x576 24-bit color pixels over 25 frames per second - a fair amount of data is generated and must be processed by the PC before it can be displayed on the video monitor screen. Some Analogue TV cards for PCs have onboard MPEG2 encoders which permit the raw digital data stream to be presented to the PC in an encoded and compressed form - similar to the form that is used in Digital TV.

The purpose of a simple budget digital TV card (DVB-T,C or S) is to simply:

- Tune the received to receive a broadcast signal. * Extract the encoded digital datastream from the broadcast signal.
- Make the encoded digital datastream (MPEG2) available to the data bus.

The significant difference between the two is that the tuner on the analogue TV card spits out an Analogue signal, whereas the tuner on the digital TV card spits out a compressed encoded digital datastream. As the signal is already digitised, it is trivial to pass this datastream to the PC databus with minimal additional processing and then extract the digital video and audio datastreams passing them to the appropriate software or hardware for decoding and viewing.

Getting the card going

The Device Driver API for DVB under Linux will the following device nodes via the devfs filesystem:

- /dev/dvb/adapter0/demux0
- /dev/dvb/adapter0/dvr0
- /dev/dvb/adapter0/frontend0

The `/dev/dvb/adapter0/dvr0` device node is used to read the MPEG2 Data Stream and the `/dev/dvb/adapter0/frontend0` device node is used to tune the frontend tuner module. The `/dev/dvb/adapter0/demux0` is used to control what programs will be received.

Depending on the card's feature set, the Device Driver API could also expose other device nodes:

- /dev/dvb/adapter0/ca0
- /dev/dvb/adapter0/audio0
- /dev/dvb/adapter0/net0
- /dev/dvb/adapter0/osd0
- /dev/dvb/adapter0/video0

The `/dev/dvb/adapter0/ca0` is used to decode encrypted channels. The other device nodes are found only on devices that use the av7110 driver, with is now obsoleted, together with the extra API whose such devices use.

Receiving a digital TV channel

This section attempts to explain how it works and how this affects the configuration of a Digital TV card.

On this example, we're considering tuning into DVB-T channels in Australia, at the Melbourne region.

The frequencies broadcast by Mount Dandenong transmitters are, currently:

Table 1. Transponder Frequencies Mount Dandenong, Vic, Aus.

Broadcaster	Frequency
Seven	177.500 Mhz
SBS	184.500 Mhz
Nine	191.625 Mhz
Ten	219.500 Mhz
ABC	226.500 Mhz
Channel 31	557.625 Mhz

The digital TV Scan utilities (like dvbv5-scan) have use a set of compiled-in defaults for various countries and regions. Those are currently provided as a separate package, called dtv-scan-tables. It's git tree is located at LinuxTV.org:

https://git.linuxtv.org/dtv-scan-tables.git/

If none of the tables there suit, you can specify a data file on the command line which contains the transponder frequencies. Here is a sample file for the above channel transponders, in the old "channel" format:

```
# Data file for DVB scan program
#
# C Frequency SymbolRate FEC QAM
# S Frequency Polarisation SymbolRate FEC
# T Frequency Bandwidth FEC FEC2 QAM Mode Guard Hier

T 177500000 7MHz AUTO AUTO QAM64 8k 1/16 NONE
T 184500000 7MHz AUTO AUTO QAM64 8k 1/8 NONE
T 191625000 7MHz AUTO AUTO QAM64 8k 1/16 NONE
T 219500000 7MHz AUTO AUTO QAM64 8k 1/16 NONE
T 226500000 7MHz AUTO AUTO QAM64 8k 1/16 NONE
T 557625000 7MHz AUTO AUTO QPSK 8k 1/16 NONE
```

Nowadays, we prefer to use a newer format, with is more verbose and easier to understand. With the new format, the "Seven" channel transponder's data is represented by:

```
[Seven]
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 177500000
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = AUTO
        CODE_RATE_LP = AUTO
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE
        INVERSION = AUTO
```

For an updated version of the complete table, please see:

https://git.linuxtv.org/dtv-scan-tables.git/tree/dvb-t/au-Melbourne

When the Digital TV scanning utility runs, it will output a file containing the information for all the audio and video programs that exists into each channel's transponders which the card's frontend can lock onto. (i.e. any whose signal is strong enough at your antenna).

Here's the output of the dvbv5 tools from a channel scan took from Melburne:

```
[ABC HDTV]
        SERVICE_ID = 560
        VIDEO_PID = 2307
        AUDIO_PID = 0
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 226500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 3/4
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE

[ABC TV Melbourne]
        SERVICE_ID = 561
        VIDEO_PID = 512
        AUDIO_PID = 650
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 226500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
```

```
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 3/4
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE

[ABC TV 2]
        SERVICE_ID = 562
        VIDEO_PID = 512
        AUDIO_PID = 650
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 226500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 3/4
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE

[ABC TV 3]
        SERVICE_ID = 563
        VIDEO_PID = 512
        AUDIO_PID = 650
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 226500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 3/4
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE

[ABC TV 4]
        SERVICE_ID = 564
        VIDEO_PID = 512
        AUDIO_PID = 650
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 226500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 3/4
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE

[ABC DiG Radio]
        SERVICE_ID = 566
        VIDEO_PID = 0
        AUDIO_PID = 2311
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 226500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 3/4
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE

[TEN Digital]
        SERVICE_ID = 1585
        VIDEO_PID = 512
        AUDIO_PID = 650
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 219500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 1/2
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE
```

```
[TEN Digital 1]
        SERVICE_ID = 1586
        VIDEO_PID = 512
        AUDIO_PID = 650
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 219500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 1/2
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE

[TEN Digital 2]
        SERVICE_ID = 1587
        VIDEO_PID = 512
        AUDIO_PID = 650
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 219500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 1/2
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE

[TEN Digital 3]
        SERVICE_ID = 1588
        VIDEO_PID = 512
        AUDIO_PID = 650
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 219500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 1/2
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE

[TEN Digital]
        SERVICE_ID = 1589
        VIDEO_PID = 512
        AUDIO_PID = 650
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 219500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 1/2
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE

[TEN Digital 4]
        SERVICE_ID = 1590
        VIDEO_PID = 512
        AUDIO_PID = 650
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 219500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 1/2
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE

[TEN Digital]
        SERVICE_ID = 1591
        VIDEO_PID = 512
        AUDIO_PID = 650
        DELIVERY_SYSTEM = DVBT
```

```
        FREQUENCY = 219500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 1/2
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE

[TEN HD]
        SERVICE_ID = 1592
        VIDEO_PID = 514
        AUDIO_PID = 0
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 219500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 1/2
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE

[TEN Digital]
        SERVICE_ID = 1593
        VIDEO_PID = 512
        AUDIO_PID = 650
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 219500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 1/2
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE

[Nine Digital]
        SERVICE_ID = 1072
        VIDEO_PID = 513
        AUDIO_PID = 660
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 191625000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 1/2
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE

[Nine Digital HD]
        SERVICE_ID = 1073
        VIDEO_PID = 512
        AUDIO_PID = 0
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 191625000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 1/2
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE

[Nine Guide]
        SERVICE_ID = 1074
        VIDEO_PID = 514
        AUDIO_PID = 670
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 191625000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 3/4
        CODE_RATE_LP = 1/2
        MODULATION = QAM/64
```

```
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/16
        HIERARCHY = NONE

[7 Digital]
        SERVICE_ID = 1328
        VIDEO_PID = 769
        AUDIO_PID = 770
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 177500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 2/3
        CODE_RATE_LP = 2/3
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/8
        HIERARCHY = NONE

[7 Digital 1]
        SERVICE_ID = 1329
        VIDEO_PID = 769
        AUDIO_PID = 770
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 177500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 2/3
        CODE_RATE_LP = 2/3
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/8
        HIERARCHY = NONE

[7 Digital 2]
        SERVICE_ID = 1330
        VIDEO_PID = 769
        AUDIO_PID = 770
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 177500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 2/3
        CODE_RATE_LP = 2/3
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/8
        HIERARCHY = NONE

[7 Digital 3]
        SERVICE_ID = 1331
        VIDEO_PID = 769
        AUDIO_PID = 770
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 177500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 2/3
        CODE_RATE_LP = 2/3
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/8
        HIERARCHY = NONE

[7 HD Digital]
        SERVICE_ID = 1332
        VIDEO_PID = 833
        AUDIO_PID = 834
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 177500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 2/3
        CODE_RATE_LP = 2/3
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/8
        HIERARCHY = NONE

[7 Program Guide]
        SERVICE_ID = 1334
        VIDEO_PID = ...
```

```
        VIDEO_PID = 865
        AUDIO_PID = 866
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 177500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 2/3
        CODE_RATE_LP = 2/3
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/8
        HIERARCHY = NONE

[SBS HD]
        SERVICE_ID = 784
        VIDEO_PID = 102
        AUDIO_PID = 103
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 536500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 2/3
        CODE_RATE_LP = 2/3
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/8
        HIERARCHY = NONE

[SBS DIGITAL 1]
        SERVICE_ID = 785
        VIDEO_PID = 161
        AUDIO_PID = 81
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 536500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 2/3
        CODE_RATE_LP = 2/3
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/8
        HIERARCHY = NONE

[SBS DIGITAL 2]
        SERVICE_ID = 786
        VIDEO_PID = 162
        AUDIO_PID = 83
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 536500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 2/3
        CODE_RATE_LP = 2/3
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/8
        HIERARCHY = NONE

[SBS EPG]
        SERVICE_ID = 787
        VIDEO_PID = 163
        AUDIO_PID = 85
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 536500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 2/3
        CODE_RATE_LP = 2/3
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/8
        HIERARCHY = NONE

[SBS RADIO 1]
        SERVICE_ID = 798
        VIDEO_PID = 0
        AUDIO_PID = 201
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 536500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
```

```
        CODE_RATE_HP = 2/3
        CODE_RATE_LP = 2/3
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/8
        HIERARCHY = NONE

[SBS RADIO 2]
        SERVICE_ID = 799
        VIDEO_PID = 0
        AUDIO_PID = 202
        DELIVERY_SYSTEM = DVBT
        FREQUENCY = 536500000
        INVERSION = OFF
        BANDWIDTH_HZ = 7000000
        CODE_RATE_HP = 2/3
        CODE_RATE_LP = 2/3
        MODULATION = QAM/64
        TRANSMISSION_MODE = 8K
        GUARD_INTERVAL = 1/8
        HIERARCHY = NONE
```