

# 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 obsolete, 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 Melbourne:

```
[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 = 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