In this issue

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David Shaw M5TXJ

Editorial

Ok here we go CQ-DATV issue 61 and what a packed issue.

In descending order, we have news that we have a problem with the DATV transmitter on board the international space station. Being old enough to remember Apollo 13 (the film not the real event, we are all far too young for that, well maybe just Trevor) let's say worse things have happened in space, but let's hope we can get a replacement unit up their as soon as possible.

Descending to a lower altitude Nigel Walker G8AYC had plans to fly in an air ship, might not be quite as ambitious as the ISS, but never the less got thwarted this time by the weather! But he did bring back some excellent pictures of the Friedrichshafen rally - better luck next time Nigel.

Our next story comes from ground level and is a report on the R1 ATV contest from Giorgio de Luca IU3IOU who is in Montebelluna, a town and commune in Veneto Italy, approximately 50 kilometres (31 mi) Northwest of Venice.

Richard VK4XRL looks back on his own and others work on early PAL TV inspired by Trevor's series of articles, if not by his earlier ATV handbook colour bars. For those not in the know, colour bars are based on a descending staircase waveform while their predecessor, grey scale, was based on an ascending staircase waveform....except in the ATV handbook. Trevor has his tin hat on, nothing new, the word incoming is frequently heard in the CQ-DATV production office.

Trevor however has managed to finish his 50 years of PAL series with a look at PAL Plus, as a system designed to extend the life of PAL. Something else that never really got off the ground, at least in the UK. Seems it's just not a good time for our contributors to leave ground level.

So could we pass them off as SECAM colour bars

David Shaw M5TXJ has just taken part in his first contest/activity weekend. Unsuccessfully as it happens, but is on a learning curve (aren't we all David - Ed)

Dr. Gough Lui looks at HEVC-encoded 1080p, from New South Wales, following a wakeup call from Shaun Ruigrok letting him know about a test transmission from Sydney's main transmitters at Artarmon/Gore Hill. The trial was using DVB-T2 technologies for eventual replacement of DVB-T to bring 4K TV to consumers.

So we have brought you ATV from every possible level and location, thanks to all our contributors, we could not have done it without you.

So sit back and enjoy CQ DATV 61.

CQ-DATV Production team

ARLS007 Space Station Digital Amateur Radio TV System Transmitter Determined to be Defective

Astronaut Drew Feustel is pictured outside of the International Space Station during a spacewalk on May 16 to swap thermal control gear.
Picture credit: NASA

The Amateur Radio on the International Space Station (ARISS) "Ham Video" digital Amateur Radio TV (DATV) transmitter on the International Space Station (ISS) is reported to be defective, with onboard repair not possible.

Also known as HamTV, the DATV system stopped working in mid-April, and a subsequent test on June 1 using a second L/S band patch antenna on the Columbus module had failed.

ARISS-EU Mentor Gaston Bertels, ON4WF, said ARISS plans to return the transmitter to Earth to repair, pending space agency approvals and availability of ARISS funds.

"Schools and crew members performing educational ARISS school contacts are delighted to use Ham Video," Bertels said. "We will do the best we can to restart this service as soon as possible."

Following extensive testing, the Ham TV system was first used for an ARISS school contact in February 2016.

From ARRL Headquarters

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G8AYC's visit to Friedrichshafen Ham Fest

Written by Nigel Walker G8AYC

I've known about this rally for many years but never imagined going to see it for myself. But I managed it this year!

First of all, Friedrichshafen is a wonderful place to visit, even without the rally. It's on Lake Constance with ferries to many other towns scattered around the lake. It is also a resident to the Zeplin which was invented here and you can fly in one.

Unfortunately, my flight was cancelled due to an impending thunderstorm which never materialised!

Zeppelin photo courtesy of Michael Rademacher DG8YP

By Friedrichshafen lakeside, there is an observation tower. The first picture is a view of from the top of it showing the lakeside bars and restaurants.

The next two pictures show familiar views of a radio rally. The difference is the scale.

Five large exhibition halls altogether, one with all new stuff, one with flea market type stuff, one was a maker fair and two more I didn't get to see but were apparently more flea market.

The final picture above shows a small section of a stand with all sorts of old radio components - plus a modern Tesla coil!

TV Amateur is a German Language ATV Magazine. It is published 4 times a year and if you would like to subscribe go to *http://agaf-ev.org/*

ATV Contest IARU Region 1 9-10 June 2018

Written by Giorgio de Luca IU3IOU

As by now tradition during the second weekend in June, the one that has just ended, it was held the Contest ATV IARU Region 1.

Although rarely used given the technological alternatives, this video wireless transmission technique is exciting and challenging in terms of testing this allows you to do and also for the study of the propagation conditions.

In view of this appointment last week I made several tests and receiver tests ATV (link) is from my station from Section ARI Montebelluna .

I had already participated last year (link) with the receive-only station, receiving only one station's Francesco IK3HHG from Mount Cesen on the frequency of 10 GHz.

At this point I said to myself, why not also try again this year?

Obviously this year it was to participate in receive-only mode still valid for the contest, having no equipment for transmission.

Thanks to the support rate and a bit more comfortable with the technique ATVs compared to last year, it was not hard to get Francis IK3HHG who worked in the company Giorgio IK3GHY from Mount Cesen in Valdobbiadene (TV) JN65AW lessor. The reception was carried out on the frequency of 10 GHz - 3 cm.

After a moment of flicker, the reception was almost perfect in color, with no disturbances and includes audio: P5 relationship.

Receiving ATV of Francesco IK3HHG in the company Giorgio IK3GHY about 10 GHz

Once you do this reception I thought I had entered the contest. On Sunday, however, thanks to the equipment of the section I was able to receive the station IK3HHG and other stations on the band of 1.2 GHz - 23 cm.

Receiving ATV of Francesco IK3HHG in the company Giorgio IK3GHY on 1.2 GHz

Among these at some point I had the pleasure of receiving also the signal Guido IW6ATU , the contest manager, which operated from JN63QN. This signal has been received by me as a repeater committed while Guido was trying to connect with the station on Mount Cesen, so this reception can not be considered valid for the contest but anyway a great feeling to receive just the manager.

Receiving ATV of Guido IW6ATU Repeater Bridge

Setup used for the reception of signals ATV
- Receiver: Fraccaro ASR500
- Antenna: 40 cm dish and modified illuminator
- The receptions were made from my QTH in Crocetta del Montello (TV) JN65AS lessor.

Not content of reception on Sunday afternoon in fellow Riccardo IU3GKJ , we climbed Mount Cesen to say hello to the two operators ATV IK3HHG Francis and George IK3GHY . Together with them we toasted to thank them for their commitment and their availability.

Here are some pictures of their station ATV multiband.

Continued next page...

At the next, hoping eventually to also try the transmission!

73 de Giorgio IU3IOU

(Translated from Italian by that nice Mr Google - Ed.)

Check out the DKARS website at:-
http://dkars.nl/

IARU International ATV Contest June 9/10

Written by Dave Crump G8GKQ
The International Contest weekend saw the highest activity levels across the UK for many years. I know of 41 stations who participated, many from more than one location. I was particularly pleased to see activity in Northern Ireland – we just need to get Scotland on the air next year!

The results are not yet finalized, but so far 26 entries have been received for the IARU International Contest and 10 entries received for the BATC 146 MHz Contest.

The 4 leading stations operated on all bands 146 MHz to 24 GHz; 3 of them from different portable locations on the Saturday and the Sunday; all were single-operator, and one also had digital ATV contacts on 76 GHz.

Future BATC Activity Weekends and contests will be organized by Clive, G3GJA, which will allow me more time to promote DATV through further development of the Portsdown Project (*https://wiki.batc.org.uk/The_Portsdown_Transmitter*) and similar initiatives. The contest e-mail address will not change: *contests@batc.tv*

Finalised UK league tables for each band will be ready for the next issue of CQ-DATV. In the meantime, please don't forget the Activity weekends that happen every month.

Contest and Activity Weekend Calendar

- 1200 UTC 14 July 2018 – 1800 UTC 15 July 2018: ATV Activity Weekend
- 1200 UTC 11 August 2018 - 1800 UTC 12 August 2018 - ATV Activity Weekend
- 1200 UTC 8 September 2018 – 1200 UTC 9 September 2018: ATV Activity Weekend
- 1200 UTC 20 October 2018 – 1800 UTC 21 October 2018: ATV Activity Weekend
- 1200 UTC 17 November 2018 – 1800 UTC 18 November 2018: ATV Activity Weekend
- 1200 UTC 8 December 2018 – 1800 UTC 9 December 2018: ATV Activity Weekend
- 1200 UTC 12 January 2019 – 1800 UTC 13 January 2019: ATV Activity Weekend
- 1200 UTC 9 February 2019 – 1800 UTC 10 February 2019: ATV Activity Weekend
- 1200 UTC 9 March 2019 – 1800 UTC 10 March 2019: ATV Activity Weekend
- 1200 UTC 6 April 2019 - 1800 UTC 7 April 2019 - ATV Activity Weekend
- 1200 UTC 4 May 2019 - 1800 UTC 5 May 2019 - ATV Activity Weekend
- 1200 UTC 8 June 2019 - 1800 UTC 9 June 2019 - IARU International ATV Contest

Right: G8GKQ/P ATV Portable Operation on all bands 146 MHz – 24 GHz

A Look at SPG's and Colour Bar Generators

Written by Richard Carden VK4XRL

Trevor's article in CQ-DATV No.60 brought back some vivid memories of when I started out in ATV all those years ago.

My first foray into colour was to to colourise the Cropedy Test card Generator using the TEA 2000 PAL encoder. Another PAL encoder I built was based on the TBA520 which performed extremely well considering its simplicity.

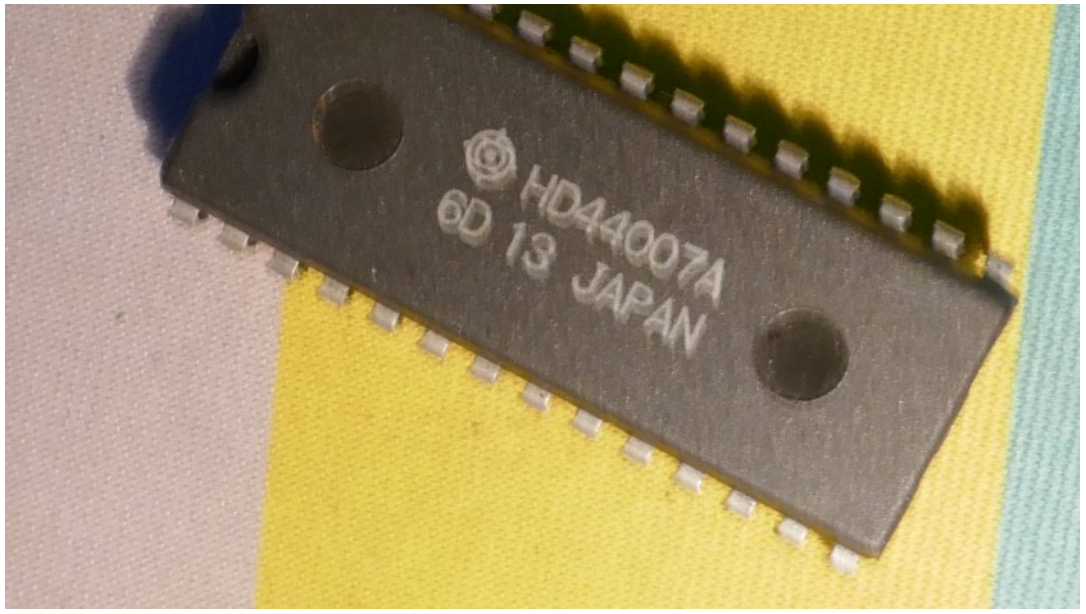
My first SPG was a unit designed by Alan Nation from the Adelaide (Australia) stable of ATV. The group was very big at the time and into ATV with live shows at their Royal show.

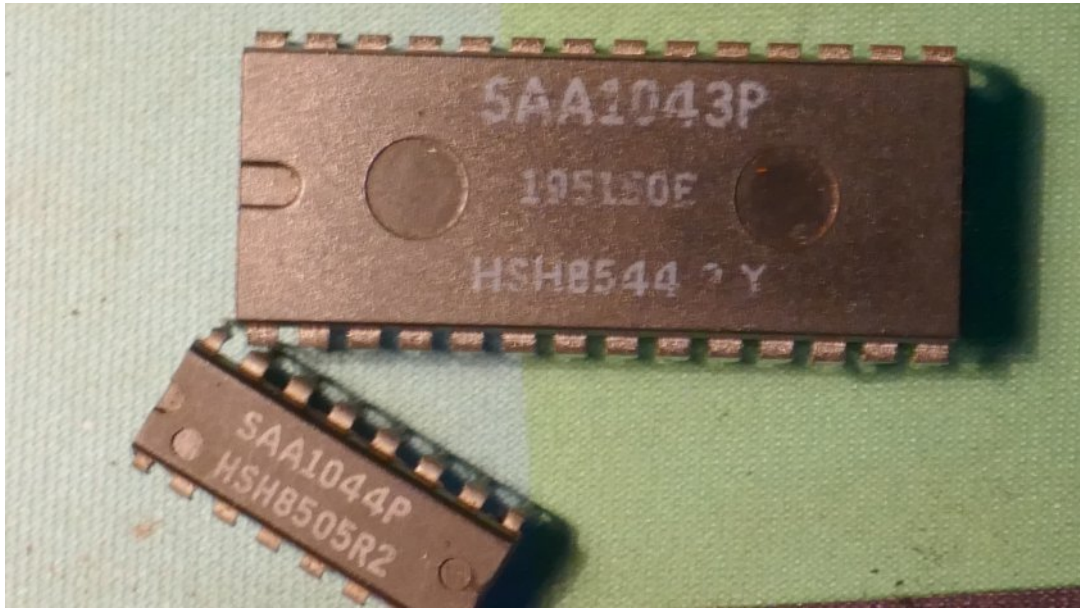
The group also had a working telecine chain, not many of those around in ATV. My first vidicon camera was also based on Alan Nation's design and used a Nuvistor in the head amplifier and the scanning coils from the BATC shop, anyone remember those.

In 1966 I travelled to Adelaide and caught up with Alan, who was then looking at down-convertors and antennas. I am very much indebted to Alan, along with John Ingham and Bill Semester during that period.

Like Trevor I also built the Arthur Critchley's triple standard SPG, back in the 70's, that's 405/525/625 (remember 405).

This single board TTL SPG used monostables to generate pulse durations so there was a little tweaking, but nothing too taxing. It was a mono SPG with no Colour pulses like burst gate or PAL SWITCH let alone subcarrier, locked or otherwise.

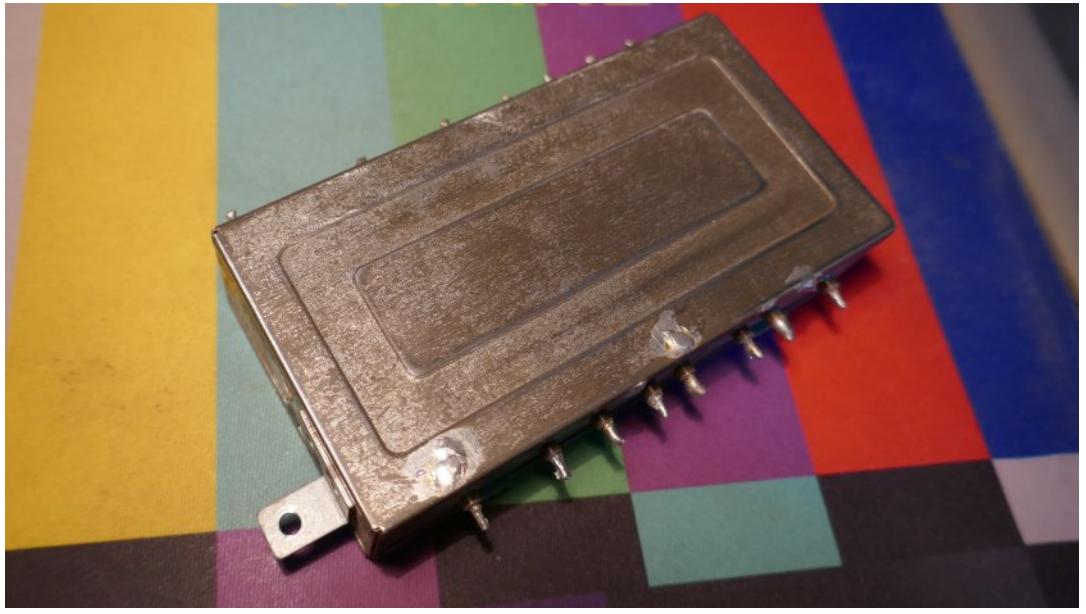




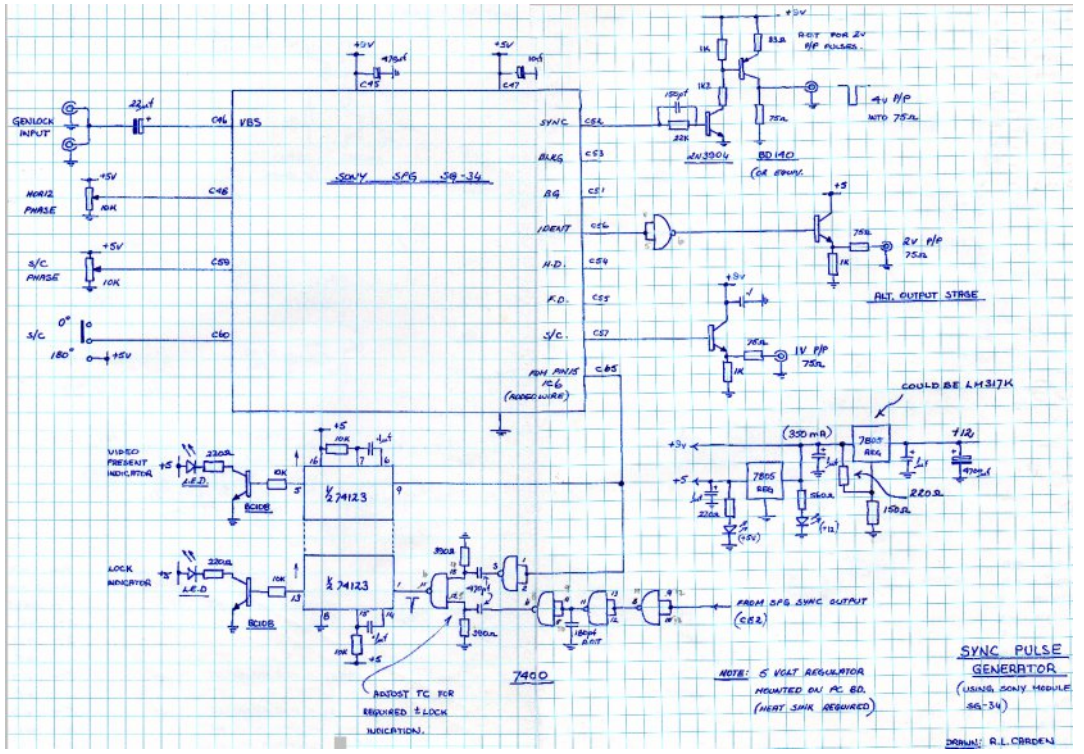
SPG and PAL encoder chips

The next SPG was the Philips IC's the SAA1043 and SAA1044 and more information can be found from an article that appeared in the "THE ATV COMPEDIUM".

There were also a number of other IC's around at that time like the Hitachi HD44007A and they could be found in many vision switchers.



Sony SPG module SG-34



Sony module used as an SPG SPG

Sony also produced an SPG module SG-34 which was used in their commercial helical VCR's. I used one of these modules to provide a colour black locking system similar to the MONOSYNC from Marconi.

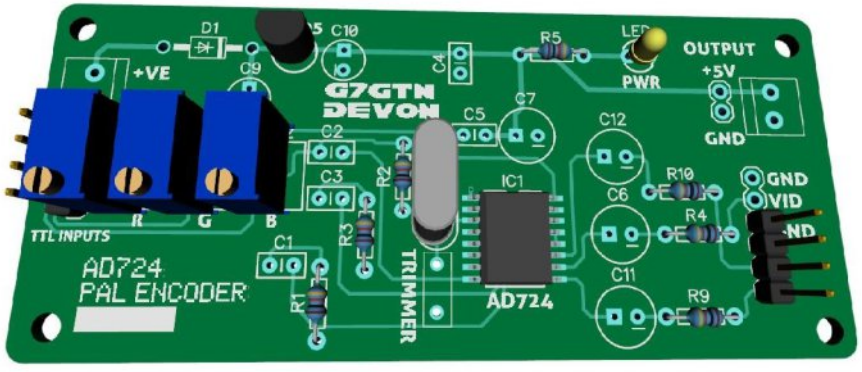
My original paper work is shown above right (sorry was done on A3 graph paper at the time-1986, CAD software was not then a reality. (Note all outputs not shown).

The Philips chips were later replaced by a single IC type SAA1101, our good friend Mike Cox produced an article for 'Electronics World' in February 1996 using this device. It's worth a look if you're interested in SPG's.

There were also various PIC designs for SPG pulses, I haven't a PIC programmer so haven't done much with those, but there is still room for these in a digital world.

If you have any ideas on the subject just drop a line to the editor.

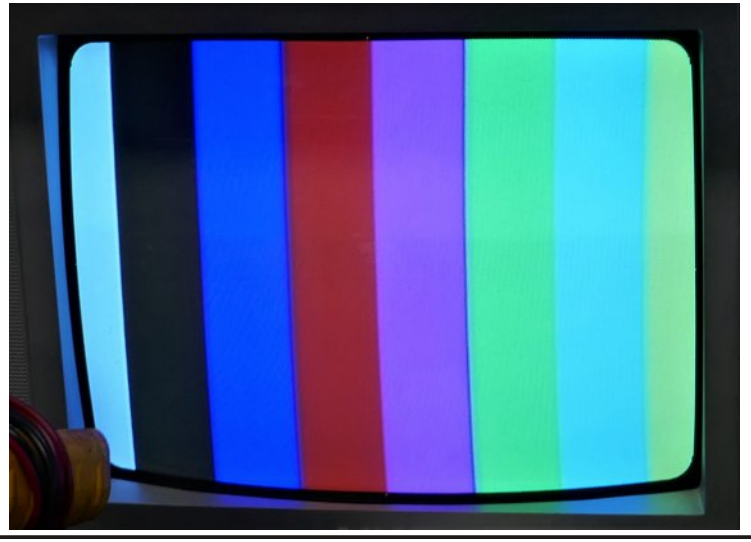
The colour Bar Generator is another interesting subject and was highlighted when I wanted to test a new (or not so new encoder AD724) from the stable of Mike G7GTN.



I therefore started to look for circuits and as I had built many before for people I didn't see any problems. The first design was from the old white handbook produced from the BATC called "An introduction to ATV", this used the up/down counter, a 74LS193. It had a design flaw, it produced colour bars, but they were in the ascending direction, from black to white. The 74LS193 was used in the UP mode (pin 5) and changing this to (pin4) the Down mode didn't help.

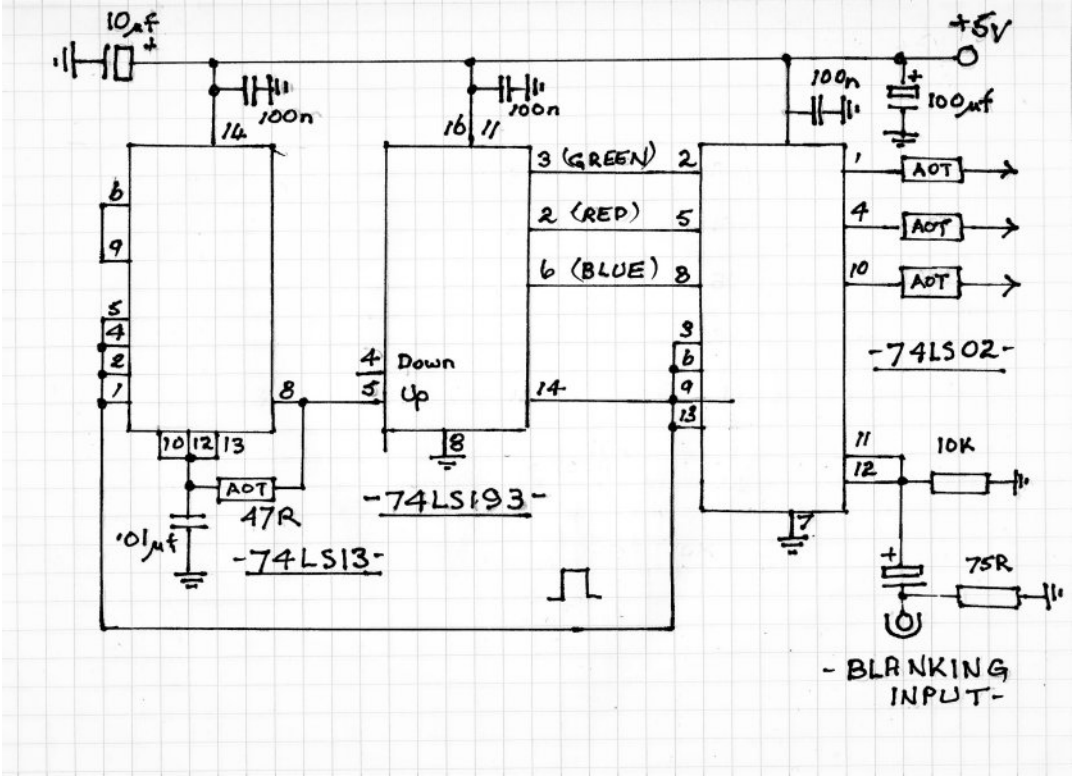
There was a circuit in the old Yellow handbook and it used the Down mode (pin 4). This circuit produced the colours in the correct descending order (white to black). This design had a slightly different problem in that the white bar didn't start at the end of blanking it appears that this part was missing from the complete colour bar generator.

Now again scrolling through the other colour bar designs, I found using the UP mode (pin 5) and with the three colour feeds being fed via inputs of a 74LS02 (Nor Gate).The other inputs been fed from the inverted blanking signal using the fourth spare gate the signal was now correct. The encoder I used for these tests was the professional COX-153 unit so now when the AD724 is working it should be easier to test knowing that all is right with the input signal.



On screen Colour Bars ascending, well almost except for the white Bar

I left the unit as wired as per the yellow handbook circuit because it worked. Also note if you change pin 5 to pin 4 it produces an interesting bar pattern. The AOT resistor for bar width could either be a 100 ohm pot or a fixed resistor around 47 ohm. The resistors use to raise the output impedance from the 74LS02 again could be a fixed resistor or a Pot, the setup I was using fed into 75 ohm terminated inputs on the Cox coder. One last thing to mention is that the +5 volt supply should be well regulated as this will effect levels and therefore the AOT resistors.



Colour Bar Generator for descending 100% colour Bars

All issues of CQ-DATV magazine are available for free download at https://cq-datv.mobi/ebooks.php

Written by Trevor Brown G8CJS

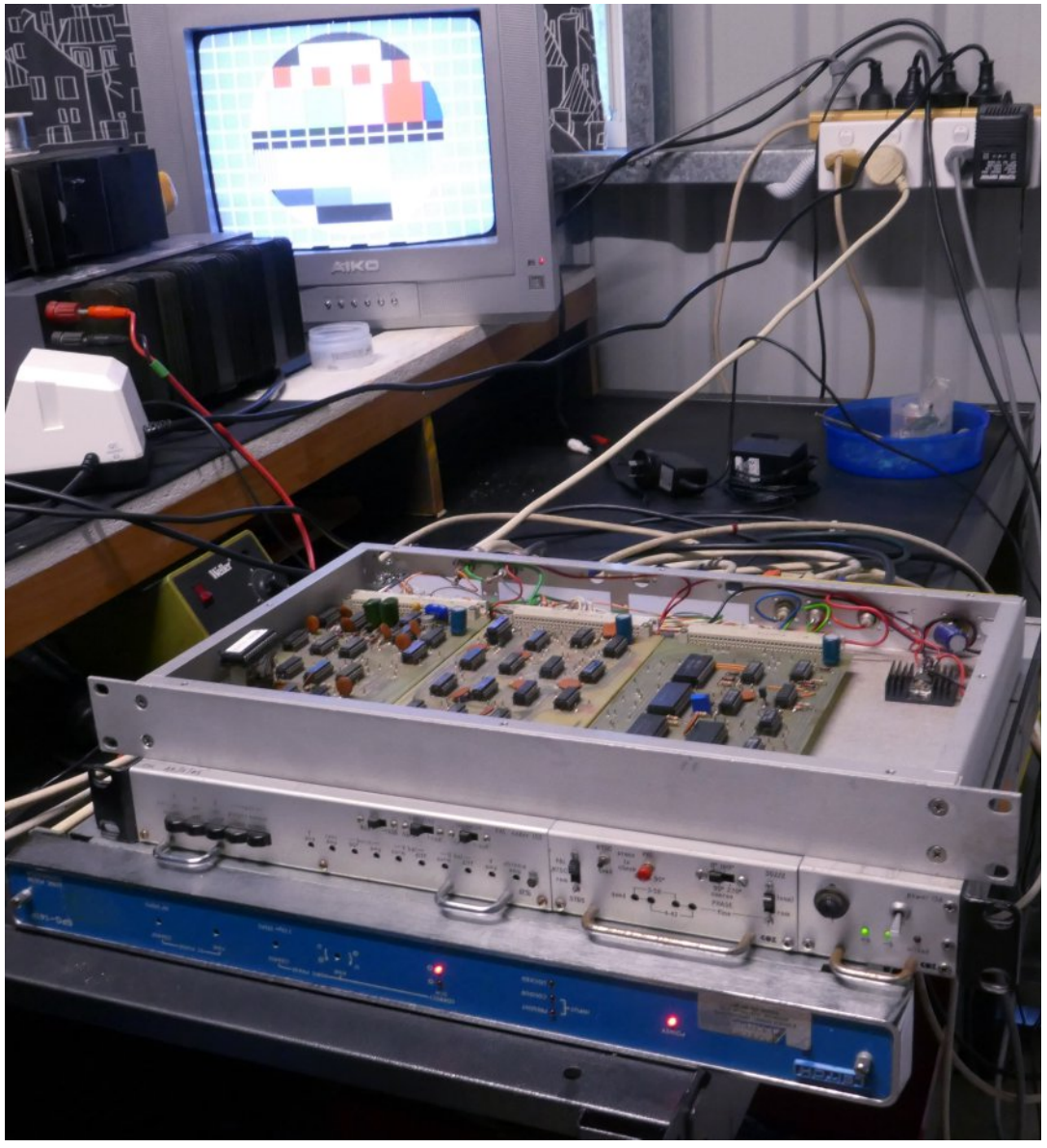
The beginning of the end....

Well the story of bringing PAL to the ATV community certainly seems to have captured Richards VK4XRL's imagination. Apologies for the descending rather than ascending colour bars Richard, but that ATV book was put together on a very tight schedule and some of the proof readers and circuit testers might just have been sleeping on the job, so apologies if one of circuits might have escaped final test, it's a little late to start holding a post mortem. I am sure we can remedy that design in a future edition of CQ-DATV.

A PAL SPG without a PAL coder is little like a multi meter without leads, there were numerous coder chips around, but my favourite is the David Ellis Jones GW8PBX and John Lawrence GW3JGA's design in the blue ATV handbook, which is available from the CQ-DATV download site *https://cq-datv.mobi/handbook.php*. This book also has the design for the compatible electronic test card from Richard Russell G4BAU these three units together produce an excellent ATV test signal.

The problem is all good things come to an end. PAL being an analogue signal does suffer degradation from transmission paths. In the UK ITV started to go digital for television networking and programme interchange in the 90's, the problem was how to pass this along to the viewer.

The TV screens were changing from 4:3 which had its origin in the round CRT to the more pleasing 16:9 flat panel screens. These suffered numerous initial problems, black level that changed with viewing angle springs to mind, but the problems were slowly been overcome and receivers were now starting to evolve and screens grow in size.



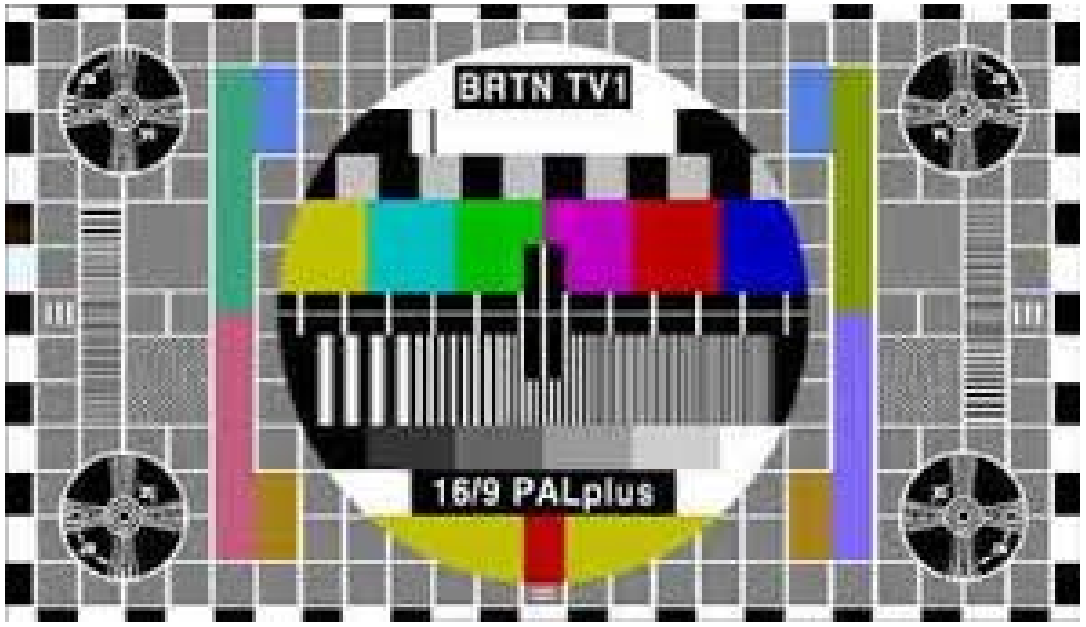
Professional PAL Coder from Mike Cox (middle unit) alas these can often be found at radio rallies at a fraction of their original cost). The original Blue Handbook test card generator (top unit) running in Richard VK4XRL's shack.

This new generation of TV receiver placed more demands on incoming TV signal quality and well PAL did not cut the mustard any more. So the broadcasters had a problem, what could they do within the constraints of the limited transmission bandwidth channels to improve their quality.

Thinking caps on they came up with PALplus. This new standard was developed at the University of Dortmund and was designed to compete with DMAC and D2 MAC transmissions, while at the same time keeping compatibility with existing PAL receivers, something neither of these systems had.

Every good product launch needs a LOGO

PALplus was a 16:9 transmission (ideal for the flat panels), but a standard 4:3 PAL receiver would still display the 16:9 image in letterbox format with 432 active lines. This reproduces noticeably less vertical detail than the 576 lines used for 4:3 broadcasts.



Not the best example of a PALplus transmission

The space above and below the picture was used for extra information called helpers that could be used by a PALplus receiver to recover the lost vertical resolution. This was not so for a standard PAL receiver where the result is a horizontal resolution that is 73% of the vertical resolution.

The PAL colour sub carrier was modulated making use of correlation between 2 fields, in order to give a cleaner Y/C separation in the PALplus receiver. It was used with signals with high horizontal luminance frequencies (3 MHz) that share the spectrum with the chrominance signals. Colour pictures on both standard and PALplus receivers were enhanced.

It had two processing modes "Film mode" which used "Fixed Colour-Plus. (Remember films had the same picture presented twice) E.G. there was no motion between the image fields and "Motion Adaptive Colour-Plus" (MACP) for video camera pictures, where there was.

Line 23 carried a 14 bit data signal which switched the PALplus receiver modes between 4:3/16:9/PALplus/MACP/Fixed colour plus/ and also could enable a "Ghost Cancellation" feature. The bandwidth of these signalling bits was low enough to be recorded on VHS and allow the receiver to switch to the proper format, another important consideration at the time.

In the United Kingdom, Channel 4 used to broadcast selected films as PALplus during the late 1990s along with some programmes, including the omnibus edition of Brookside.

Alas there were not many PALplus receivers in the UK and although the system was compatible with a standard PAL receiver its letterbox viewing was not well received by the viewing public. So PALplus was not sufficient to rescue what was once called "perfection at last" and PAL broadcast ceased in the UK in 2012.

Everything has to run its course and PAL was no exception, the system was a clever inception and improved throughout its life time, but all the work and effort was never going to compete with digital delivery.

PALplus was born out of a worry that the traditional broadcast channel with their limited bandwidth would lose out to the satellite broadcasters with greater bandwidth channels able to host better quality pictures.

The better solution of Freeview for Digital Terrestrial broadcasting saved the day. The narrow channels were scrapped and the band was reworked so traditional broadcasters were not constrained by the narrow channels they feared would be their epitaph.

The Modern Logos of Digital Television Transmission

Written by David Shaw M5TXJ

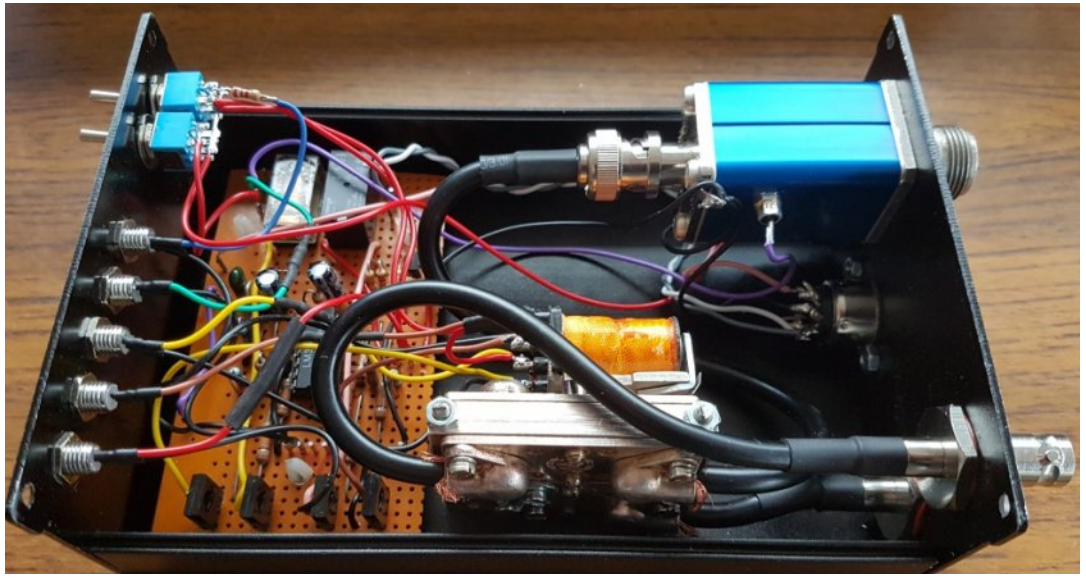
I can't remember what drew me to the BATC website but somehow I found the Portsdown builders map, I didn't even know what the Portsdown was then. On looking at the map I spotted Ian G4EXD as a builder, knowing Ian since I was licensed almost 40 years ago I had to investigate. Seeing that the Portsdown was based on a Pi3 and having one lying around unused, a build seemed logical.

Well here we are almost a year later and I've just taken part in my first contest/activity weekend, unsuccessfully as it happens but I'm on the learning curve.

Building the Portsdown was only the start, of course a receiver (Minitiouner) was needed, a PA, sequencer, aerial (Marconi and Fessenden used aerials) and preamp. This is all without things like cameras, OSD unit and all the necessary power supplies, talkback gear, cables and masts etc, and this was all just for a single band, 2m.

l was a little naive thinking I was well on the way having a Pi!

I decided to be active in time for the June IARU contest and BATC activity weekend and all was progressing well until my little van burst a hose on the eve of the weekend, the wife's car had to be pressed into service.



I arrived at my chosen site near GB3EV late morning and set everything up quite quickly, I had practised several times so that I knew l had everything I needed.

Monitoring 144.750 nothing was heard until early afternoon when one or two 5.6GHz stations came on, I called in to say that I was around on 2m of anyone had that band, GW4CBW said he would come onto 2m later. I had a chat with Chris M0KPW who I'd helped with programming an OSD unit for and during this conversation Dave G3ZGZ appeared and offered to try with me on 2m.

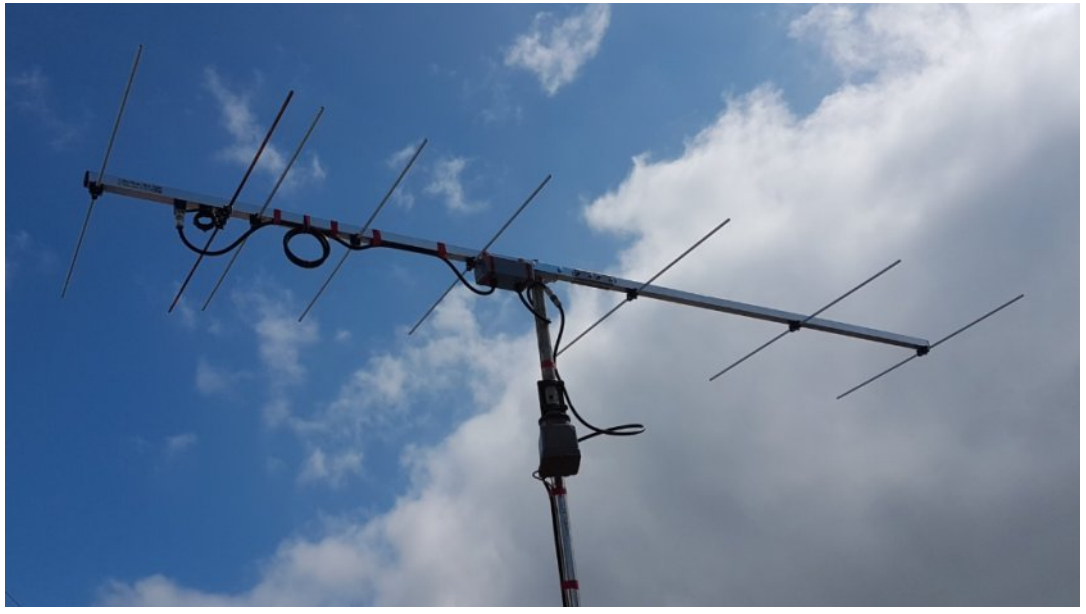
I received Dave P5 but however we tried he could not get my video to lock even though he could hear my signal on a scanner, Dave thought it could be noise local to him.

I was just considering packing away as thunder was rumbling and the sky getting very dark when Tony GW4CBW reappeared. Unfortunately it was the same result as with Dave, P5 picture from Tony but no video from me, work to be done somewhere.

I got packed up and into the car literally seconds before the heavens opened. Not a successful first attempt at DATV but many lessons learnt, now to find what's wrong, I suspect psu noise getting into the DDS or the filter modulator board so first step is psu modification with lots of extra filtering.

My station (so far);

- Antennas-amplifiers PA144-148-8-3
- DG8 preamp
- Minitiouner v2
- BATC Portsdown
- GM3SEK RA60H1317M1 PA
- Homebrew sequencer with bias tee
- 1000 line FPV camera
- Micro minim OSD with 3 outputs
- 4.3" TFT monitor
- TR9000 + 170W PA (talkback)



Thanks to all for support I've received and apologies to Seamus G7ITT who is also building a system after seeing mine.

Analysis: DVB-T2 Australian Television Networks Test Transmission

Written by Dr. Gough Lui

As I've been quite busy lately with work and job hunting, I really haven't had much time to watch TV or look at the signals on the air. In fact, I've not had enough time even to look at Twitter, not that I really use it much. Imagine my surprise when a *message from @Shaun_R* was waiting for me from 20th May, letting me know about a test transmission in Sydney with HEVC-encoded 1080p. I had to do some analysis – even if I'm now at a location with marginal signals from Sydney's main transmitters at Artarmon/Gore Hill.

The Test

Looking into the past, it seems that the test itself was publicly announced on *21st March 2018 by Broadcast Australia* in an article about partnering with Free TV to trial DVB-T2 technologies for eventual replacement of DVB-T and to bring 4K TV to consumers. At the time, it acknowledged the existence of lab tests in Chatswood with transmission from three sites from April to June with further information available on the Broadcast Australia website.

However, despite this, there hasn't really been much fanfare or more information made available, possibly to avoid any needless enquiries from the general public. On 24th April, *tvcl made a post* on MediaSpy forums with the footage from the test transmission. I wasn't aware of this until it was bought to my attention and began my hunt for the signal on 22nd May.

Knowing what I know now, it seems that the transmissions were licensed under the name of *Free TV Australia Ltd*.

They have two licenses (*10424871/1* and *10402649/1*) covering three sites for scientific purposes, expiring 30th June 2018. The information tables from the license images are reproduced below, as I know ACMA tends to remove such information upon license expiry and it could be of academic interest in the future.

The first license covers two sites on frequency 536.500Mhz – one at Kings Cross and the other in Manly. The reported EIRP is 1.07kW and 1.64kW respectively which appears consistent with the powers used normally (EIRP 1066W at Kings Cross for 529.500Mhz, EIRP 1640W at Manly for 529.500Mhz). Because of the use of very much similar powers and geographically close location, I suspect these two sites have been chosen to test real-life single-frequency network (SFN) performance of DVB-T2 signals.

Main Station Site **Station 1:**

Site details	
Site ID	153380
Site address	Elan Building, Victoria St, KINGS CROSS NSW 2011
Co-ordinates (GDA94)	Latitude: -33.875949 Longitude: 151.222629

Transmitter details	
Assigned frequency	536.500000 MHz
Bandwidth	7.000000 MHz
Freq. assign. ID	0002112575
Transmitter power	0 mW
EIRP	1.07 kW
Emission designator	6M70V7W
Antenna details	
Antenna ID	
Antenna polarisation	H - Horizontal linear
Antenna azimuth	
Antenna height (m)	128
Antenna type	

NOTE:- Clicking on any picture in this article will take you to the original pictures on the website of Dr. Gough Lui

Continued next page...

Main Station Site	Station 2:
Site details	
Site ID	40743
Site address	Broadcast Site, Sewage Treatment Plant, MANLY NSW 2095
Co-ordinates (GDA94)	Latitude: -33.807497 Longitude: 151.300623
Transmitter details	
Assigned frequency	536.500000 MHz
Bandwidth	7.000000 MHz
Freq. assign. ID	0002112576
Transmitter power	0 mW
EIRP	1.64 kW
Emission designator	6M70V7W
Antenna details	
Antenna ID	
Antenna polarisation	H - Horizontal linear
Antenna azimuth	
Antenna height (m)	51
Antenna type	

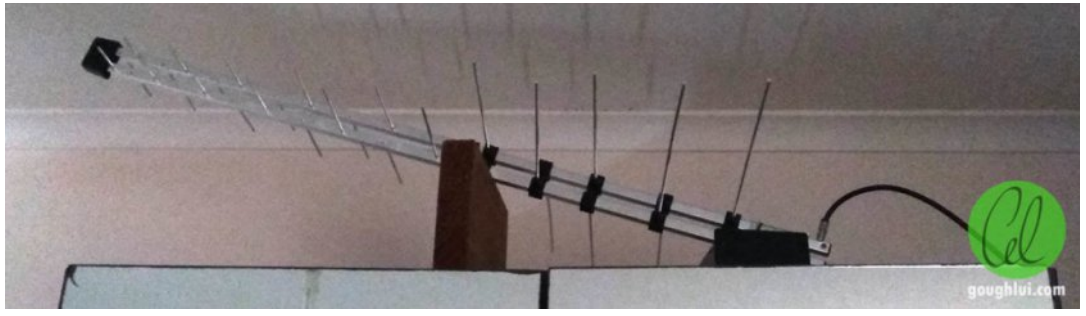
The second license covers the main transmitter on VHF at 212.500Mhz which should cover most of the Sydney basin from Gore Hill. It has a claimed EIRP of 82kW, identical to the EIRP for ABC on 226.500Mhz from the same location. This particular transmission in VHF probably will assess how well DVB-T2 signals cover wide areas and cope with propagation conditions in Sydney. This one would probably be quite good for drive-around tests across most of Sydney.

Main Station Site	Station 1:
Site details	
Site ID	48711
Site address	ABC Tower, 221 Pacific Highway, GORE HILL NSW 2064
Co-ordinates (GDA94)	Latitude: -33.820079 Longitude: 151.185000
Transmitter details	
Assigned frequency	212.500000 MHz
Bandwidth	7.000000 MHz
Freq. assign. ID	0002081563
Transmitter power	0 mW
EIRP	82.00 kW
Emission designator	6M70V7W
Antenna details	
Antenna ID	
Antenna polarisation	H - Horizontal linear
Antenna azimuth	
Antenna height (m)	158
Antenna type	

Both licenses seem to have been granted 16th April 2018, so transmission could have started at that time or soon afterward.

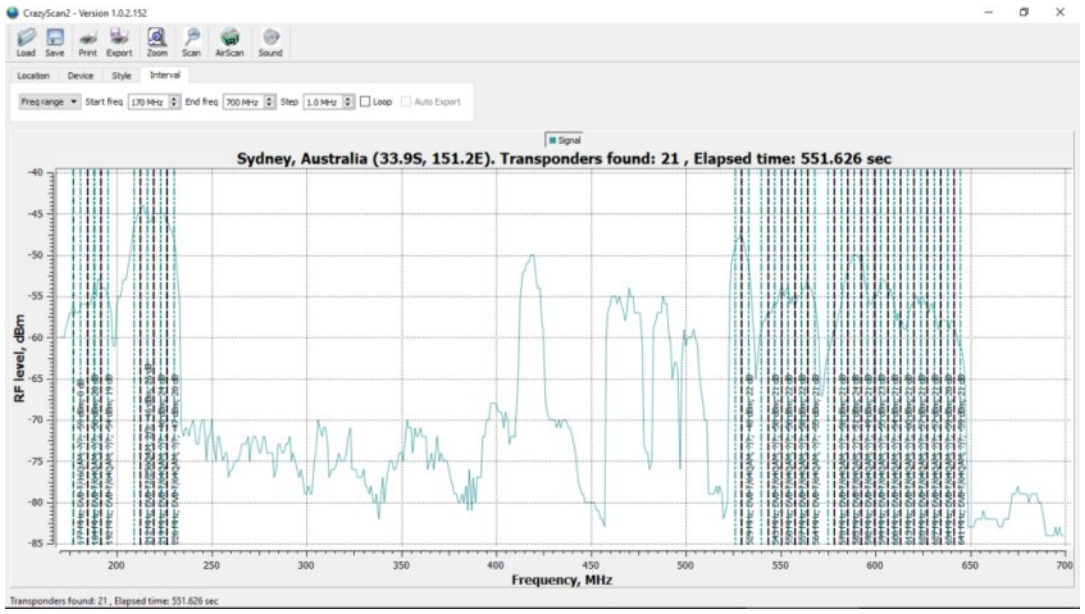
The Signals on the Air

In my present location, I get best service from Sydney North West over UHF, which is not part of the DVB-T2 trial sites (as above). As a result, I needed to get a signal from Gore Hill. The roof-top aerial hasn't been in the best shape and as houses have cropped up on the side of the hill, they've obstructed our line-of-sight resulting in much diminished signal levels.



I started with a VHF/UHF combination log-periodic antenna propped above the highest cabinet in the upper storey, pointed upward to catch signal diffraction around the houses at the top of the hill. It was connected to a 19dB Kingray masthead amplifier straight into my *TBS 5220SE* running CrazyScan2.

In the present location, I can receive Gore Hill/Artarmon with rather limited SNR (20-28dB normally, varying quite frequently). I also receive Sydney South-West and Sydney North-West fill-in signals on UHF (from off-axis in the above scan). The only DVB-T2 carrier is the VHF one at 212.500Mhz, as expected, as the local fill-in at Kings Cross and Manly could not be expected to reach out to the west of Sydney. After some testing, I found my roof-top antenna with masthead amplifier had about 3dB more signal than my



"antenna of desperation" above, so I swapped over for the remainder of the experiments.

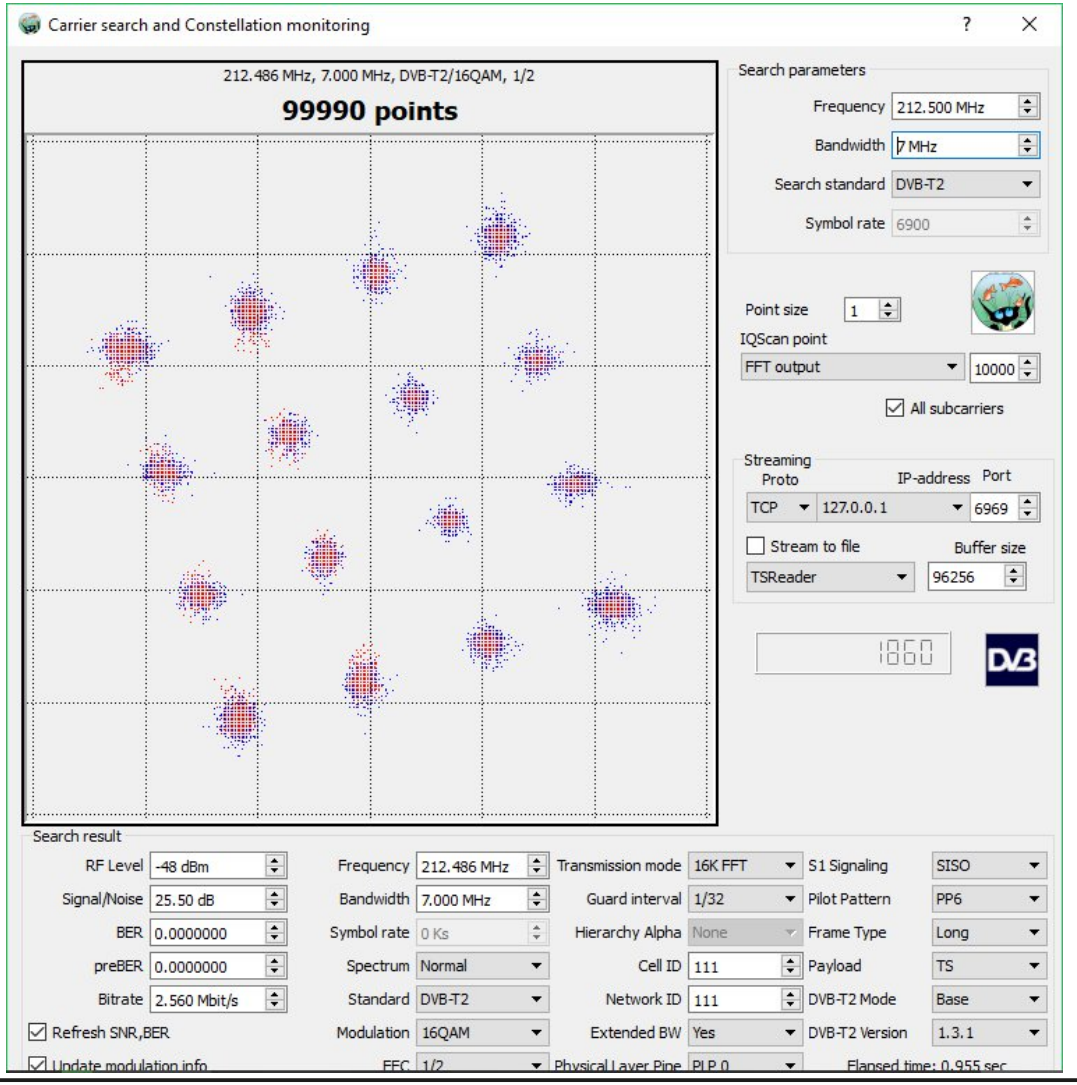
I observed the signal on the air from 22/05/2018 through to 29/05/2018 to before writing this article. At this time, the test transmissions still have about one month remaining on-air.

Three modes of broadcast were identified in the trial – the transmitter cycles between these modes at semi-random times, probably under the command of testing engineers. Provided you have a DVB-T2 capable device and a decent signal, you will be able to receive the physical layer data conveyed by the transmissions at 212.500Mhz and 536.500Mhz. However, being able to receive the physical layer transmission may not allow you to "watch" the service due to the compression formats in use (see next section).

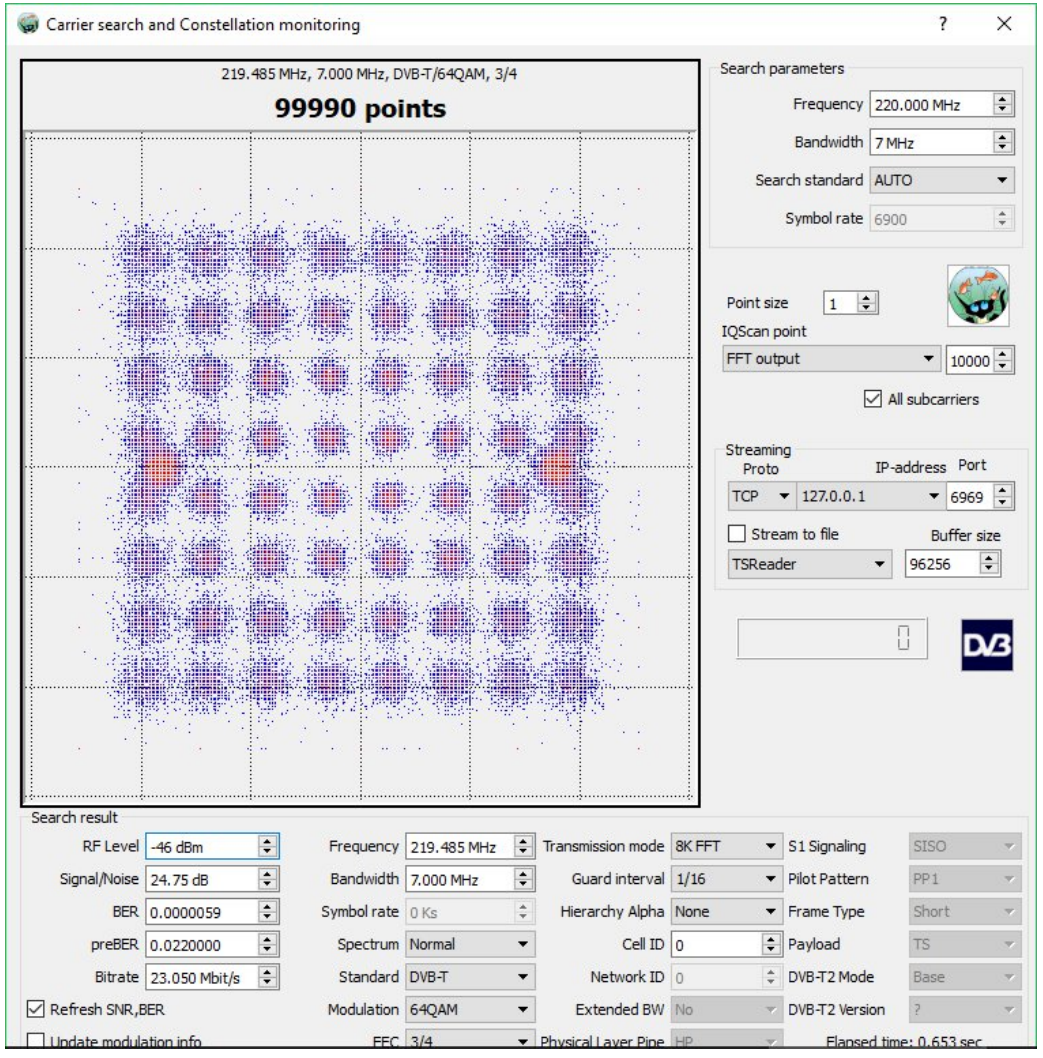
Mode 1: 16QAM, 1/2 FEC, 16k FFT, 1/32 GI, PP6

The least dense mode is 16QAM with 1/2 FEC rate.

This mode offers much more robust reception where signal quality varies and seems to me to be a good mode for mobile reception or lower power coverage of wide areas where a single channel is to be conveyed. The mode tested offered only 2.56Mbit/s payload rate, using a 16k FFT mode with 1/32 guard interval which is half that of our present DVB-T. The transmission carried a regular transport stream but utilized Physical Layer Pipe (PLP) encoding which allows for different protection modes for the services carried on the multiplex. This particular transmission uses Pilot Pattern 6 .



One thing that stood out to me was the rotated nature of the constellation. If you're used to regular DVB-T and DVB-S/S2 transmissions, you'd expect the constellations to be "dead straight" unless you had some phase non-linearities or amplitude imbalances, similar to the DVB-T transmission below. You might also expect some fixed pilots as well.



As it turns out, the rotation is a feature of DVB-T2 which improves resilience to frequency-selective effects, allowing for better decoding under lower SNR conditions when combined with the more sophisticated LDPC encoding.

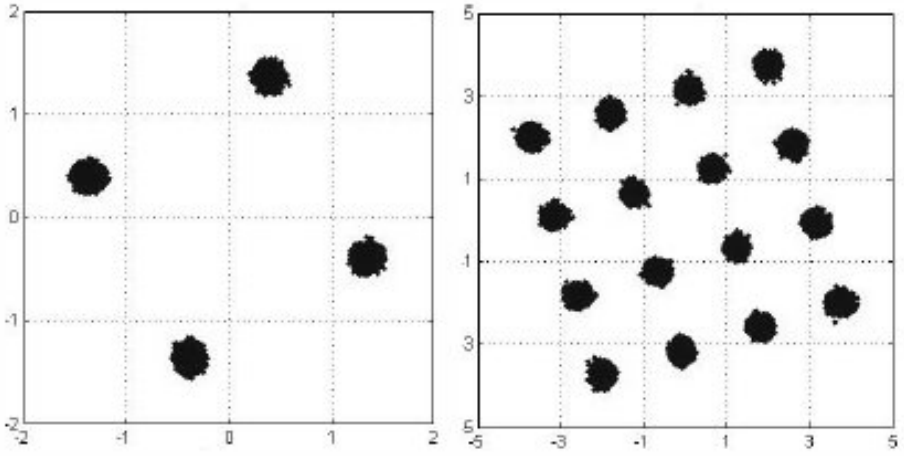


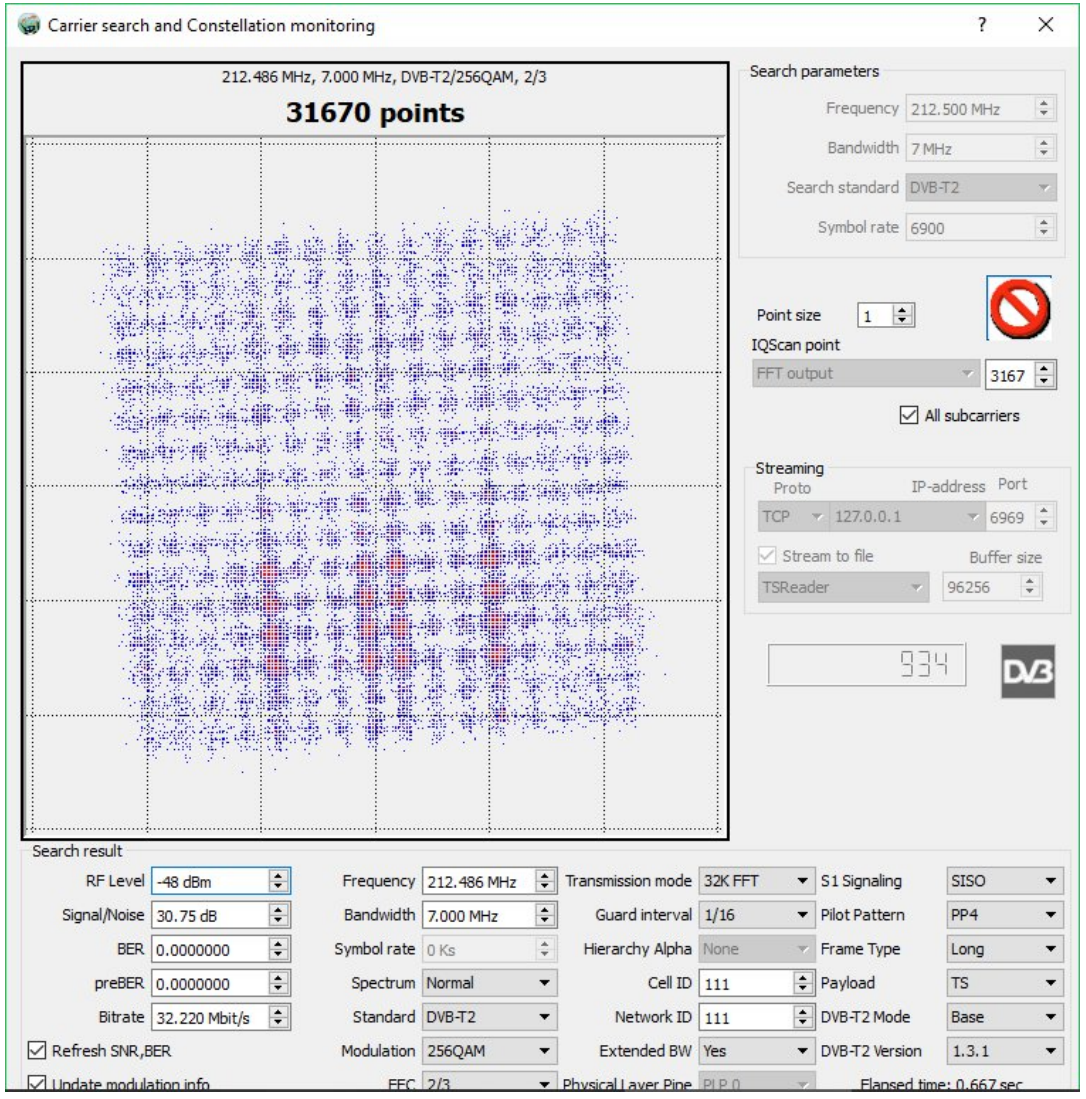
Figure 2. A simulated rotated constellation diagram for a) QPSK with Φ_1=29.0 and b) 16QAM with Φ_2=16.8 in AWGN channel with C/N = 20 dB.

The figure above was taken from a paper titled " Performance of the Rotated Constellation in DVB-T2 [17] " by Ladislav Polak and Tomas Kratochvil from Brno University of Technology which explores this effect.

Mode 2: 256QAM, 2/3 FEC, 32k FFT, 1/16 GI, PP4

The second mode is a highly-dense 256QAM with 2/3 FEC rate. This is considerably more dense than the 64QAM used with DVB-T today, however, the improved error correction and signal acquisition strategies of DVB-T2 actually put up a surprisingly competitive performance. This offered similar or better performance than DVB-T at my location where the SNR is low enough to cause both of them to fault. It seems that DVB-T2 has a much steeper "digital cliff" where the signal loses lock or the data is garbled versus being just fine. Given my observation on reception likelihood, it's also rather interesting to see that it delivers a payload rate of 32.22Mbit/s, almost 40% more than the 23.05Mbit/s from our regular DVB-T. It does use more complex 32k FFT, but has 1/16 guard interval which should provide similar

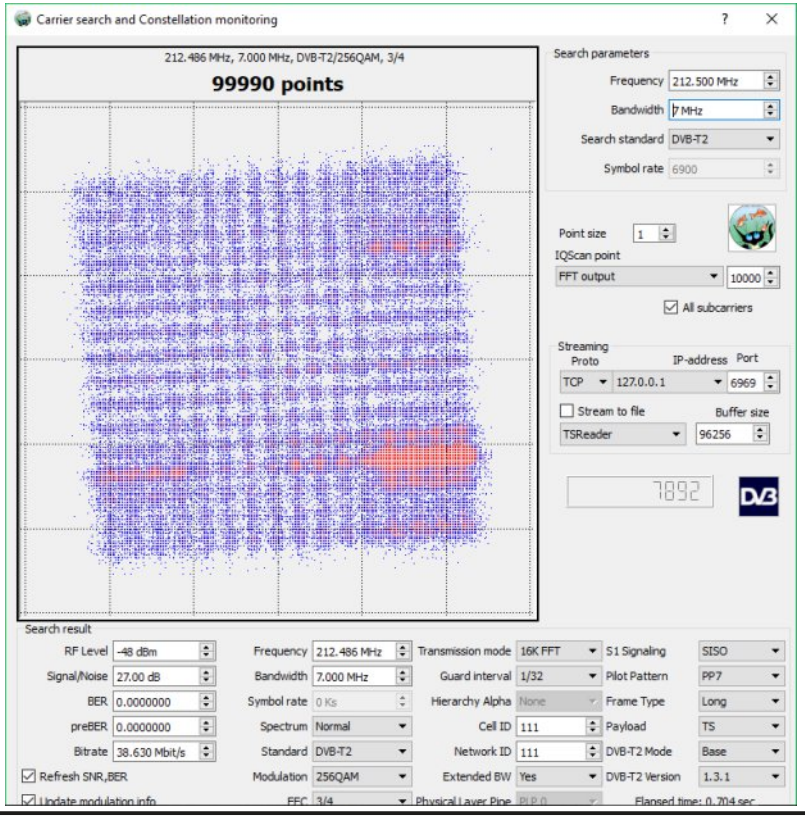
multipath resilience compared to our present broadcast DVB-T. It uses Pilot Pattern 4, which (I suspect) rotates the pilots amongst the 16 bright "spots" in the constellation below.



This mode would probably be a decent replacement for the regular DVB-T multiplex for use carrying all the services from a single broadcaster, with the additional bitrate helpful for carrying more HD services or even UHD 4k services.

Mode 3: 256QAM, 3/4 FEC, 16k FFT, 1/32 GI, PP7

The third and final mode uses 256QAM like the above, but with reduced FEC to 3/4, thus requiring higher SNR. It reduces the FFT complexity to 16k, but also reduces the guard interval to 1/32 which is half of that of regular DVB-T transmissions today. This may reduce the resiliency to multipath conditions. The benefit, however, is an increase in payload bitrate to 38.63Mbit/s – around 20% more than the mode above and a whopping 68% more than the currently used DVB-T mode. This transmission uses Pilot Pattern 7, which results in a different set of "bright" spots on the constellation. Maybe they're deciding just how far they can push the modulation parameters while maintaining a similar level of service to the present DVB-T, or even seeing if these changes in pilot pattern affect locking performance.

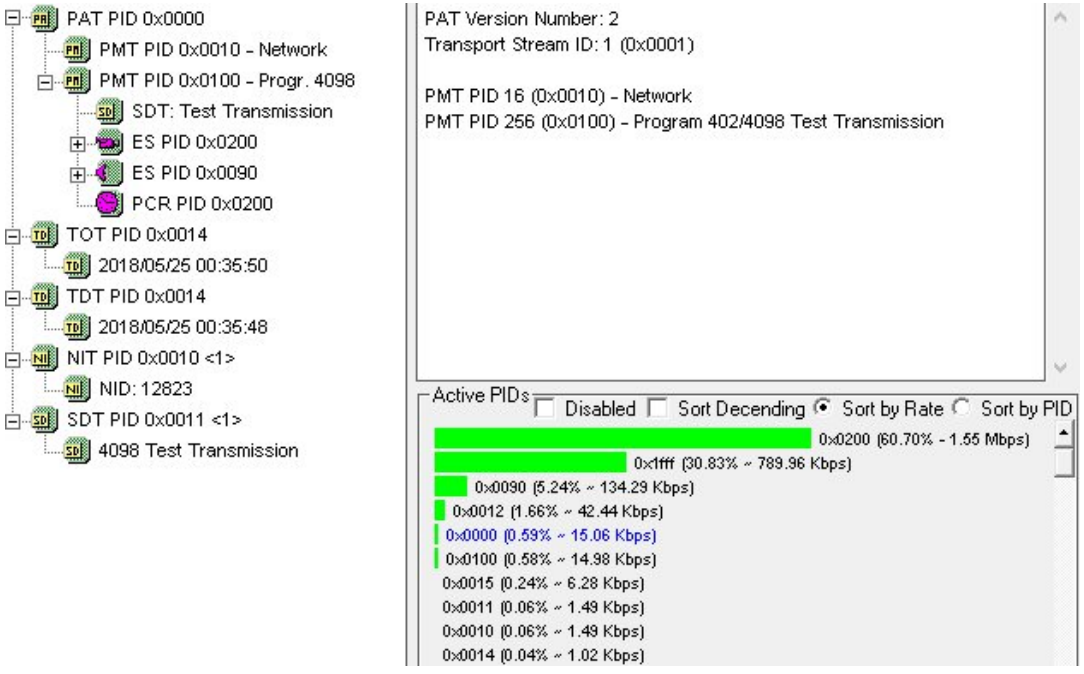


This mode would be useful in much the same way as Mode 2 – for carrying all the services from a given broadcaster in a single multiplex. However, given the available bitrate and improvements in compression afforded by H.264 (AVC) and H.264 (HEVC) services, there is the potential that a single multiplex could be shared amongst broadcasters to save spectrum and transmission costs in much the same way Digital Radio (DAB+) currently operates. Somehow, I hope this doesn't happen.

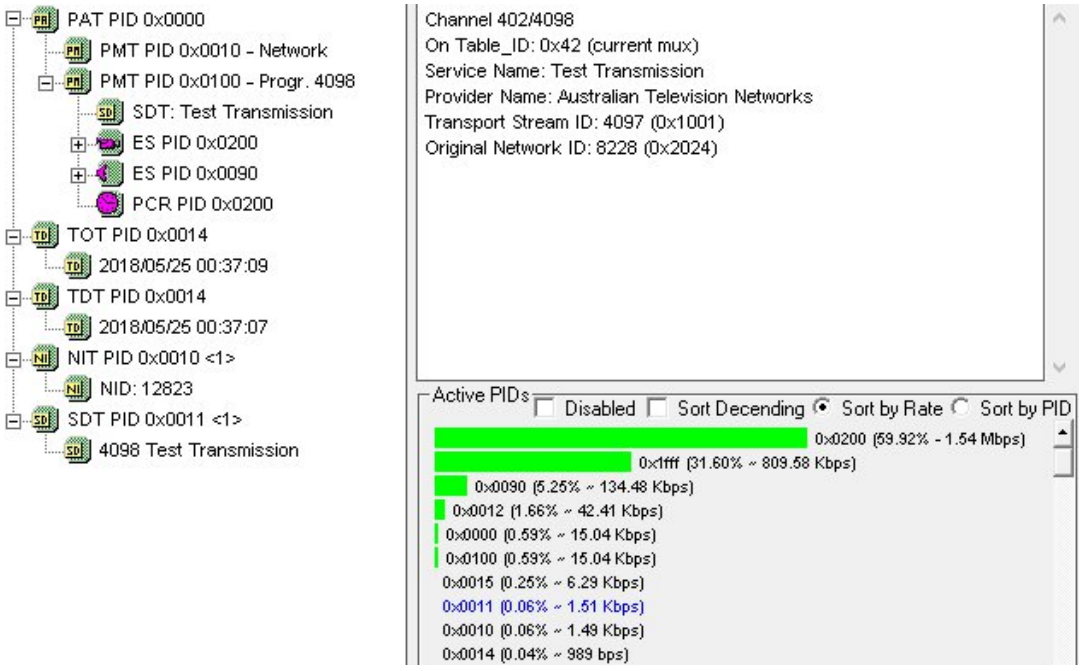
The Content

In all three modes, the DVB-T2 multiplex carried a regular Transport Stream (TS). The contents of the TS varied depending on the mode.

Mode 1 transmissions provided significantly less bitrate and accordingly carried a different version of the test payload.



According to TSReader, the transmission consisted of a single program with LCN 402 and a name of "Test Transmission". Around 30% of the stream was null packets.



The NIT has a provider name of "Australian Television Networks" with a network ID of 8228.

Video
ID : 512 (0x200)
Menu ID : 4098 (0x1002)
Format : HEVC
Format/Info : High Efficiency Video Coding
Format profile : Main@L3.1@Main
Codec ID : 36
Maximum bit rate : 2 500 kb/s
Width : 960 pixels
Height : 540 pixels
Display aspect ratio : 16:9
Frame rate : 25.000 FPS
Color space : YUV
Chroma subsampling : 4:2:0
Bit depth : 8 bits
Color range : Limited
Color primaries : BT.709

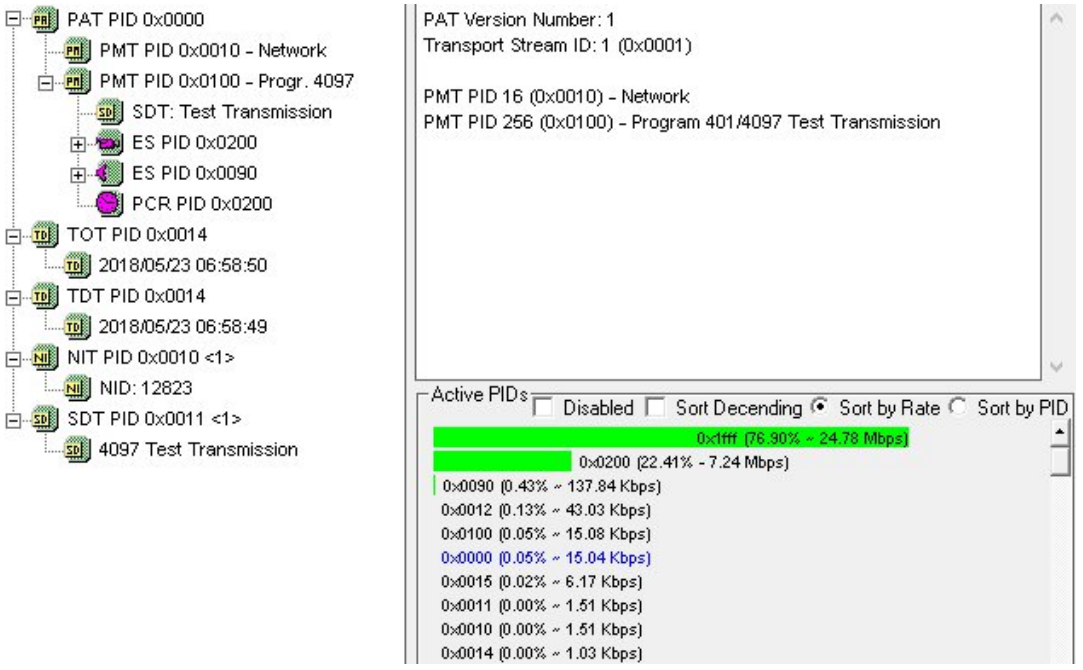
Transfer characteristics : BT.709
Matrix coefficients : BT.709

Audio
ID : 144 (0x90)
Menu ID : 4098 (0x1002)
Format : AAC
Format/Info : Advanced Audio Codec
Muxing mode : LATM
Codec ID : 17
Maximum bit rate : 156 kb/s

MediaInfo reported the video stream to be encoded in 8-bit HEVC using Main@L3.1@Main profile. The stream has a resolution of 960 x 540 pixels at 25fps with 4:2:0 chroma subsampling in the BT.709 colour space. Audio was AAC encoded.

The above is a screenshot from the stream (click for 1:1) which shows an approximately 2m37s loop of scenes from around Shepherds Hill. The audio appears to be silent.

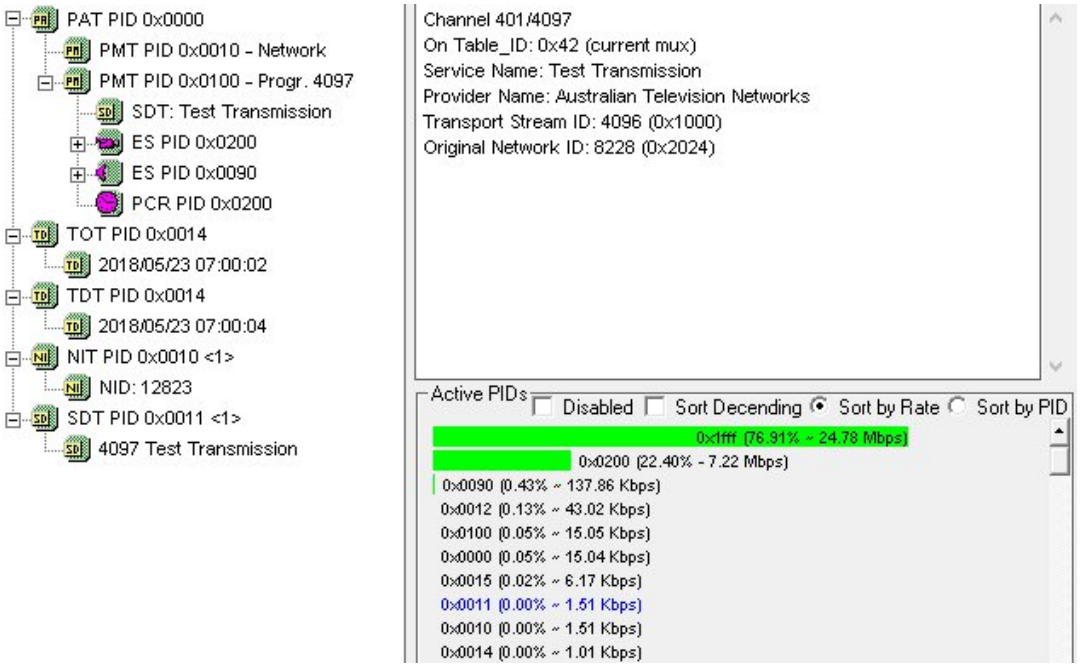
Mode 2 and Mode 3 transmissions were identical for content and carried a higher bitrate and resolution version of the content.



The transmission identifies itself as "Test Transmission" with an LCN of 401 (rather than 402 as above). A single service is carried in much the same way, instead, the video now occupies about 7.24Mbit/s rather than 1.55Mbit/s as above. The majority of the multiplex (77%) carries null packets.

The NIT ID remains identical.

Video
ID : 512 (0x200)
Menu ID : 4097 (0x1001)
Format : HEVC
Format/Info : High Efficiency Video Coding
Format profile : Main 10@L4.1@High
Codec ID : 36
Maximum bit rate : 7 500 kb/s
Width : 1 920 pixels

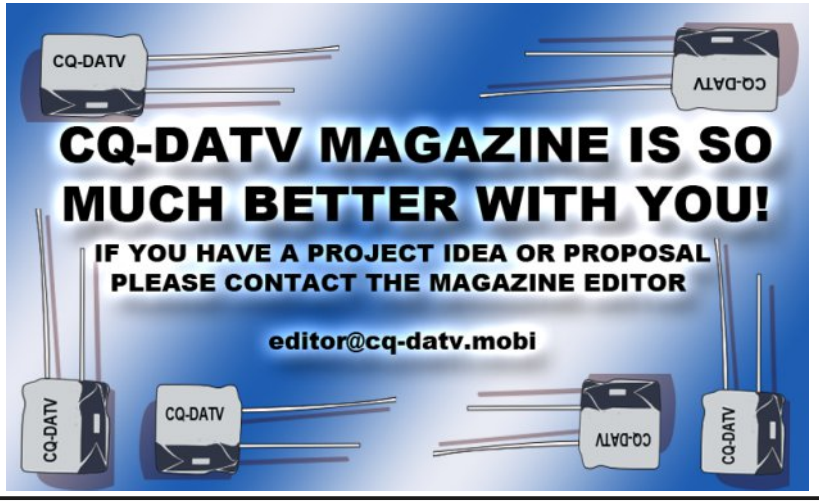


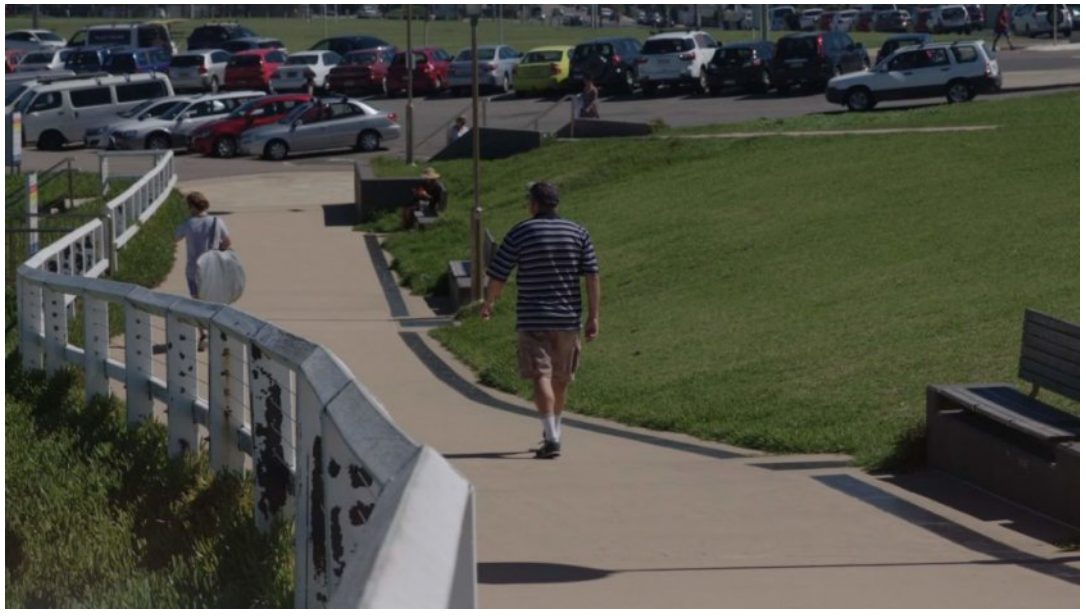
Height : 1 080 pixels
Display aspect ratio : 16:9
Frame rate : 50.000 FPS
Standard : Component
Color space : YUV
Chroma subsampling : 4:2:0 (Type 0)
Bit depth : 10 bits
Color range : Limited
Color primaries : BT.709
Transfer characteristics : BT.709
Matrix coefficients : BT.709

Audio
ID : 144 (0x90)
Menu ID : 4097 (0x1001)
Format : AAC
Format/Info : Advanced Audio Codec
Muxing mode : LATM
Codec ID : 17
Maximum bit rate : 156 kb/s

MediaInfo reports the stream to be encoded with 10-bit HEVC, using the MAIN 10@L4.1@High profile. It delivers a full-high-definition 1920 x 1080 resolution at 50 frames per second (progressive). Chroma subsampling is 4:2:0 with a colour space of BT.709 and AAC audio as before.

The above is a screenshot from the stream above (click for 1:1). The content of the broadcast is the same loop with no actual audio. Some more compressed screenshots follow.





Instead, damage to HEVC seems to render as flashing large grey segments, contrasty colourful blocky areas, etc.

While watching the stream, it occurred to me that the software codec I was using does not handle corrupted HEVC streams as gracefully as I might have expected. Generally, the better MPEG error-concealment algorithms result in regions of errors staying "static" showing previous results or becoming blocky.

On the upside, it did not crash the decoder, but this error-concealment performance may factor into whether HEVC itself is used in the future.

This is especially pertinent given the patent royalties that may be involved with HEVC when similarly-performing royalty-free competitors may exist (e.g. VP9, AV1).

Conclusion

It's rather exciting to see that, at last , Australia has some interest in DVB-T2. It's taken a long time to move away from analog TV to DVB-T, which is unfortunate, as we have reached the limit of what DVB-T is capable of. The physical layer modulations and error correction code abilities can only deliver so much bit-rate, with most broadcasters settling for 23.05Mbit/s in a 7Mhz channel to deliver the balance of coverage versus payload.

DVB-T2 brings a number of innovations, including more dense modulations, more complex waveforms for better real-world performance and better error correction codes to squeeze out the last few bits from the air. The modes tested included a robust mode enough for a single SD channel in HEVC and two modes more suited for network multiplex carriage applications, boosting the bitrate over present DVB-T multiplexes by 40-68%. This should provide the additional bitrate necessary to carry more services or higher resolution services.

This trial also demonstrated the use of HEVC over DVB-T2 transport streams, a rather new video compression format claimed to be twice-as-efficient as AVC while being somewhat more computationally complex. This may eventually mean that multiplexes could be shared between broadcasters to save on spectrum even further. This may, sadly, be necessary especially if we are to transition to DVB-T2 over time in parallel (similarly to how the UK is doing it).

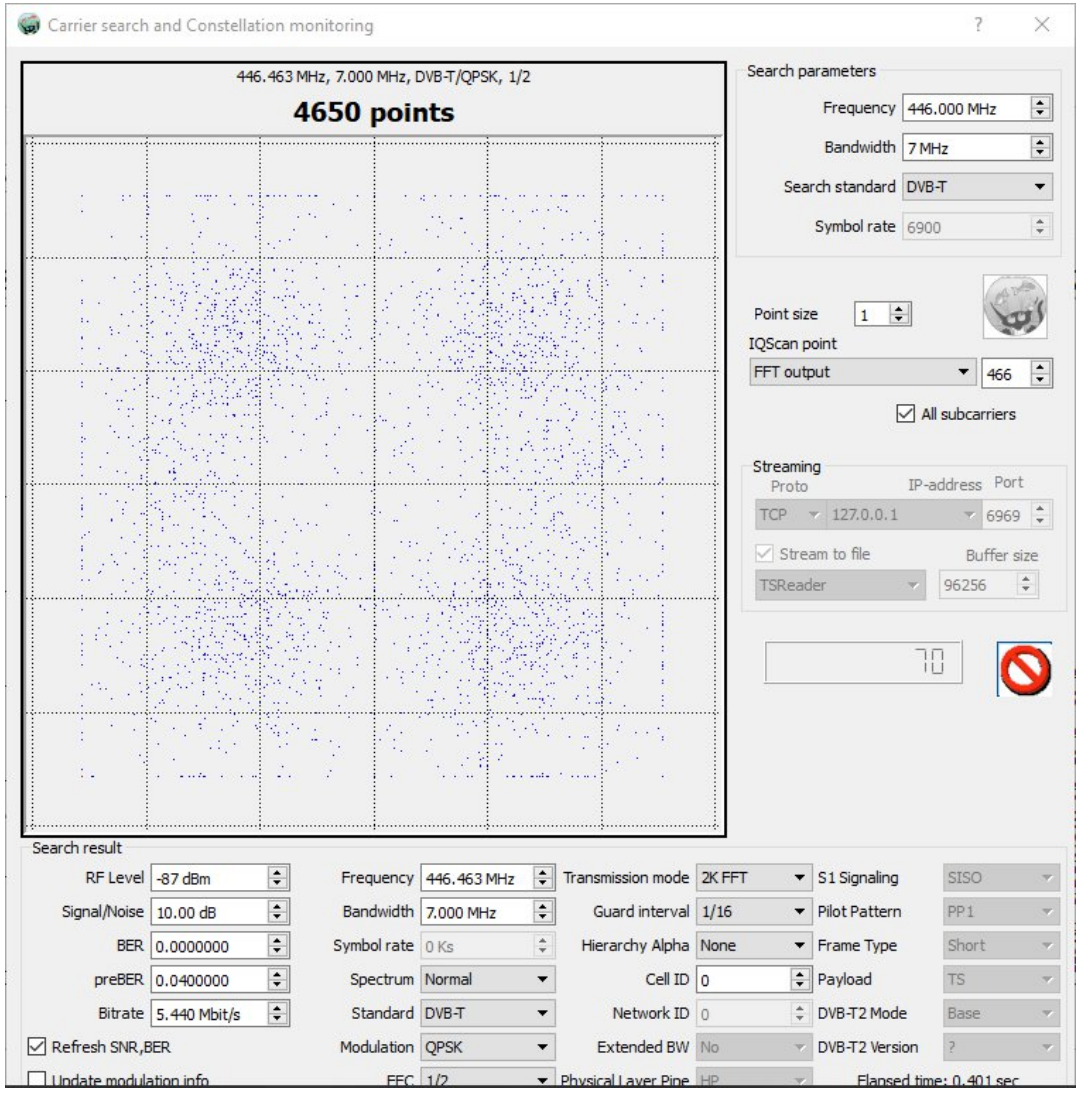
It is a shame, but despite observing for a number of days, there was no test of broadcasting 4k content. While it would only mean a small change to the input TS to carry it, it would demonstrate the full ability of DVB-T2 stream. Owing to a lack of time, if they change the broadcast content now, I probably wouldn't notice!

The use of three transmitters seems to imply that testing was also done to see how well DVB-T2 modes handle SFN applications, which is important given the present-day fill-in transmitter frequency co-ordination.

There's no need to worry though – while older TV sets won't be DVB-T2 capable and some newer TV sets may be DVB-T2 capable but not HEVC capable (in the broadcasting profile used), it seems that the road to DVB-T2 is all but assured. For one, it will take close to a decade to make the change (assuming we choose to and that broadcast TV survives that long). Another is because of the complexity of managing spectrum – there aren't that many "free" channels to run new multiplexes in parallel for a "phase-over". Eventually, when it does happen, older sets may need DVB-T2 and HEVC capable set-top boxes to watch the new services, but there's no point in grabbing one right now since we don't know exactly what codecs and profiles might be adopted in the future as the

standard. That being said, it seems that a PC-based tuner is probably the safest bet for now.

Bonus: Amateur DVB-T from VK2RTS

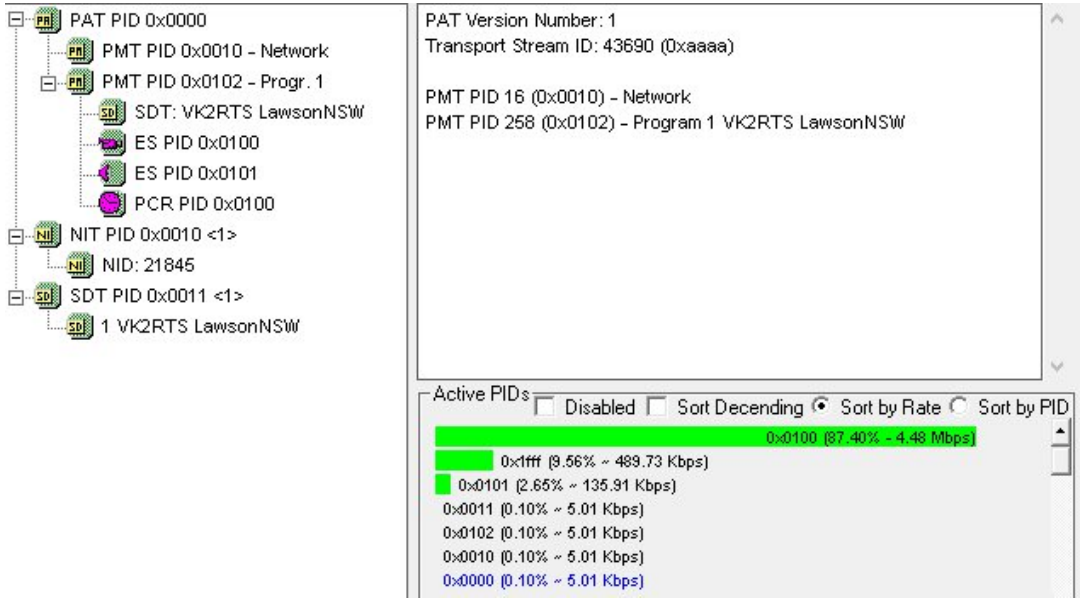


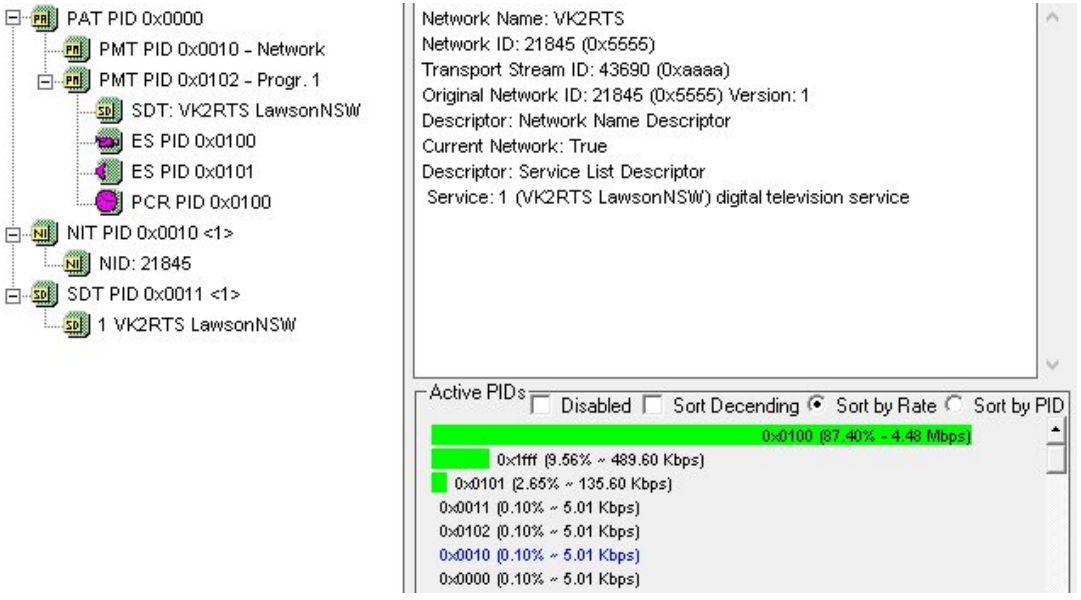
While scanning around the band looking for services, I managed to come across a transmission in the amateur radio band at 446.500Mhz.

The transmission originates from VK2RTS, an amateur digital TV repeater stationed at Lawson, NSW (in the Blue Mountains). I've never received an amateur digital TV broadcast and I suspect a majority of people have not either. Many TV tuners are programmed with the Australian band plan (174 – 230Mhz + 526 – 820Mhz) and would miss the amateur band entirely without using a manual entry (if it was allowed). The other reason is that it's not particularly strong and doesn't broadcast continually.

Regardless, it seems that *VK2RTS* tries its best to cover the Sydney basin by using a combination of power (40W), antenna gain (11dB), location and modulation mode.
As a result, it uses QPSK which is more akin to satellite transmissions rather than higher order 16QAM or above.

It also uses a very high level of forward error correction – 1/2 rate. This allows reception down into around 6dB SNR at the cost of delivering "only" 5.44Mbit/s of payload rate. This is enough for a basic SD service in MPEG-2 though.





The program identifies its name as "VK2RTS LawsonNSW", using a Network ID of 0x5555 and a transport stream ID of 0xAAAA.

```
00003AC0 | 47 1F FF 10 6D 61 69 6E  74 65 63 68 6D 61 69 6E | G ÿ maintechmain
00003AD0 | 74 65 63 68 6D 61 69 6E  74 65 63 68 6D 61 69 6E | techmaintechmain
00003AE0 | 74 65 63 68 6D 61 69 6E  74 65 63 68 6D 61 69 6E | techmaintechmain
00003AF0 | 74 65 63 68 6D 61 69 6E  74 65 63 68 6D 61 69 6E | techmaintechmain
00003B00 | 74 65 63 68 6D 61 69 6E  74 65 63 68 6D 61 69 6E | techmaintechmain
00003B10 | 74 65 63 68 6D 61 69 6E  74 65 63 68 6D 61 69 6E | techmaintechmain
00003B20 | 74 65 63 68 6D 61 69 6E  74 65 63 68 6D 61 69 6E | techmaintechmain
00003B30 | 74 65 63 68 6D 61 69 6E  74 65 63 68 6D 61 69 6E | techmaintechmain
00003B40 | 74 65 63 68 6D 61 69 6E  74 65 63 68 6D 61 69 6E | techmaintechmain
00003B50 | 74 65 63 68 6D 61 69 6E  74 65 63 68 6D 61 69 6E | techmaintechmain
00003B60 | 74 65 63 68 6D 61 69 6E  74 65 63 68 6D 61 69 6E | techmaintechmain
00003B70 | 74 65 63 68 6D 61 69 6E  74 65 63 68 47 1F FF 10 | techmaintechG ÿ
```

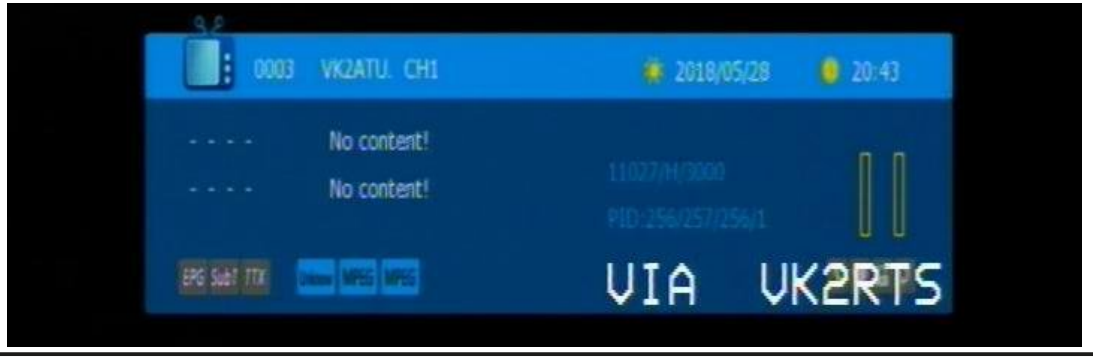
An analysis of the null packets inside the transport stream suggests they are using a MainTech GmbH DVB modulator, probably the *MiniMod*.

As is customary, Vivid is in Sydney at this time, so there was some imagery of this in the stream at the time I tuned in in the evening of 28th May. It seems the video source is an analog PAL source.

Later in the evening, I caught VK2ATU coming in via VK2RTS. Given the technical challenges of making it all work, it was amazing to see it on the air myself and receive a solid image despite the antenna facing Gore Hill rather than the Blue Mountains. It's really something also to see VK2ATU come into the repeater (presumably) via S-band being received by a satellite decoder box.

From the settings it seems that the frequency tuned on the box is 11027Mhz with a symbol rate of 3000Ks/s. Assuming that the tuner is set to "universal" LNB, it would assume it is

connected to an LNB with a 9750Mhz L.O., thus 11027Mhz set on the unit would correspond to tuning on the IF at 1277Mhz which sits right inside the ATV Channel 2 (1274-1292Mhz) part of the WIA Bandplan although not quite their recommended centred on 1283Mhz unless the offset is to account for inaccuracies in the receiver alignment.



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