TechTalk #79
Comparing DATV Repeater Designs - Part I

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This latest TechTalk article on DATV (Digital-ATV) technology looks at the design of three different types of D-ATV repeaters. First, we will look at a very simple DATV repeater design that is proposed for the OCARC club in the future. Then we will look at the first operational DATV repeater in the US, WR8ATV in Columbus, Ohio. Finally, we will look at the design of the first DATV repeater in Australia to go 100% DATV transmissions, VK3RTV near Melbourne.

Proposed W6ZE DATV Repeater Design

If testing of cross-town DATV simplex portable session by W6HHC and KB6CJZ continues to go well, then there are future plans being proposed to add DATV repeater for OCARC use. This repeater has a very simple design compared to later ones we will look at:

- DVB-S Uplink on 1.2 GHz
- DVB-S Downlink on 3.4 GHz
- Downlink RF Bandwidth is 3 MHz
- One Transport Stream Channel (1xTS)

The choice of the 3.4 GHz downlink frequency here is highly influenced by crowded band-plan conditions here in Orange County, near the city of Los Angeles.

As shown in **Fig 1** below, there is a single DATV uplink receiver on 1.2 GHz feeding a single DATV transmitter on 3.4 GHz. The DVB-S receiver planned for the W6ZE repeater is a "satellite" Set-Top Box. This type of STB is commonly called "Free-To-Air" (aka FTA) and can be easily found used on e-Bay.

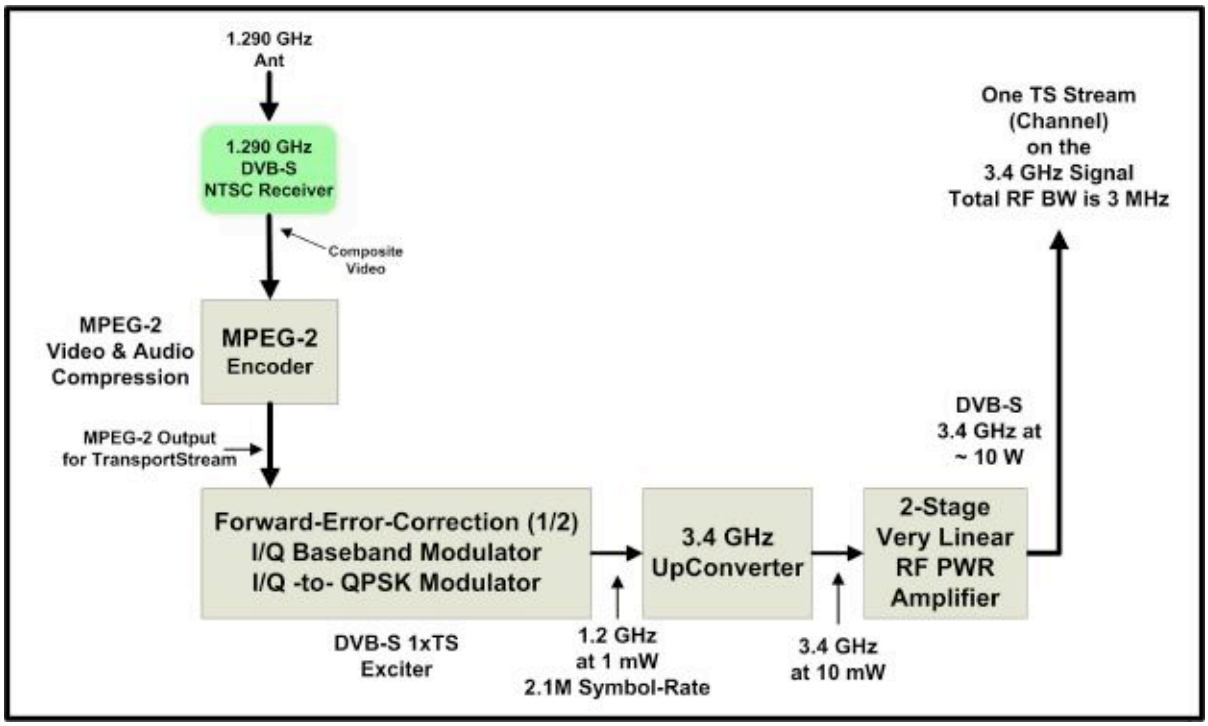
The choice of symbol-rate of 2.1 M Symbols/sec for NTSC and a Forward Error Correction setting of 1/2 provides a significant error correction redundancy factor of 1/2 while still obtaining a narrow DATV RF bandwidth of only 3 MHz.

WR8ATV DATV Repeater Design

A block diagram of the current WR8ATV DATV repeater in Columbus, Ohio is shown in **Fig 2** on the following page. The Amateur Television of Central Ohio (ATCO) runs the only currently active DATV repeater in the United States. The WR8ATV repeater design is more complex than the simple repeater design that we showed in Fig 1:

- DVB-S Uplink on 1.2 GHz
- Analog uplink on 439 MHz, 1.2, 2.4 & 10 GHz
- DVB-S Downlink on 1.2 GHz
- Downlink RF Bandwidth is 4 MHz
- Two Transport Stream Channels (2xTS)

Figure 1 – Block Diagram Showing Simple Planned DATV Repeater Design for W6ZE



In January of 2004 the ATCO Group in Columbus, Ohio installed a DVB-S digital output to their repeater which has been in service 24-7 since then.

The WR8ATV DATV repeater design allows two channels to be simultaneously interleaved on one DATV transmission signal. The choice of a symbol-rate of 3.125 M Symbols/sec and a Forward Error Correction setting of 3/4 allows packing two channels into a narrow DATV RF bandwidth of only 4 MHz. Each channel uses 1.5625 MS/sec symbol-rate that will support an MPEG-2 video output stream Net-Data-Bit-Rate of 2.16 mbps (when configured at FEC 3/4).

Figure 3 – DATV Test Pattern of WR8ATV

VK3RTV DATV Repeater Design

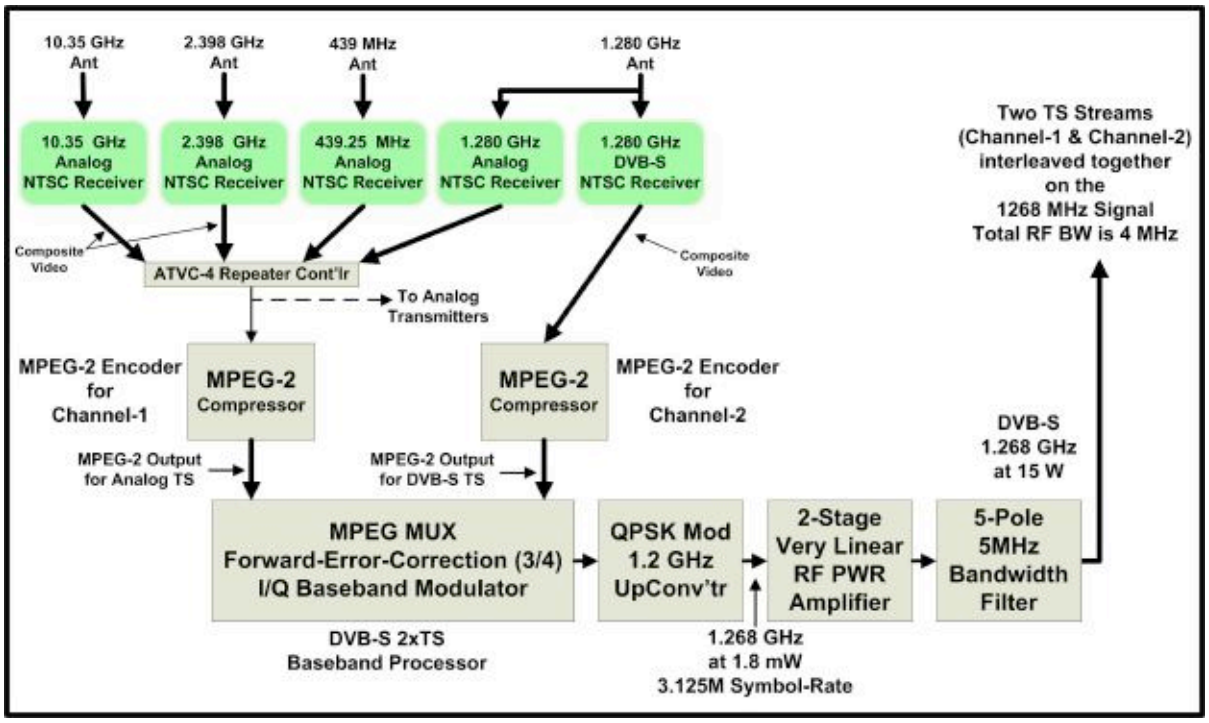
The VK3RTV Amateur TV repeater near Melbourne has been transmitting analogue ATV pictures for 30 years. In September 2009, VK3RTV began transmitting only Digital-ATV using the terrestrial standard, DVB-T. As Peter-VK3BFG, custodian for the VK3RTV repeater, told us "…The quality has taken a quantum leap over the old analogue to analogue system, although I felt a bit of a 'pang' when I decommissioned [the analogue repeater output]…".

The block diagram for the VK3RTV DATV repeater design is shown in **Fig 4**, on the following page. The VK3RTV DATV repeater design is also very complicated (in our minds):

- DVB-S Uplinks on 1.250 GHz and 1.280 GHz
- Analogue uplinks on 1.2 GHz and 10 GHz
- DVB-T Downlink on 446.5 MHz
- Downlink RF Bandwidth is 7 MHz
- Two Transport Stream Channels (2xTS)

The VK3RTV designers chose the DVB-S standard for the digital uplinks as DVB-S transmitters are currently a lot cheaper than DVB-T transmitters. Because the Aussies have a lot bandspace in Australia, they are using a symbol-rate of 5 M Symbols/sec for the DVB-S uplink transmitters that produces an RF bandwidth of 7 MHz. Most Europeans seem to be using 2 M symbol-rate for PAL which pixelates on very fast camera-pan motion.

Figure 2 – Block Diagram Showing WR8ATV DATV Repeater Design



The DVB-T downlink transmitter technology is easily able to interleave two channels of video (VK3RTV1 and VK3RTV2) on the same 446.5 MHz signal within a total RF bandwidth of 7 MHz. Channel VK3RTV1 displays either the input from the analogue 1.250 GHz receiver or the input from the DVB-S STB tuned to 1.250 GHz. If no signal is present from either receiver, a microprocessor controlled input selector switch inserts a TEST PATTERN. Channel VK3RTV2 displays either the input from the analogue 10.41 GHz receiver or the input from the DVB-S STB tuned to 1.280 GHz. If neither receiver signal is present, the input selector switch inserts a TEST PATTERN. The microprocessor input switching has DTMF inputs for controls and can also switch in a camera or DVD.

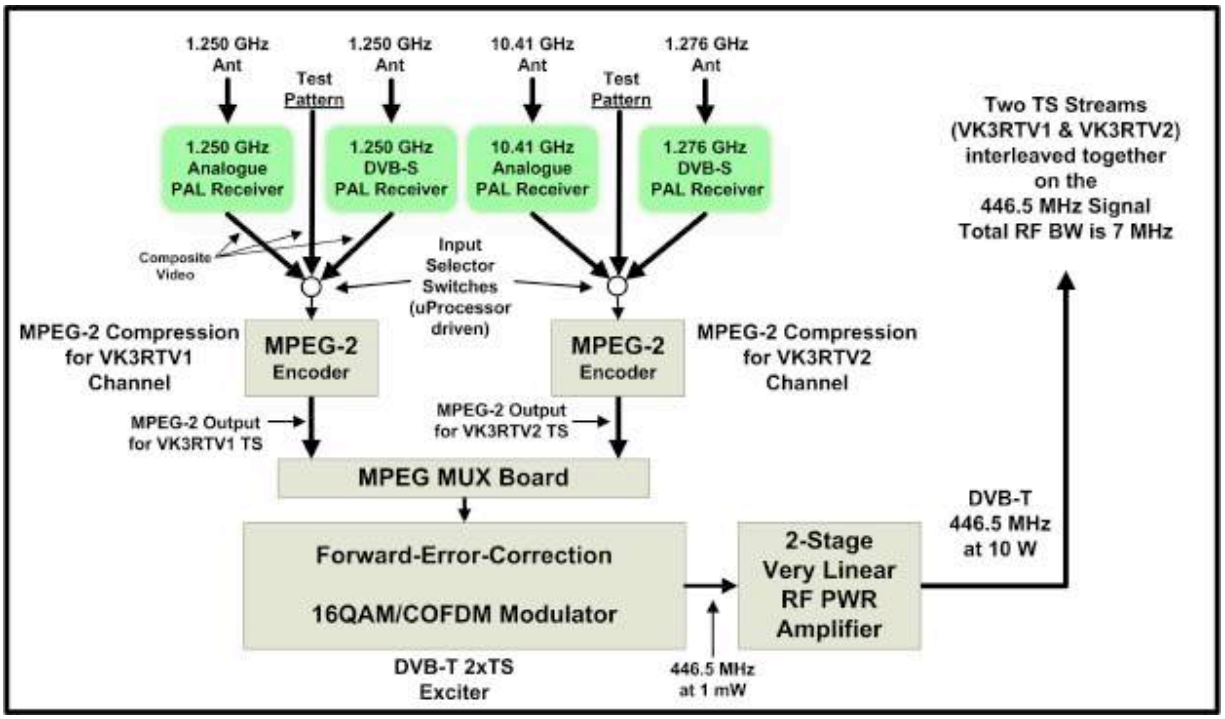
One aspect that we think is very clever is that the VK3RTV team decided to cut-off analogue repeater transmissions and go to 100% DATV output, but continued to allow the analogue uplinks. DATV Set-Top Boxes are cheap. This move forced all members to buy low-cost TerrestrialSTBs as STEP 1. But, at the same time this first move did not cut-off their home analogue ATV transmitters. It allows members to migrate to the more expensive DATV home transmitters at their convenience. A very neat migration plan for moving from analogue-ATV to Digital-ATV!!!

Figure 5 – VK3RTV Screen Shot from First Tests

Acknowledgments

We would like to give special thanks to Peter Cossins VK3BFG for sharing detailed information on the VK3RTV DATV repeater and for answering our many questions, and also to Art Towslee WA8RMC for sharing detailed information on the WR8ATV DATV repeater and answering our many questions.

Figure 4 – Block Diagram Showing VK3RTV DATV Repeater Design



Useful DATV Links

- Melbourne DATV Station VK3RTV – see www.VK3RTV.com/latest.html
- British ATV Club - Digital Forum – see www.BATC.org.UK/forum/
- Amateur Television of Central Ohio WR8ATV – see www.ATCO.TV
- OCARC newsletter series of DATV articles – see www.W6ZE.org/DATV/
- TAPR Digital Communications Conference free proceedings papers – see www.TAPR.org/pub_dcc.html
- Ultimate Resource for Digital Amateur Television – see www.D-ATV.com