DVB-T - Digital Terrestrial Television

Reception in Llandudno

The Background

The situation in Llandudno is that a large slice of the populace are well served by Winter Hill Tx situated at Bolton and although being around 90 miles away because of the nature of the path being largely across the sea, good field strengths are available across the range of analogue channels, with channel 5 being about -10db down on the 4 main channels, which are broadcast at an ERP of 100KW. Those served by Winter Hill, effectively see signal levels of around +5db on an average contract 10 element C/D with decent cable. The town is masked effectively by the Little Orme and homes located on or to the edges of this line still get service by using high gain aerials with amplifiers. Llanddona, the transmitter serving the main town is situated on the Isle of Anglesey and is for most parts roughly 180 degrees behind the town when looking at Winter Hill. Such is the signal strength from Llanddona received on a contract 10 element beamed to Winter Hill, that it is often within a few db of the Winter Hill main channels. The homes unable to see Llanddona, are alternately served by Conwy, a 2KW vertical polarised group B relay. Both Winter Hill and Llanddona run 100KW horizontally polarised in group C/D. Additionally, some sites in the town, see Moel-y-Parc transmitter, again running 100KW, horizontally in group B.

The Problem(s)

Faced with 4 possible transmitters from which service can be obtained, (some sites"see" all 4 transmitters). Most people have elected to have Winter Hill (since it brings Channel 4 as opposed to S4C) and allows for Channel 5 reception, something none of the North Wales transmitters do. The classic installation of choice in the town (where possible) was always a C/D to Winter Hill diplexed with a B to Conwy. In the past a grouped diplexor was used and the cut point was ch53, allowing 4 chs each from both transmitters (ch 5 was dropped by this scheme of course). Now the channels are :-

Winter Hill

- 65 - Channel 4

- 62 - BBC 2
- 59 - Granada
- 55 - BBC 1 (Northwest)
- 48 - Channel 5

Conwy

- 50 - S4C
- 46 - BBC 2 (Wales)
- 43 - HTV
- 40 - BBC 1 (Wales)

Llanddona

- 63 - BBC 2 (Wales)
- 60 - HTV
- 57 - BBC 1 (Wales)
- 53 - S4C

Moel-y-Parc

- 52 - BBC 1 (Wales)
- 48 - HTV
- 45 - BBC 2 (Wales)
- 42 - S4C

Now with only Winter Hill and Moel-y-Parc carrying digital transmissions (until June), most people will elect for Winter Hill, since Moel-y-Parc is mostly only accessible from the more elevated parts of the town (slopes of the Gt Orme). It can be seen from the table that the digital MUX's from Winter Hill will suffer trouble from swamping on channels 60 and 63 from Llanddona and also with swamping from channel 50 from Conwy. Tests confirmed this and the analogue vision carrier was some 30db higher than the required digital MUX. This totally ruled out any kind of filtering or shielding from Llanddona. However, channel 50 from Winter Hill is paralleled by channel 64 from Moel-y-Parc and selective reception and single channel filtering would be totally impossible in that case, so channel 50 would have to be greatly reduced from Conwy in order to make the Winter Hill channel viable.

The Solutions

Having now settled on the following channels, 68, 66, 56 and 50 from Winter Hill along with 34 and 30 from Moel-y-Parc to get the full compliment of MUX's, 2 aerials were needed, one beamed onto Winter Hill and one beamed at Moel-y-Parc. Because of the analogue channel 50 swamping from Conwy, a Jaybeam transmitting log periodic was chosen and aligned carefully, so as to null out as much of the vision carrier (remembering that the sound carrier is lower level at the ratio of 5:1) as physically possible. Of course the sound and vision carriers occupy the edges of the bandwidth of the COFDM signals, so in theory (if the FEC works), if the analogue levels are down at similar levels to the digital signals, then it should work. In practice, the log periodic was brought down a single feeder (aluminium foil tape screened) to the back of the set. Additionally, an 18 element contract group B was fitted and beamed to Moel-y-Parc. This was heavily filtered by cascaded group A bandpass filters and fed into a masthead 28db amplifier and again, fed directly by single feeder

to the set back. Tests showed successful signals were decoding on all MUX's when each feeder was plugged into the Philips box. To diplex the two feeders together, required great patience and setup of diplexing filters and the addition of a further 11db of gain to the Winter Hill feeder (to bring all the signal levels within a few db). As luck has it, the adjacent channel rejection of analogue carriers is good on the Philips box and despite there being strong adjacent channels in the order of 30-40db higher, the Philips coped very well indeed.

All of this is in fact further muddied by local VHF/UHF transmitters running the Amateur Radio Packet BBS at the same site (using in fact the same masts from the transmitting antennae. Each of the radios (3 UHF 430-440MHz, 2 VHF 144MHz and 70MHz) runs constantly using intermittent Tx (short packets of a few hundred milliseconds to a max of 20 seconds) - the Philips is largely immune to these signals, unfortunately the masthead amplifier is swamped by them occasionally, so the signal drops out from time to time.

Some questions answered about Signals

DVB, Digital Video Broadcasting (which has gained the suffixes -T for terrestrial and -S for Satellite) uses COFDM for transmitting the MPEG data. The acronym stands for Coded Orthogonal Frequency Division Modulation. In the case of DVB-T it uses 2048 carriers as opposed to 8192 used on Satellite. I do not propose to get into the technical details of all this here, this is best dealt with elsewhere. To understand a little more it is necessary to look at how analogue television signals are broadcast before we look at digital channel broadcasting. Domestic UHF TV in the UK uses PAL with an AM (amplitude modulation) Vision Carrier with an FM (Frequency Modulation) sound sub carrier 6MHz higher with a lower power in the ratio 5:1. These carriers are centred at the edges of the bandspace occupied by the digital carrier :-


A typical analogue channel, this one was Channel 4 at 823.25MHz with a sound carrier (right) at 829.25MHz


Here is a typical digital channel, this is channel 68 occupying 839.25MHz to 845.25MHz

Now the first thing to note is that the digital channel occupies the entirety of it's allotted bandspace and in an ideal world the digital MUX should be square topped (indicating that all the individual carriers are equal amplitude). Filtering opens up a new facet altogether since the filtering techniques used for analogue channels cannot be used for digital work. Typically, filters designed for analogue work, are setup to have an envelope very similar to that of the analogue shape above with it's peak erring towards the lower side of the envelope to account for the higher level VC (vision carrier). In a digital environment, this kind of shape is useless since it removed a large portion of the wanted signals. What is needed here, is an envelope shape with very straight vertical walls and a square top, in other words linear across it's

frequency range of 6MHz and with "brick wall" characteristics. Such filtering is not possible with passive methods (economically anyway) so it is only really feasible to use active filters. All the original techniques used in MATV/SMATV design go out of the window with digital. In fact, everything that made a communal system into a well engineered, well setup and good quality system with first class performance, now works against us for digital reception.

Since most folk reading this and the majority of ONdigital subscribers have no ability to "see" the signals they receive, I have presented here, the digital channels I am receiving on my own system, from Winter Hill diplexed with Moel-y-Parc. So as not to burden everyone with large graphics (I hate them), small clickable images are laid out, and you can view the channel by clicking on the ones you want.

The images are taken from a spectrum meter and they are ascending, the bottom of the frame is the lowest frequency. The amplitude of the signal is shown by extending to the right, the vertical white bar is the base line at zero signal level.

 The full UHF band sweep from 470MHz to 860MHz, the scale is 60dbuV at FSD.

 This is the same sweep with an additional 30db of attenuation. The 4 primary analogue signals can be clearly seen from Winter Hill.

 Channel 68 from Winter Hill.

 Channel 66 from Winter Hill, the intrusive spike at the bottom of the MUX is the sound carrier from analogue channel 65.

 Channel 56 from Winter Hill, sandwiched between the analogue signals of 55 from Winter Hill and 57 from Llanddona.

 Channel 50 from Winter Hill, this was the most troublesome and the VC of Conwy's analogue 50 can be seen at the bottom of the MUX with the SC (Sound Carrier) just visible 6MHz up (top of MUX). This was just above the threshold for the FEC to work OK.

 Channel 34 from Moel-y-Parc, note the slope towards the lower part of the MUX. This was very flat before the amplifier and a certain amount of compensation was needed to flatten it to this point by moving the aerial off beam by about 15 degrees.

 Channel 30 from Moel-y-Parc, considering the level of amplification, this is good.

Now a look at the channels that are being killed by Llanddona

 This is channel 63 from Winter Hill and the massive analogue signal from Llanddona can be clearly seen right on top.

 Again, channel 60 has exactly the same problem.

OK, this represents (probably) the worst case scenario that one is likely to encounter and it should be said straight away of course that ONdigital state there is no reception (and hence service) in this area. As a result of this, I had to make special arrangements for subscribing and getting service. Obviously in my case I did the work, simply because I am quite able and wanted the service. Having said that, I have some 20 years experience behind me as well, which made the process easier. In terms of cost, there was about 50 quids worth of bits but of course the time cost, would have been prohibitive to an ordinary customer paying for the work.

There are a lot of hurdles to overcome with terrestrial digital TV and the North Wales coastal area is denoted as a high risk problem area for digital. However, my own installation has additional problems compounding (Amateur Radio Transmitters on the same masts) the situation, yet it still works and this has to be one of the "almost impossible" areas (given that Llanddona is not yet in service).

I should stress that if you can get away without amplifiers then do, so for fitting amplifiers usually compounds any problems. If the signal level you are receiving is too low for analogue reception as well, then consider fitting a separate aerial for the digital box - it will probably pay off in the end. Also, the RF output from the Philips is not the best and of course adds yet another double sideband modulator (which most folk can do without). If you can use SCART, then so much the better, preferably set to RGB outputs.

On the subject of using RF outputs, you should be aware of the basic rules governing channel allocations. As I mentioned above, the UHF band consists of channels 21 to 69, or in frequency, 471.25MHz to 855.25MHz (with the sound carriers being 6MHz above these values). Now UHF channels are spaced at 8MHz apart and you should avoid channels with an N+9 relationship, for example, if your BBC 1 is on channel 45,

you should avoid putting your UHF output onto channel 36 because you will have 9 channels spacing. Now, this would give a figure of 72MHz (9 x 8MHz). In this example, the local channel (36) is 591.25MHz and the terrestrial one is on 663.25MHz. Mixing these two channels together (at this spacing) gives a sum and a difference frequency as well (another two frequencies of 72MHz higher and 72MHz lower. Half of this value is 36MHz and well within the UHF tuner's passband. Victims of this kind of interference will often see "ringing" on the picture of one or the other of the 2 pictures, this looks like a halo or strong local (close) ghosting. Since N+5 channels, will also produce a signal in the tuner passband (40MHz), these combinations should also be avoided. It is for these reasons that the classic "3/3/3/4" spacing is most often used for UHF channel allocations. Witness Winter Hill's allocations for analogue 65/62/59/55 - check out your own local transmitter's allocations for the first 4 main channels.

Bear in mind finally, that this is a new field, the engineers that we have are generally local contractors and this is a new field to them. Also, there is little equipment about for digital work. I have lost count of the number of manufacturers who apply the marketing hype "digital TV ready" to aerials and the like. No-one is yet making a filter (that I know of) suitable for COFDM signals on UHF. Amplifiers are also not yet optimised for digital, we need to see greater linearity in the carrier/noise performance than previous designs for UHF analogue TV. You must remember that the manufacturers and broadcasters moved the goalposts several times with Satellite DTH broadcasting and the distribution amplifiers I saw back in the early nineties were truly horrid (but that's all there was).

It is my belief that a large can of worms has been opened up with the advent of digital and market pressures will bring about the demise of analogue broadcasting rather sooner than later. It is completely impossible to equip every UHF transmitter in the UK with digital outputs simply because there are not enough channels available. For this reason, there are going to be a number of transmitters in the UK (especially important relays) that will never get digital (we have no Channel 5 in North Wales for example due to lack of UHF space). The only logical way to do the job properly, would be to close the analogue network down and replan the transmitter network from the ground up, using alternate channel spacing (22/24/26/28 etc). The best I think we can hope for is a complete mish mash, since replanning would need new aerials in many homes (if not all).

OK, not much more to say really. Oh yes, despite the background, this page has no connection with ONdigital (I just made it from a letter I had off them) other than I am a subscriber. My spectrum meter is a Unaohm EP740AFM that has seen 15 years service and yes, I know the damn tube is no longer aligned but the yoke is VERY well glued onto the tube, so that's the way it stays. Another point I should make (but will probably be flamed for it) is that competent engineers usually carry or have access to spectrum meters and know how to use them. One thing is for sure, when dealing with MATV/SMATV communal systems they are a very important accessory and when they are carrying digital they are the very minimum (meters with COFDM, BER testing and carrier/noise measurment are what is really needed).

Please don't deluge me with mail about transmitters in your area, whilst I know North Wales, I'm not too familiar with other parts of the Country. Having said that, if you think I can help with technical questions, then you're welcome to ask but remember I don't get paid to answer questions, it is purely voluntary.

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