

Results of RF measurements with DVB-T chip-set and comparison with ATSC performance

Contribution to DVB-TM

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1 Introduction

This paper presents the results of RF measurements of a current domestic DVB-T demodulator chip-set, under various channel conditions. Results were recorded for both the standard DVB measurement criterion of quasi error-free (QEF) and for the failure point (FP), allowing a comparison between these two points to be made. These results show the excellent performance with the DVB-T system, using a domestic receiver chip-set, in both Gaussian channel conditions and in channels with severe multipath or co-channel interference.

2 Details of the measurements

Measurements have been made of the performance of a domestic DVB-T demodulator chip-set in a Gaussian channel, with co-channel PAL and in a severe multipath channel (a 0 dB echo with a delay of 0.8 μ s and 1 Hz of Doppler). The measurements are all made for the mode used for current operational services in the UK: 2K, 64-QAM, code rate 2/3, guard interval 7 μ s.

For each channel, the performance to two measurement criteria has been recorded. The first criterion is for a bit-error ratio of 2×10^{-4} after the Viterbi decoder. At this error-ratio, there are essentially no uncorrectable packets in the demodulated transport stream, and so this point has often been referred to as the quasi error-free (QEF) condition¹. The second measurement criterion is referred to as the failure point (FP), which for these measurements has been defined to be an average of two uncorrectable packets per ten seconds. This is simply the lowest rate it is practical to observe, requiring an observation interval of about 1^{1/2} minutes. In the DVB-T mode used for current operational services in the UK, which has a transport data rate of 24 Mbit/s, this leads to an output bit-error ratio of approximately 2×10^{-7} at the failure point. Hence this is still an order of magnitude more severe than the criterion used for measurements with the ATSC system, which has been defined as an error ratio of 3×10^{-6} , the so-called threshold of visibility (TOV).

PAL co-channel measurements for protection ratios are often made with no added noise (referred to as infinite loss of noise margin). However, these measurements were made under more realistic conditions where noise was added at a level of 6 dB below that for the Gaussian channel (in other words, for a 6 dB loss of noise margin). The system would tolerate approximately 2dB more interference if measured for infinite loss of noise margin.

¹ Strictly the definition of QEF is 1 uncorrectable transport packet per hour

3 Results

The results of the measurements are given in the following table:

Gaussian channel <i>C/N</i> dB		PAL CCI channel <i>C/I</i> dB		<i>C/N</i> dB for PAL CCI channel		0dB echo channel <i>C/N</i> dB		0dB echo channel LONM dB	
QEF	FP	QEF	FP	QEF	FP	QEF	FP	QEF	FP
18.7	17.6	3.2	0.5	24.7	23.6	25.5	22.7	6.8	5.1

4 Discussion

From the Gaussian channel measurements it can be seen that difference between measurements at QEF and FP is 1.1 dB. For comparison with ATSC measurements at TOV, a further allowance should be made for the more relaxed TOV criterion. This is estimated to be a further 0.2 dB. Hence for comparison purposes, the equivalent DVB-T measurement at TOV would be 17.4 dB. This is approximately 2 dB more than ATSC reported measurements, rather than the 4 dB often claimed by ATSC.

The results with co-channel PAL confirm that excellent performance is possible with co-channel signals, without the need for specially implemented rejection filters, such as are required for ATSC.

The figures for 0 dB echo performance confirm that the expected level of performance can be achieved. ATSC often quote the relatively poor results for 0 dB echo performance measured during the Australian laboratory tests [1]. A further important point here is that the difference between QEF and FP (approximately 3 dB) is much larger for such selective channels than is the case in Gaussian channels. Appropriate allowance for this difference should be made when comparing the two systems, which in any case is only possible for echoes weaker than 3 dB, the maximum the ATSC system can withstand. This is shown dramatically in the attached curves. Fig. 1 shows an erroneous multipath comparison curve taken from the ATSC FAQ (<http://www.atsc.org/pub/faq.pdf>). Fig. 2 shows a corrected version of this based on the figures given above, and shows that the true advantage is significantly in favour of DVB-T. It should also be noted that this only applies for static channels – reference [1] shows that ATSC is not able to deal with conditions where the channel changes, such as with flutter.

5 Conclusions

The results of RF measurements with a domestic DVB-T demodulator chip-set have been presented, and it has been shown that excellent performance has been achieved. The results compare the performance for QEF and failure point, and show that the difference is more than 1 dB in a Gaussian channel and much more still (up to 3 dB) in a selective channel. This difference is very important when comparing DVB-T with ATSC, for which results are quoted to the so-called threshold of visibility, an even more relaxed criterion than the failure point defined for these measurements. The results show that some of the claims made for ATSC are somewhat erroneous.

6 References

[1] N. Pickford, "Laboratory testing of DTTB modulation systems", Laboratory Report 98/01, Australia Department of Communications and Arts, June 1998.

DTV Modulation Performance Comparison

Figure 1 ATSC curves with erroneous values for DVB-T

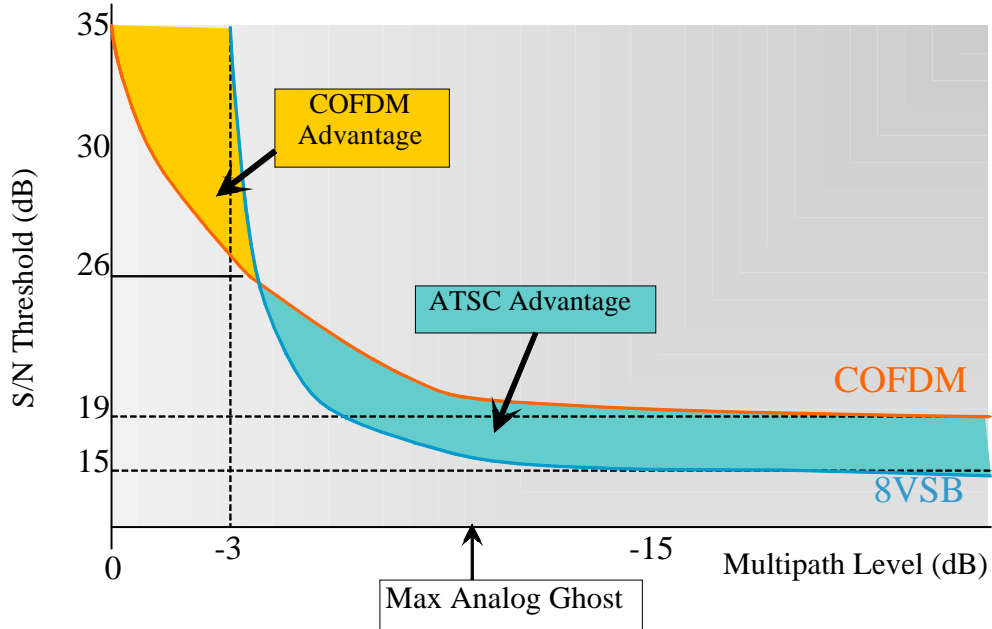


Figure 2 Repeat of figure 1 but with realistic values for DVB-T

