First results of digital video quality measurements in DVB networks

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Abstract

A brief description is given of the first measurement results on digital video quality parameters obtained with a new single-ended video quality test instrument that measures in real-time. The video sequences used as examples were taken from normal services currently available on the Munich cable network and via satellite.

INTRODUCTION

Over the last years, an increasing demand for objective video (and audio) quality assessment and measurement developed in the world of digital television. Since today many more programmes need to be monitored than a decade ago, the visual system of television experts has become too valuable and consequently too expensive for many applications.

Another reason for considering objective measurement strategies for video quality in a DVB environment is the effect experienced in such networks that the measured values of physical layer and protocol layer parameters do not in all cases correlate sufficiently with apparent impairments which are visible to the end-user.

THE ROHDE & SCHWARZ APPROACH

We started our activities in this area about three years ago. At an early stage of the definition of a possible implementation, we decided to pursue a single-ended, real-time evaluation of digital video quality. The theoretical approach and simulation results of the first off-line software implementation were described, for example, in a paper at IBC 1998 [1, 2].

The integration on a suitable hardware platform took place over the last nine months. Today we can present some results of real-time measurements on DVB networks with public distribution of programmes.

The results given in Figure 1 were measured on a constant bitrate service available on the Munich cable network. The curves display the actual bitrate, the temporal activity and the weighted digital video quality parameter.

The bitrate is measured by the instrument (Rohde & Schwarz Type DVQ) itself. The accuracy of the measurement depends on the number of Transport Stream Packets received within the measurement interval.

As an indication of the temporal activity in the received and decoded video programme we use a relative measure that is derived from the temporarily available variables during the processing of the algorithm.

The algorithm itself targets mainly the blockiness of the video material after decoding for the evaluation of the video quality. The raw parameter (Digital Video Quality Level – unweighted: DVQL-U) is derived from each video frame. It is then filtered with a weighting filter that reflects the masking effects of the human visual system for this sort of distortions or impairments. The result is labelled as DVQL-W (Digital Video Quality Level – weighted).

All the measurement results are output via a data interface with are standard rate of one set of parameters every 0.4 seconds.

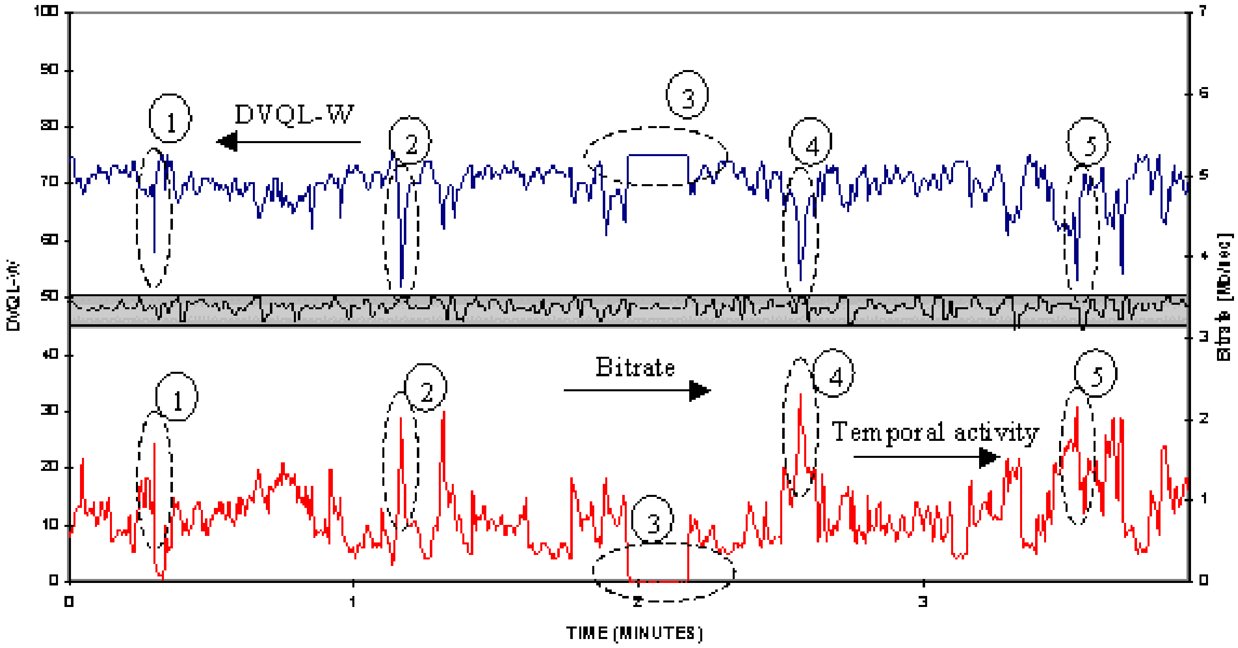

Figure 1: Measurement results for a constant bitrate programme

MEASUREMENT RESULTS

Constant bitrate video

The example in Figure 1 was taken from a home order television programme. During most of the sequence a presenter explained product features to the audience.

The bitrate of this programme on the Munich cable network remains constant within certain limits around 3.4 Mb/sec. The programme has a standard resolution of 576 active lines and 720 pixel per line. The instrument measures the bitrate by counting the Transport Stream packets between to time markers, and displays the result with the same repetition rate as the other results. The slight variations stemming from residual bitrate variations in the encoder/ multiplexer and from this measurement procedure, are visible in Figure 1.

The video quality parameter itself remains for most of the four minutes sequence at a rather good level. This is due to the content with low temporal or spatial activity. Only scene cuts with their peaking temporal activity level produce significant slumps in the video quality (see Figure 1, points 1, 2, 4, 5).

The period around Point 3 is characteristic for a still picture: no temporal activity corresponds with the optimal video quality that is achievable at the available bitrate.

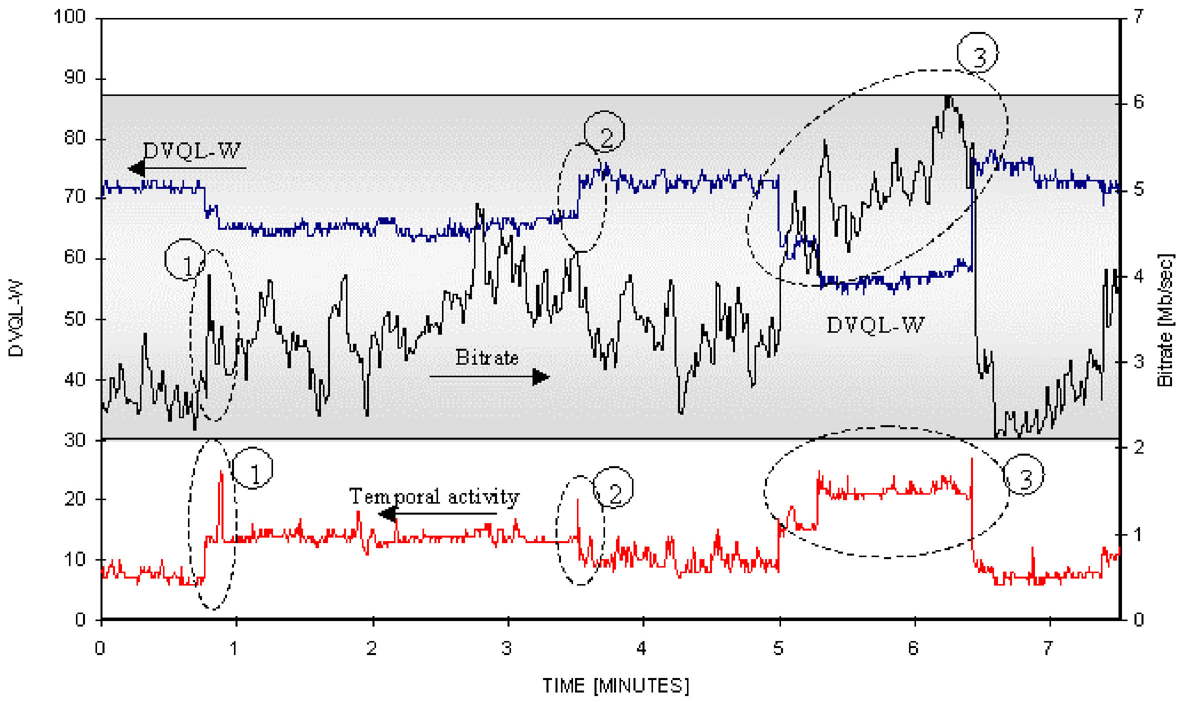

Figure 2: Measurement results for a variable bitrate programme

Variable bitrate video

The second example (Figure 2) is a sequence received from a satellite. For this programme, a variable bitrate is used. Five video programmes and several audio programmes are statistically multiplexed into one Transport Stream. The bitrate varies significantly over time, in this sequence roughly between 2 and 6 Mb/sec. The resolution of this programme is also 720 x 576 pixels. The content consists of an Open University programme with a tutor explaining things in front of a blackboard, graphics with moving elements and a short film sequence with a length of about one minute.

Scene cuts can be easily identified here as well by localising the peaks in temporal activity. In comparison with the first example, here the bitrate varies relatively more than the video quality. It seems that several levels of video quality are used by the encoder/ multiplexer to cope with varying demand for bitrate. Between Minute 1 and Minute 3 the temporal activity is higher than before, the bitrate is increased but obviously not far enough to maintain the former video quality. Only after the temporal activity has dropped again, and after the demand for bitrate was lowered as well, the video quality parameter returns to the value at the beginning of the sequence.

At Minute 5 a film sequence starts which requires a much higher bitrate. Apparently the upper limit for the bitrate that could be allocated to this programme was somewhere around 6 Mb/sec. This resulted in a reduction of the video quality for the length of the film sequence. After its end, the programme continued with the tutor which means low temporal activity and rather good video quality.

CONCLUSION

The tests described in this paper are encouraging in the sense that they prove that real-time monitoring of video quality with a single-ended approach, i. e. without a reference signal, can be done with currently available computing power in a normal test and measurement instrument.

Although we expect that the quality of certain material cannot be measured with the wanted degree of confidence and accuracy, we think that many effects and impairments can be spotted by such an instrument applied for monitoring purposes.

The next steps will include the measurement and evaluation of impairments inserted by the transmission system itself. We expect significant differences depending on the character of the transmission channel, whether it is for example a DVB-T channel in a mobile environment or a telecommunications network used for primary distribution of the programme material.

REFERENCES

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