CCITT SGXV
Working Party XV/1

Document #535
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Specialists Group on Coding for Visual Telephony

SOURCE: VideoTelecom
TITLE : Specification of Significant Blocks per Frame

INTRODUCTION

Document #456 described a method for limiting the rate of significant blocks at the encoder. A significant block is an 8x8 block that is coded and must be decoded and transformed at the receiver. This document proposes that the upper limit on the number of significant blocks per frame that a decoder can process be sent to the encoder. The encoder will maintain the generation of significant blocks below this limit.

BACKGROUND

Certain implementations of video codecs take advantage of the statistics of video signals to reduce the complexity and cost of the system. One such factor is the number of significant blocks that is generated per frame. In general, the number of significant blocks is naturally limited to a fraction of all the blocks by the characteristics of the algorithm, and the video data rate.

However, different implementations of the same algorithm may produce different numbers of significant blocks. One implementation of the standard may have no problems decoding its own coded data, but may be overloaded when talking to other codecs.

Figures 1 and 2 show the relationship of the number of significant blocks to the video data rate for RM8, and two variations of RM8. The simulation results were obtained for values of Q from 1 to 6, corresponding to a data rate of Qx59.4 Kbps.

The curve labelled "RM8 - THRESHOLD" was generated by modifying the adaptive threshold in the forward quantizer, and forcing the threshold to be 4 times the quantizer step size.

The curve labelled "RM8 - QSS UPDATE" was produced by disabling motion compensation and loop filtering, and updating the quantizer for each coded macro block. The quantizer was determined by scaling the normal RM8 quantizer step size by the RMS difference between the incoming 16x16 luma block, and the reference luma block. More explicitly, the interframe difference, DIFF, is first determined as follows:

```
DIFF = 0
DO K = 1, 16
  DO L = 1, 16
    DIFF = DIFF + ( INPUT_BLOCK(K,L) - REFERENCE_BLOCK(K,L) ** 2
  ENDDO
ENDDO
```

The quantizer step size for the macro block is given by:

```
QSS = 2 * INT( BUFFER_LEVEL / 200.0 / P * SQRT( DIFF / 2500.0 ) )
IF( QSS .GT. 64 ) QSS = 64
IF( QSS .LT.  4 ) QSS =  4
```

The threshold modification generates a lower number of significant blocks than RM8, and the QSS update modification generates a higher number. If a codec were developed based on the threshold method it could take advantage of the lower number of significant blocks.

PROPOSAL

It is proposed that a set of BAS codes be defined to allow the decoder to inform an encoder about it capabilities for processing significant blocks. Table 1 shows the proposed values of the significant block limit (SBL) and the percentages of total blocks for both FCIF and QCIF. The SBL is defined as the maximum number of significant blocks that the decoder can process during each of the 33.3 milli-second CIF frame intervals of a coded frame. The encoder must ensure that number of significant blocks sent for each coded frame does not exceed the product of SBL times the number of CIF frame intervals represented by the coded frame.

Table 1 Percentage of total blocks as a function of frame rate, resolution and the significant block limit (SBL)

SBL	Full CIF				Quarter CIF			
	30FPS	15FPS	10FPS	7.5FPS	30FPS	15FPS	10FPS	7.5FPS
2376	100%	>100%	>100%	>100%	>100%	>100%	>100%	>100%
1188	50.0%	100%	>100%	>100%	>100%	>100%	>100%	>100%
792	33.3%	66.7%	100%	>100%	>100%	>100%	>100%	>100%
594	25.0%	50.0%	75.0%	100%	100%	>100%	>100%	>100%
446	18.8%	37.5%	56.3%	75.0%	75.0%	>100%	>100%	>100%
297	12.5%	25.0%	37.5%	50.0%	50.0%	100%	>100%	>100%
198	8.3%	16.7%	25.0%	33.3%	33.3%	66.7%	100%	>100%
149	6.3%	12.5%	18.8%	25.1%	25.1%	50.2%	75.3%	100%
111	4.7%	9.3%	14.0%	18.7%	18.7%	37.4%	56.1%	74.7%
74	3.1%	6.2%	9.3%	12.5%	12.5%	24.9%	37.4%	49.8%
50	2.1%	4.2%	6.3%	8.4%	8.4%	16.8%	25.3%	33.7%
37	1.6%	3.1%	4.7%	6.2%	6.2%	12.5%	18.7%	24.9%

As an example, let a value of 198 be used for the SBL, and let the maximum frame rate be 10 FPS. The encoder is not allowed to send more than 198 x 3 = 594 significant blocks for a coded frame, unless more than three CIF frame intervals are used. If 600 significant blocks were generated the encoder must wait one extra CIF frame interval before starting the next frame. If 800 significant blocks were generated the encoder must wait two extra CIF frame intervals.

If the encoder's buffer becomes empty while waiting for the next frame either the stuffing code word or empty FEC frames may be sent.

CONCLUSION

The significant block limit allows for greater freedom in the implementation of a compatible codec. The significant block limitation is simple to implement on the encoder side. It only requires counting the number of significant blocks transmitted, and waiting the appropriate number of frame intervals before starting the next frame. The inclusion of the SBL specification into the standard will allow for very low cost implementations of the standard.

FIGURE 1 - SIGNIFICANT BLOCKS FOR MISS AMERICA

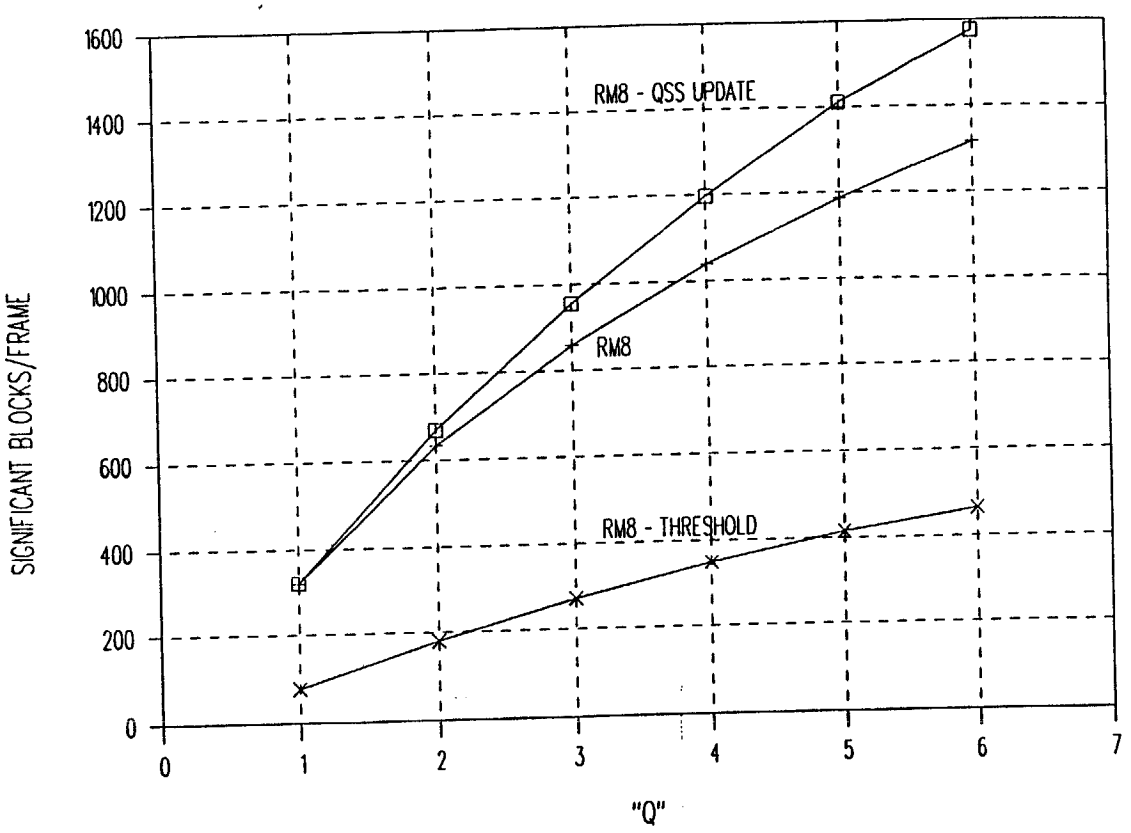

FIGURE 2 - SIGNIFICANT BLOCKS FOR SALESMAN