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CCITT SGXV
Working Party XV/1
Experts Group for ATM Video Coding

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SOURCE : JAPAN
TITLE : Proposal of TM2 Rate Control Modification for Low Delay Mode
PURPOSE : Proposal

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1. Introduction

The rate control for low delay mode is specified in Appendix H / TM2. Some simulations have been done accoding to TM2 method, and it is clarified that the rate control in TM2 works inappropriately for low delay mode. Therefore we propose new methods for the improvement.

2. TM2 rate control modification

Figures in Annex 1 and 2 show time fluctuations of total number of bits per frame and that of luminance SNR. As to the total number of bits, it is observed original low delay has a tendency where its total number of bits is decreasing toward the end of sequence, and the corresponding luminance SNR is degraded at the end of it. The cause of the tendency exists in the rate control of TM2 for low delay mode, and can be attributed to inappropriate set of target number of bits.

The solution for it has been considered in two ways. One is the way to replace orignal Tp with next equation, which keeps the target number of bits for Intra slice constant and at the value calculated from original Ti.

$$Tp = (Number\_of\_slice / Number\_of\_P\_slice) * (R - Ti * Number\_of\_I\_slice / Number\_of\_slice * Np) / Np \quad (1)$$

The other is to replace Tpp and Tpi with next equations, which keeps the sum of Tpp and Tpi at the original value of Tp.

$$Tpp = \{(Number\_of\_P\_slice \times Tp) / (Number\_of\_P\_slice \times Tp + Number\_of\_I\_slice \times Ti)\} \times Tp \quad (2)$$

$$Tpi = \{(Number\_of\_I\_slice \times Ti) / (Number\_of\_P\_slice \times Tp + Number\_of\_I\_slice \times Ti)\} \times Tp \quad (3)$$

The simulation results using equation (1) are shown as "modified low delay" in Annex 1, and those using equations (2) and (3) are shown as "modified rate control" in Annex 2. The degradation of the end of sequence is improved by both ways.

3. Conclusion

The rate control described in TM2 gives inappropriate target number of bits, and we propose that it should be modified to eq. (1) instead of Tp in the section 10, or conbination of eqs. (2) & (3) described above instead of eqs. (3) & (4) in Appendix H.

Annex 1 to AVC-335

The simulation conditions are as follows;

- structure: frame, M=1
- prediction: frame/field
- test sequence: Mobile & Calendar(1-60th frame),
  Flower Garden(1-60th frame)
- rate control: Appendix H /TM2 for low delay,
  equation (1) for modified low delay
- bitrate: 4Mbps

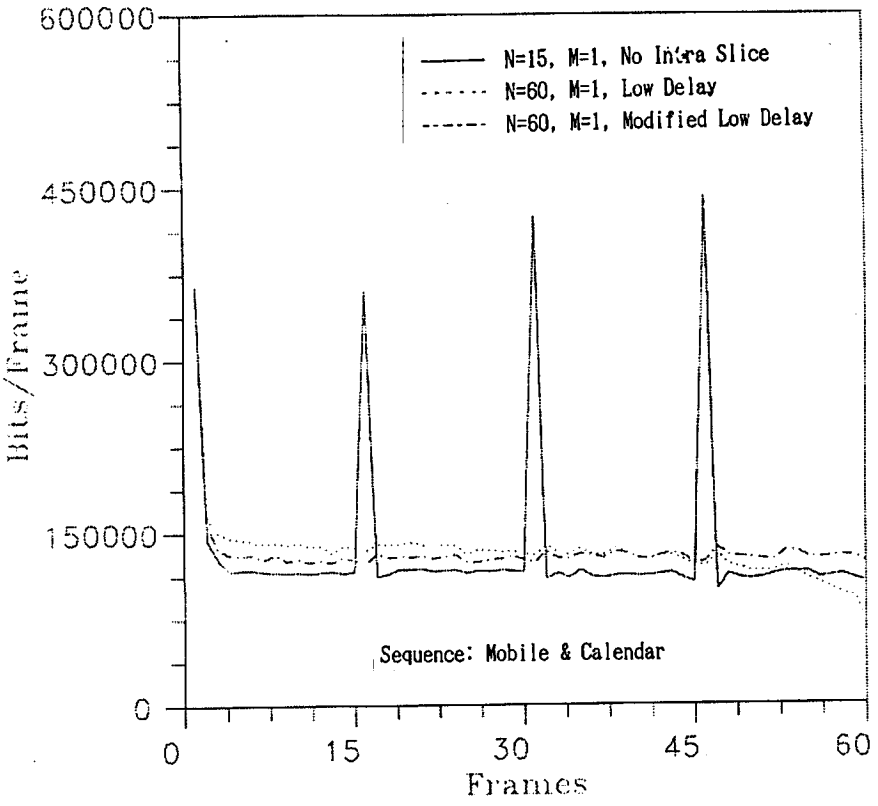
Table 1 Average SNR and Total Number of Bits per Frame

MOBILE & CALENDAR

	No Intra Slice N=15,M=1	Low Delay N=60,M=1	Modified Low Delay N=60, N=1
SNR(Y)	27.18	27.07	27.03
SNR(U)	32.42	32.42	32.37
SNR(V)	32.41	32.38	32.33
Bits/Frame	132933	133174	132488

FLOWER GARDEN

	No Intra Slice N=15,M=1	Low Delay N=60,M=1	Modified Low Delay N=60, N=1
SNR(Y)	29.38	29.22	29.27
SNR(U)	32.52	32.51	32.52
SNR(V)	34.08	34.10	34.09
Bits/Frame	131596	132001	131200



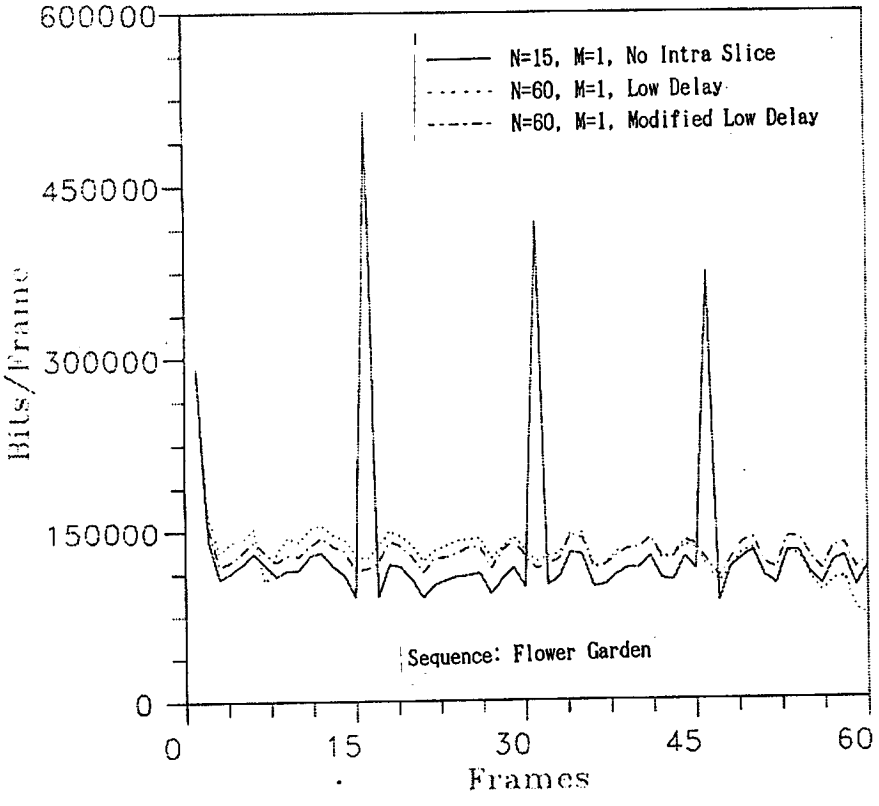
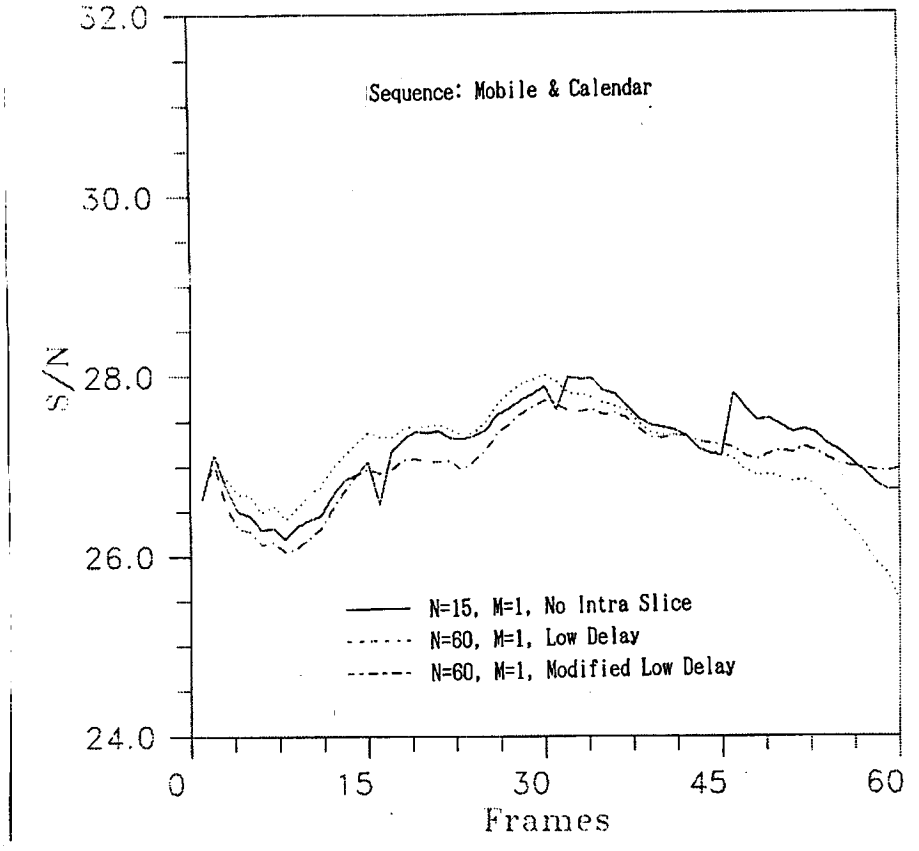


Figure 1 Time Fluctuations of Total Number of Bits per Frame



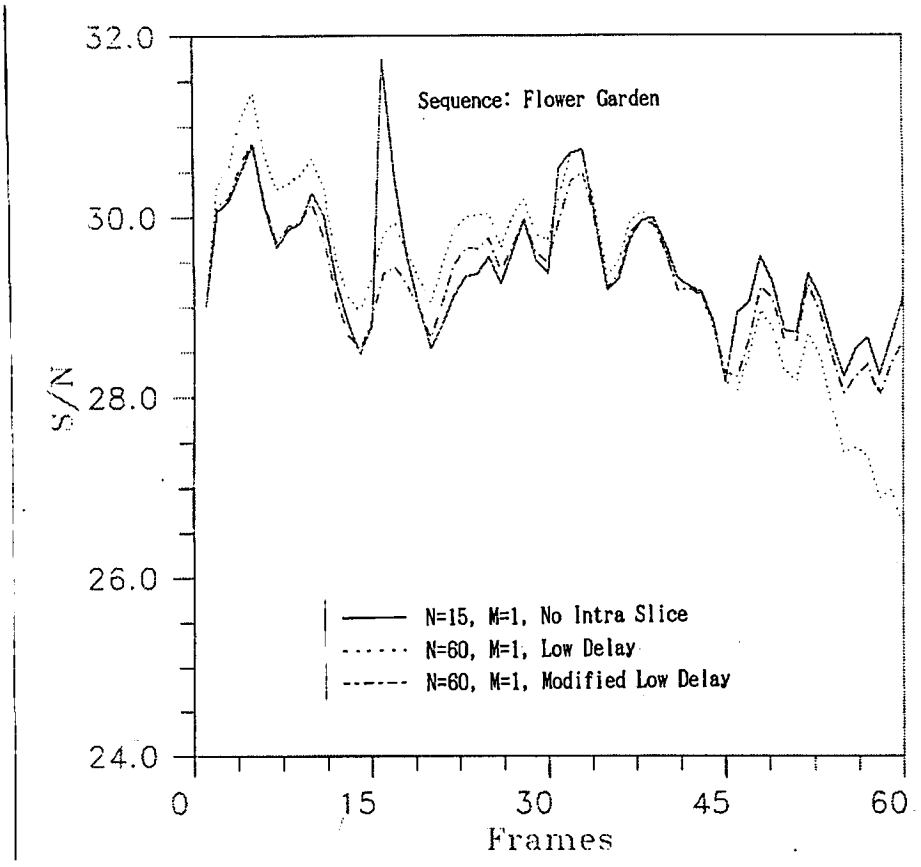


Figure 2 Time Fluctuations of Luminance SNR

Annex 2 to AVC-335

Experimental results on modified rate control for low delay

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1. Introduction

This annex shows the simulation results of modified rate control method as proposed in main body of this contribution.

2. Simulation conditions

- structure: frame
- prediction: adaptive frame/field
- bitrate: 4Mbit/s
- rate control: step 2
- sequences: Flower Garden (150 frames)
  Mobile & Calender (150 frames)

3. Simulation results

Figure 1 to 4 show the comparison of number of bits per frame and Y-SNR among the following three cases. The average SNR are shown in Table 1.

(1) N=15, M=1 (Intra picture)
(2) TM2 original target bit setting as described in Appendix H.
(3) Modified rate control according to our proposal, equation (2),(3).

The results show that the decrease of number of bits and SNR can be avoided by the proposed target bit setting scheme.

Table 1 Average SNR.

sequence	Flower Garden	Mobile & Calender
N=15, M=1	28.86 dB	27.59 dB
TM2 original	28.76 dB	27.59 dB
modified	28.86 dB	27.57 dB

END

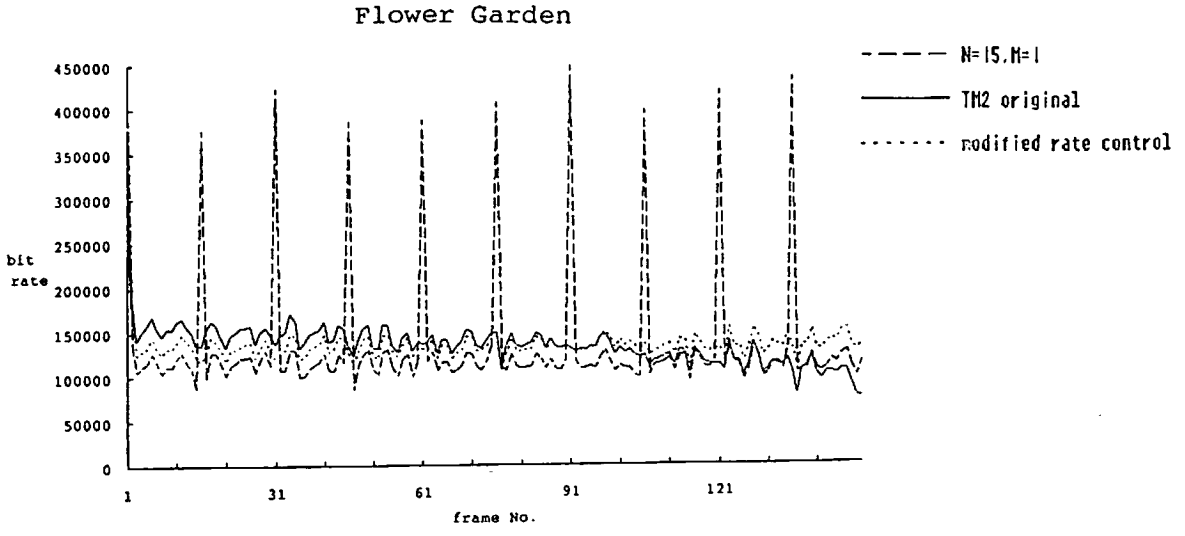

Fig. 1

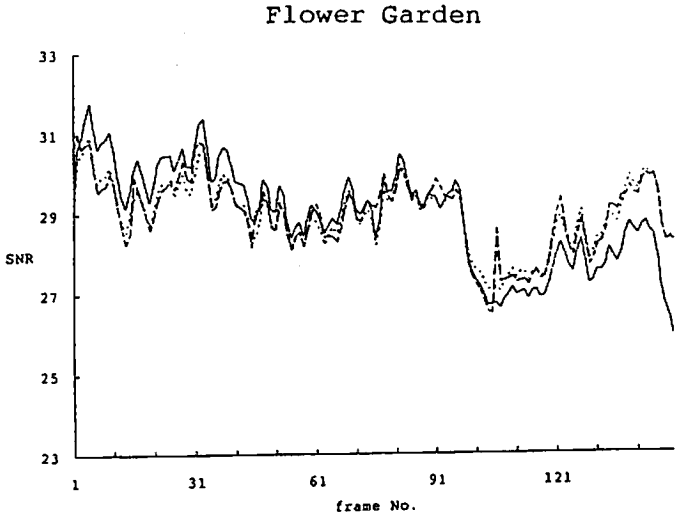

Fig. 3

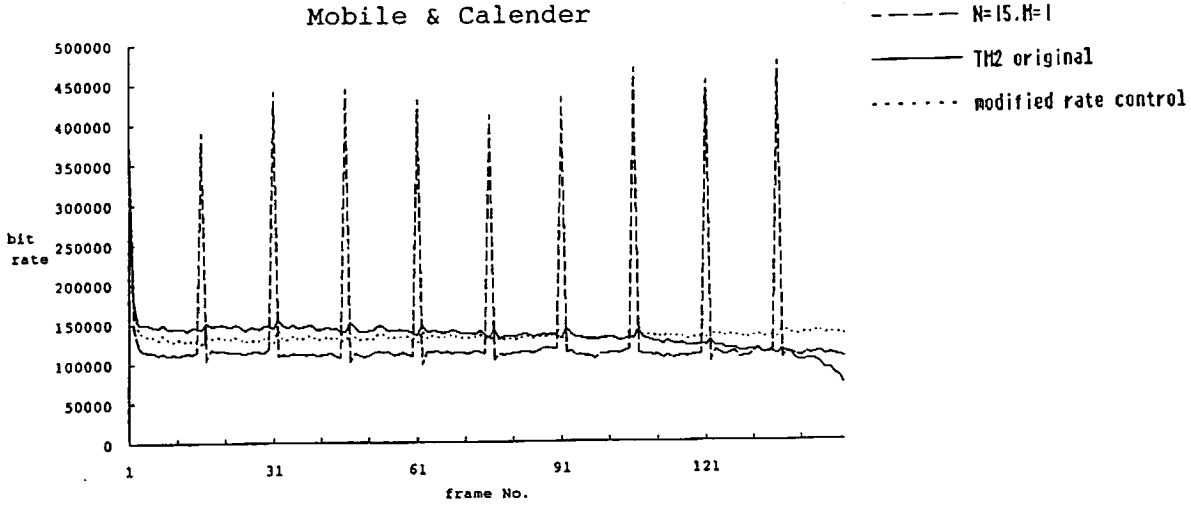

Fig. 2

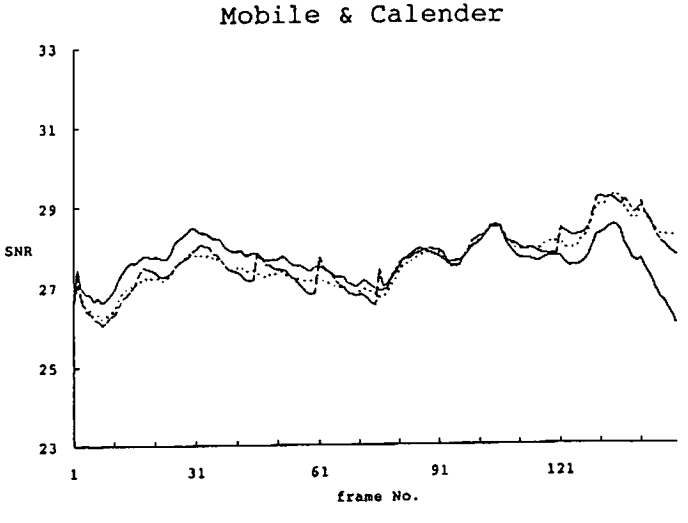

Fig. 4