1. Introduction

This document describes a video transmission method which can make use of the merit of VBR transmission under average bit rate policing with a sliding window as UPC.

2. Merit of VBR transmission under a sliding window

Any fluctuation in the generated amount of information due to a change in the prediction structure by frames like MPEG causes delay at the transmission and receiving buffers when transmission is executed on a CBR basis. Generally speaking, VBR transmission is thought to be able to solve this problem because a terminal can transmit the peak bit rate of information at the maximum and this can make the delay shorter.

However, it has been pointed out that a network using a sliding window as a UPC is difficult to use from a video coding point of view [1]. This is because a sliding window has a characteristic that the permitted transmission amount for each timing is strictly limited by the transmitted amount at the previous timing of one window size. On the other hand, it has also been pointed out that a sliding window is suitable for such coding methods with a periodical generated amount of bits like MPEG. For these kinds of coding method, VBR transmission can be thought to have a merit compared to CBR in that it can set different bit rates for individual frames.

A coding method with bi-directional predicted frames like MPEG has a coding delay from frame re-ordering, and contradicts the purpose of the above transmission method. However, there are some kind of low delay coding with a fluctuating bit rate with better coding efficiency than coding with a simple IP structure [2]. A combination of this low delay coding and VBR transmission seems to give good performance.

3. Transmission method

The following is the definite way of transmission to realize stable transmission under average bit rate policing with a sliding window. The point is that VBR transmission can prepare a temporally uneven transmission channel.

(1) Execute the same rate control method as in ordinary CBR coding for individual frames according to the predetermined target rates set periodically considering the prediction mode. Even when a larger amount than the target is allowed to be transmitted by policing, maintain the target value.
(2) Compensate the excess bit rate due to the incompleteness of rate control by allowing a fixed delay at the decoder as a delay margin.
(3) Set the maximum value of permitted delay and skip frames when a delay exceeds this value. Skip frames not referenced for prediction like B or P' frames so that the prediction structure is not affected by such frame skipping.
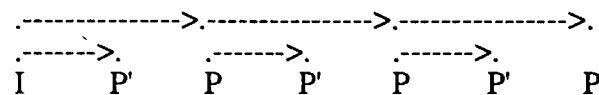
Figure 1 shows how this transmission method works and how frame skipping is executed as an example. Rate control is executed according to the predetermined target values for individual frames considering the picture type. In case of frame #2, the

generated amount of bits exceeds the target value but can be transmitted within the delay margin in the next frame without frame skipping.   As for the transmission of frame #5, frame #6 is skipped but this is not sufficient.   Furthermore, frame #8 is also skipped instead of frame #7 because frame #7 is a P frame.   Frame #7 is decoded with a delay at the decoder, but the delay is reset at the next frame timing.

4. Simulation

A simulation was carried out to investigate the situation when this transmission method was adopted to actual coding.   The simulation condition was as follows.   This coding method is a low delay mode with a better SNR than the IP prediction structure and with a large fluctuation of the bit rate (see Ref. [2]) .

coding method ; TM0 based (N=12)
prediction structure ;

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    .---------------->.---------------->.---------------->.
    .------->.          .------->.          .------->.
    I      P'       P      P'      P      P'      P
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sequence ; Mobile & Calendar, Flower Garden (150 frames)
rate control ; KP : KP' = 1 : 2
frame skipping was allowed only for P' pictures

Figure 2 and Figure 3 show the relationship between the window size and the frame skipping rate at a fixed decoding delay when frame skipping was not allowed.   Figure 4 shows the relationship between the window size and the maximum buffer delay.   These figures show that the window size of a multiple of 12 frames (= 1 GOP) gives good performance.   This characteristic is a restriction in a sense, but when this condition is satisfied, a practical frame skipping rate or the maximum delay can be obtained.

5. Conclusion

A combination of a low delay coding with a prediction structure like IPP' and a transmission method which

- controls the coding bit rate according to a periodically predetermined target bit rates for individual frames, and

- absorbs any fluctuation in the generated amount of bits within a delay margin at the decoder, and skips frames in case of a large amount of information generation

can make use of the merit of the low delay characteristic of VBR transmission.

Reference

(1) " Comparison between sliding window and leaky bucket as a UPC mechanism ", AVC-128
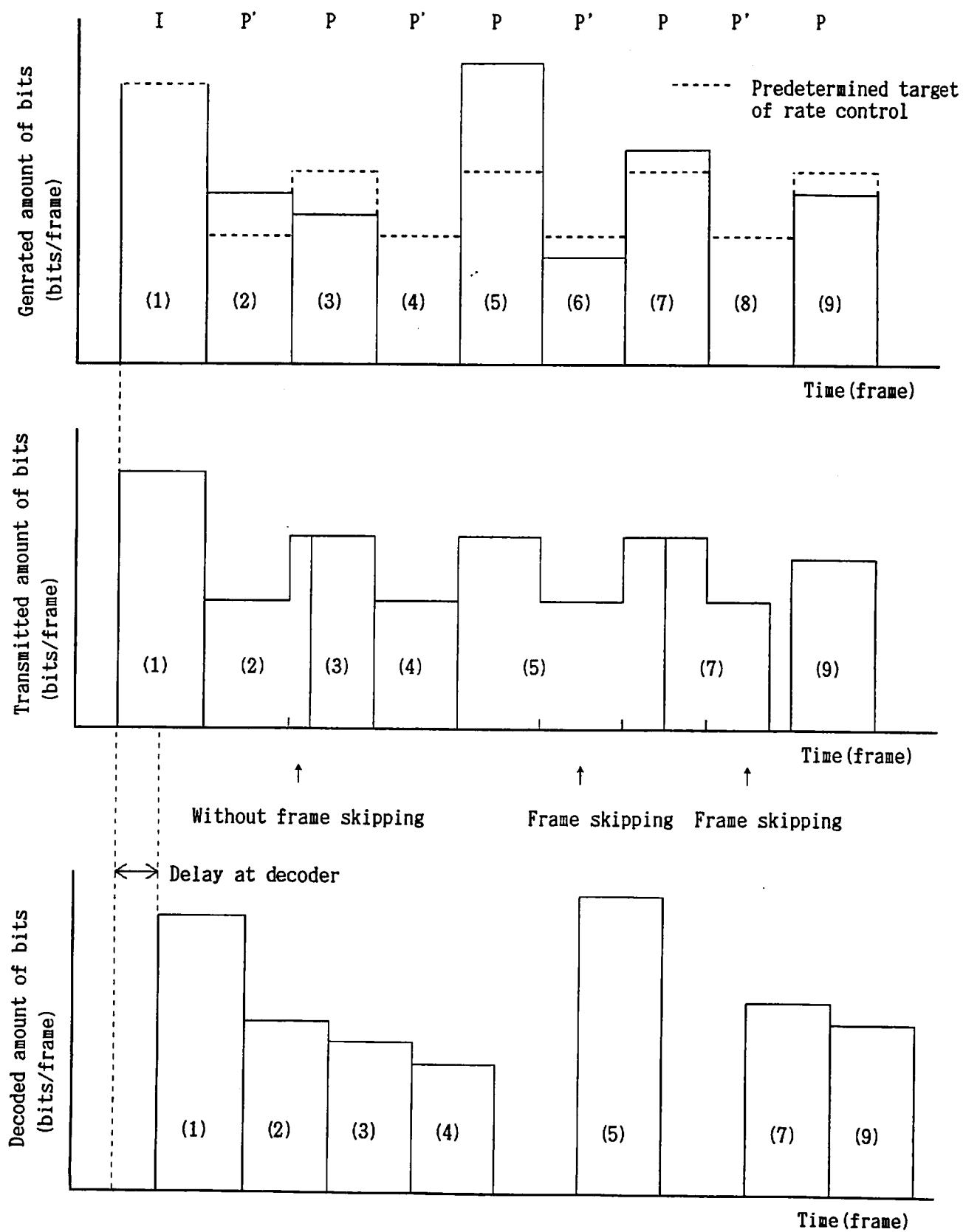(2) " Results of core experiments ", MPEG 92/105

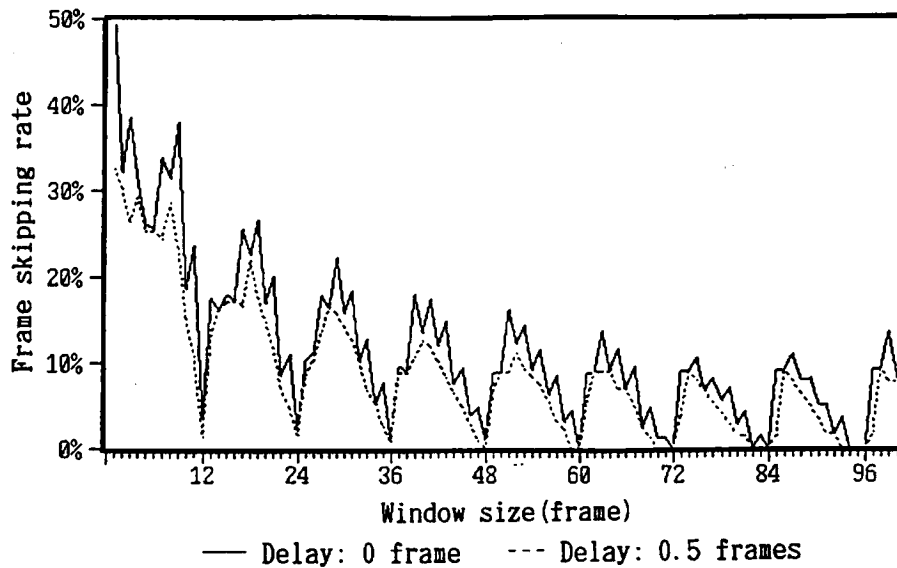Figure 1. VBR transmission method with frame skipping

Figure 2. Relation between frame skipping rate and window size
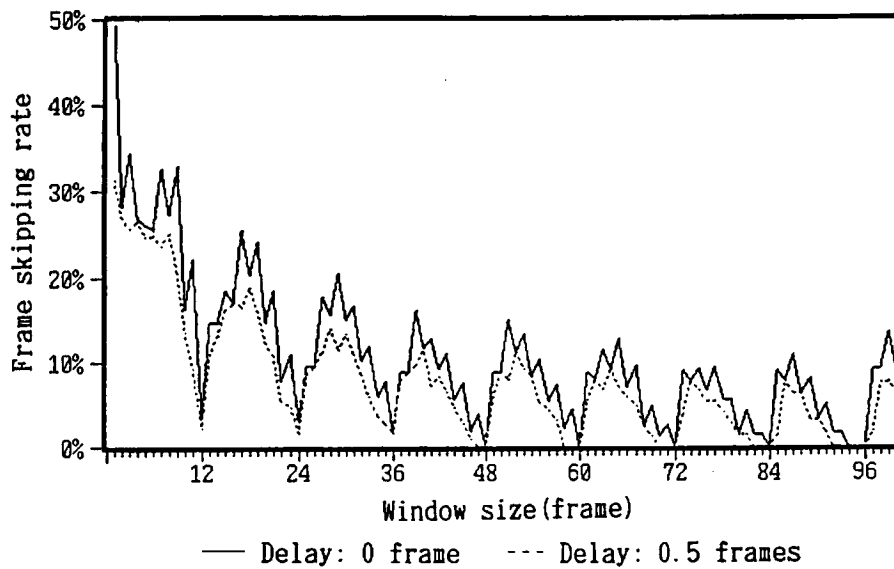(Mobile & Calendar: 150 frames, 4 Mbps)

Figure 3. Relation between frame skipping rate and window size
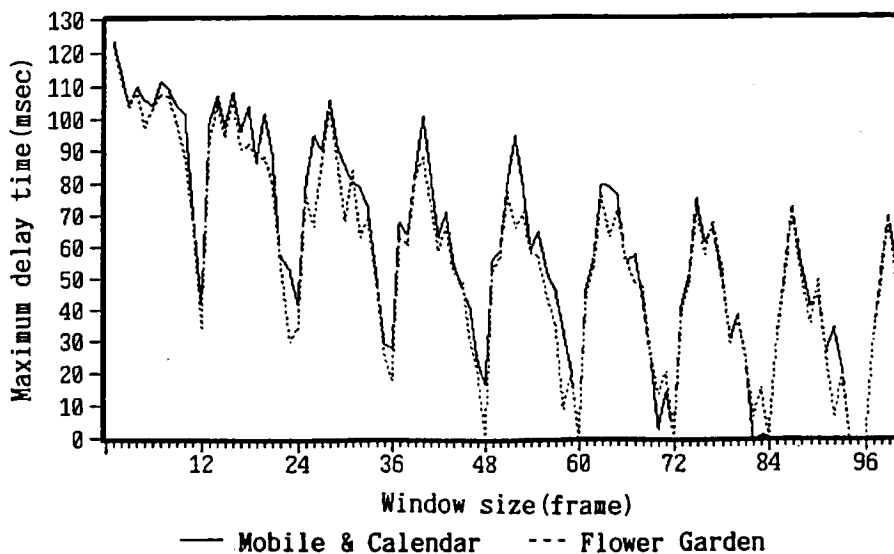(Flower Garden: 150 frames, 4 Mbps)

Figure 4. Relation between maximum delay time and window size