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

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SOURCE : JAPAN
TITLE : Transition of the buffer occupancy under VBR environments
PURPOSE : Information

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1. Background

In B-ISDN, allowing fluctuation of coding rate in VBR environments has been thought a great advantage. When considering the burden of network operation, however, some kind of restriction on the coding rate by traffic descriptor seems to be inevitable. Supposing that leaky bucket is used as UPC, for example, the size of buffer virtually located in the network affects the rate control algorithm and the design of hardware very much.

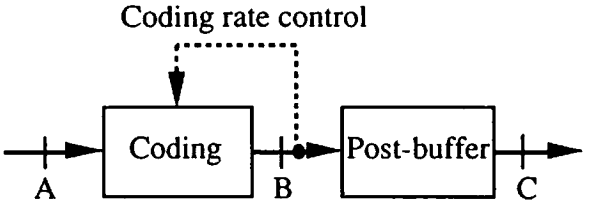
To investigate such effects, we measured transition of the post-buffer occupancy (BOC) under a certain coding rate control. It was found that coding rate control with short response time and a low coding rate provide small BOC maximum, and that a transmission rate slightly higher than the coding rate makes the BOC maximum quite small.

2. Measurement

Conditions:

Coding algorithm :	H. 261
Coding rate control :	as shown in Fig. 1 and Fig. 3.
Switching timing of Quantizer :	GOB (1/48 of one frame)
Measuring timing of BOC :	Macro Block (16 x 16)
Video sequence :	"Edited Sequence" (CCIR Rec. 601) 89 frames composed of three sequences: "Table Tennis" (29 frames), "Flower Garden" (31 frames) and "Susie" (29 frames)
Frame skipping :	no

Measurement terms:
Comparison among the convergence parameter Ns (Small N provides high response).
Comparison among the coding rates
Comparison among the transmission rates



Rate(B) (coding rate) : VBR
Rate(C) (transmission rate) : CBR

Fig. 1 Configuration of the measurement

3. Results

Table 1 Comparison among convergence parameter Ns
(coding rate = transmission rate = 10.0 Mbit/s)

N (frm)	BOC max (kbit)	Ave. SNR (dB)	Ave. coding rate (Mbit/s)
10	258.9	33.49	10.0
30	341.6	33.41	10.0
100	501.9	33.38	10.0

(The transition of the BOC and the coding rate is shown in Fig. 2 in next page.)

Table 2 Comparison among the coding rates (N=10, coding rate = transmission rate)

Rate (Mbit/s)	BOC max (kbit)	Ave. SNR (dB)	Ave. coding rate (Mbit/s)
5.0	190.5	30.76	5.0
10.0	258.9	33.40	10.0
20.0	389.0	36.13	20.2

Table 3 Comparison among the transmission rates (N=10, coding rate = 10.0 Mbit/s)

Rate (Mbit/s)	BOC max (kbit)	Ave. SNR (dB)	Ave. coding rate (Mbit/s)
10.5	34.2	33.44	10.1
11.0	29.9	33.44	10.1
12.0	23.6	33.44	10.1

4. Conclusion

In this investigation we can find that buffer occupancy is restricted in small range when the coding rate is controlled with high response, when coding rate is rather high, and when the transmission rate is slightly higher than the coding rate as far as the coding rate is well controlled.

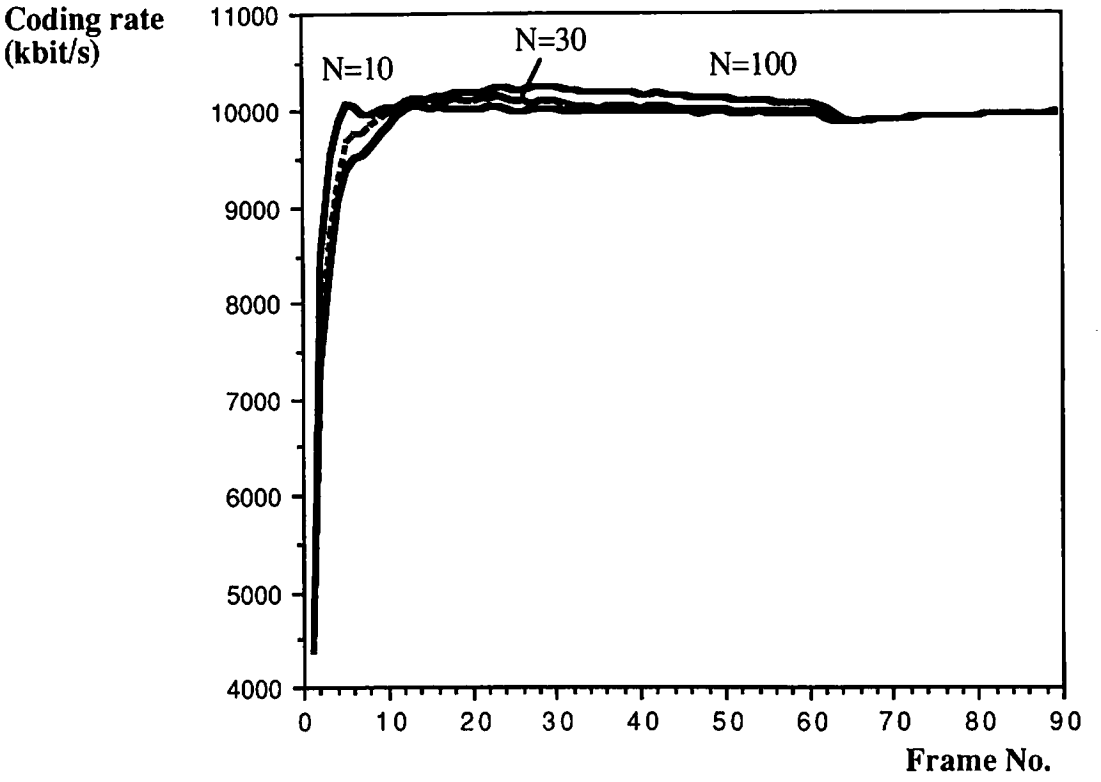


Fig. 2 (a) Transition of the coding rate

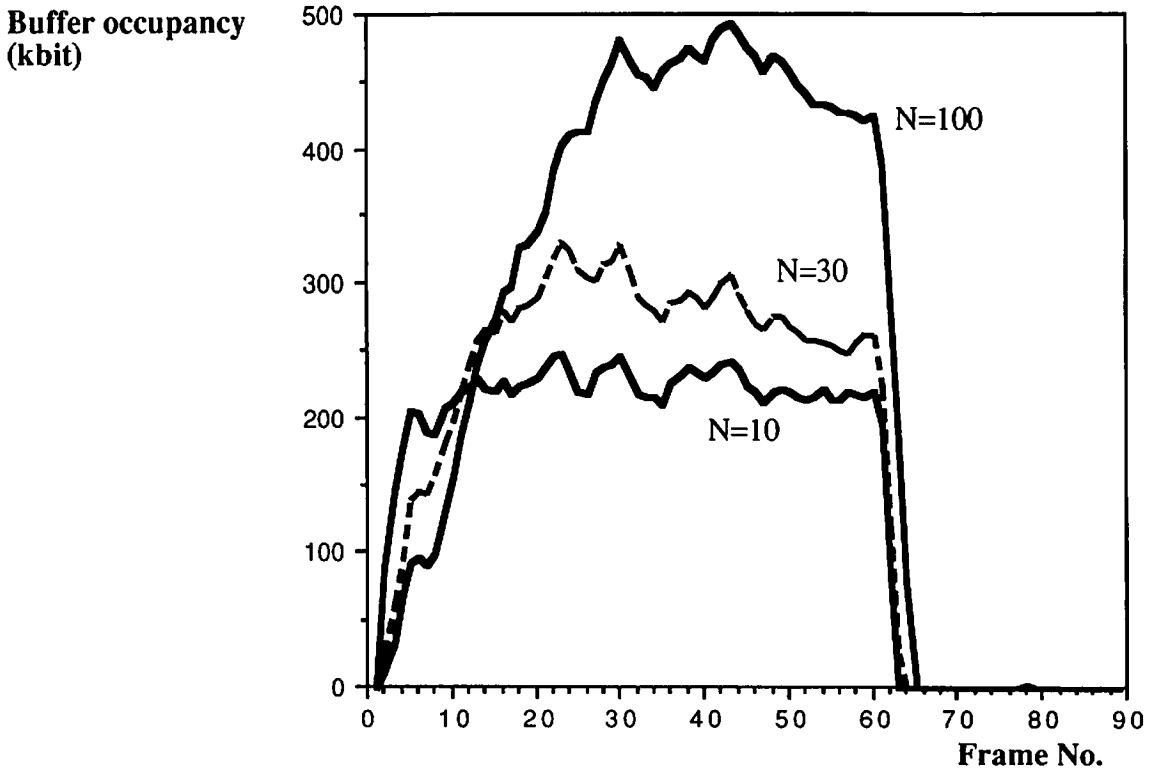


Fig. 2 (b) Transition of the BOC

ANNEX

Average Rate Control Mechanism

In this system, the average rate is controlled by changing the quantizer step size (Q). The Q selecting algorithm for the rate convergence is based on feedback control using the coding results of the previous frames, which is denoted as follows.

$Q_n = Q_{n-1} + \Delta Q$

$\Delta Q = a \cdot (I_{n-1} - I_0) + b \cdot (I_f - I_0)$

where

ΔQ : differential of Q

a, b : sensitivity constants

I_0 : target value of output amount per rate control unit
(ex. GOB as rate control unit)

I_{n-1} : output amount of previous rate control unit

n : number of currently coded rate control unit

I_v : average of output amount per rate control unit so far $= \sum_{i=1}^{n-1} \frac{I_i}{n-1}$

I_f : target value of output amount in the next N rate control units

$= \frac{1}{N} \{ I_0 \cdot (n-1+N) - \sum_{i=1}^{n-1} I_i \}$

(a target value to make the average of n-1+N rate control units equal to I_0)

N : parameter for rate convergence speed

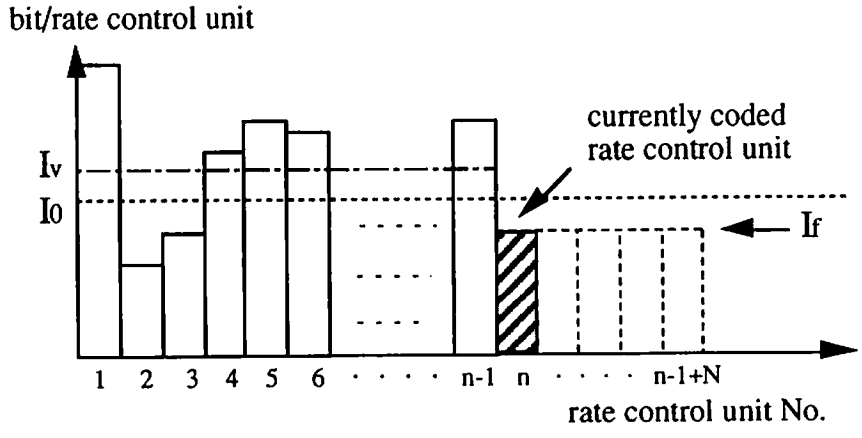


Fig. 3 Coding output amount and target values