Telecommunication Standardization Sector
Study Group 15
Experts Group for ATM Video Coding
(Rapporteur's Group on Part of Q.2/15)

Document AVC-462
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SOURCE : Japan
TITLE : VBR Coding under Usage Parameter Control (Part 2)
PURPOSE : Information

1. Introduction

This document is a sequel to AVC-372 [1] and reports hardware experimental results on VBR coding using Leaky Bucket as a method for Usage Parameter Control.

The relationship between the encoder buffer delay and the Leaky Bucket Size is newly reported. Some supplementary data are also presented concerning the picture quality vs. the Leaky Bucket Size.

2. Experiment Parameters

The same as in [1].

- Coding Algorithm
  - H.261
- Picture Format and Picture Sequence Length
  - two CIF sequences of 10 minutes (18,000 frames) duration
- UPC method
  - Peak Bitrate : 6Mbps or 3Mbps
  - Average Bitrate and control method: 1.5Mbps or 1.0Mbps with Leaky Bucket Control
  - Bucket Size: max 24bit, 16.38M Octet
  - Max duration for Peak rate: typ. 30 sec
    (e.g., =16.38M Octet x 8 / (6Mbps-1.5Mbps))
- Coding parameters control method
  - VBR mode (if Leaky Bucket Occupancy $\leq$ 90% of Leaky Bucket Size)
    $\Longrightarrow$ Constant Quantizer Stepsize and Constant Picture Quality.
  - CBR mode (otherwise)

Figure 1 shows the configuration of the experimental hardware.

3. Experiment Results

3.1 Average stepsize vs. Leaky Bucket Size

Figure 2 shows the relathionship between quantizer stepsize averaged over a 10 min sequence and the Leaky Bucket Size.

(Note that the Leaky Bucket Size in Figure 2 is shown by its actual size in Octet. The rightmost point corresponds to the Leaky Bucket Size of 30/90/27 sec for the cases Peak/Average Bitrate of (6/1.5) / (3/1.5) / (6/1) Mbps, respectively.

3.2 Peak Encoder Buffer Occupancy vs. Leaky Bucket Size

Table 1 shows the relationship between Peak Encoder Buffer Occupancy, which is the measured peak value of the instantaneous encoder buffer occupancy observed during a 10 min experiment, and Leaky Bucket Size.

Table 1: Peak Encoder Buffer Occupancy vs. Leaky Bucket Size

Peak/	Leaky Bucket Size (sec)						
Average rate	30	10	3	1	0.3	0.1	unit
6/1.5Mbps	127	127	124	126	141	127	kbit
(Delay)	(21.2)	(21.2)	(20.7)	(21.0)	(23.5)	(21.0)	msec
3/1.5Mbps	186	186	196	186	195	196	kbit
(Delay)	(62.0)	(62.0)	(65.3)	(62.0)	(65.0)	(65.3)	msec

(Note that the Leaky Bucket Size in Table 1 is represented by the time period during which Peak Rate can continuously be maintained. (eg., (6Mbps – 1.5Mbps) * 30sec = 16.38M Octet is the actual buffer size.) Also note that the actual buffer size in Octet differs three times for the two cases, (6Mbps – 1.5Mbps) : (3Mbps – 1.5Mbps) = 3 : 1), even though they are given the same values in sec.)

3.3 Bitrate, etc. vs. Time

Figures 3 and 4 show

- Top Figure
  - Bitrate averaged over 1 sec (Solid Line)
  - Leaky Bucket Occupancy (Dotted Line)
- Middle Figure
  - Encoder Buffer Occupancy (Solid Line)
- Bottom Figure

– Quantizer stepsize (Solid Line)

vs. time.

4. Discussions

4.1 Average stepsize vs. Leaky Bucket Size

Figure 2 shows that the average stepsize also decreases only gradually as the Leaky Bucket Size is increased, showing no obvious solution for determining the optimum size of the Leaky Bucket.

This is to confirm the result already reported in [1], in which the advantage of VBR coding is measured by the percentage of the frames that are coded by VBR mode (i.e., using a small stepsize quantizer as if in a open-loop VBR operation),

4.2 Peak Encoder Buffer Occupancy vs. Leaky Bucket Size

Table 1 shows that with given Peak/Average Bitrate, the Leaky Bucket Size has only minor effect on peak encoder buffer occupancy.

The middle figures of Figs. 3 and 4, (i.e., Encoder Buffer Occupancy vs. Time), give some reasoning for this result showing that the peak encoder buffer occupancy is mostly observed as an isolated impulse shaped peak and that the increase of the averaged value of the occupancy observable when the Leaky Bucket Size is decreased does not produce large effect on the height of the impulse.

In Table 1 the Peak Encoder Buffer Occupancy is also shown as Delay in msec assuming that the Peak Bitrate can always be maintained to empty the encoder output buffer.

In the experiment, with the control method described above, the leaky bucket never reached its full capacity, and this was actually the case.

5. Conclusion

The relationship between the encoder buffer delay and the UPC parameters is experimentaly examined.

It is observed that apart from the obvioius relationship (e.g., encoder buffer delay is inversely proportional to the Peak Bitrate) Leaky Bucket Size does not have critical effect on encoder buffer delay.

END

References

1. AVC–372, "VBR Coding under Usage Parameter Control," Japan, Oct. 1992.

(Seven more pages, pp. 4–10, follow as Figures.)

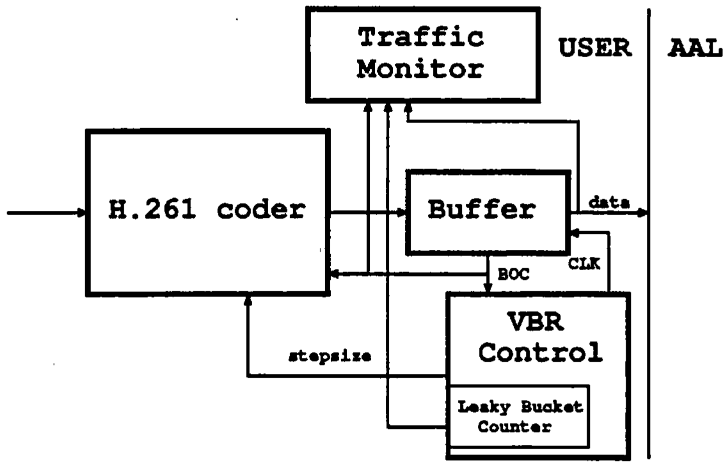


Figure 1: Experimental VBR coder configuration.

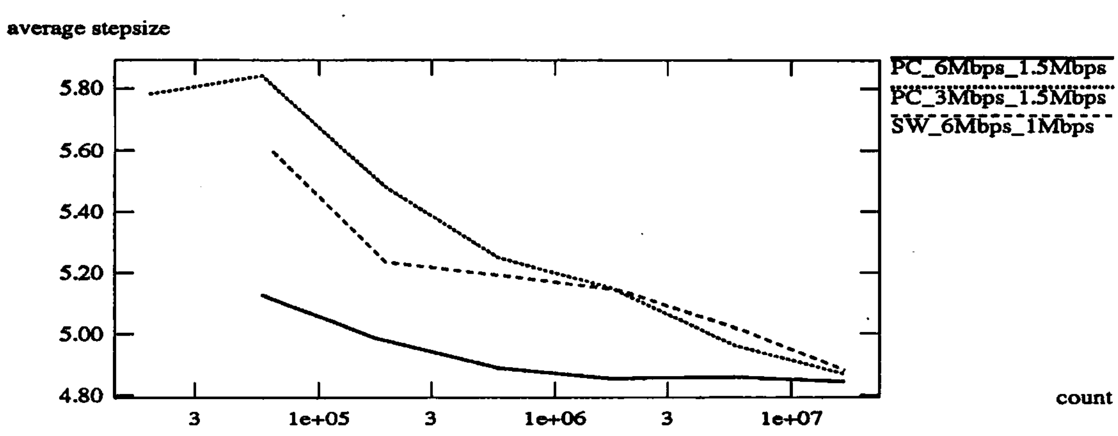
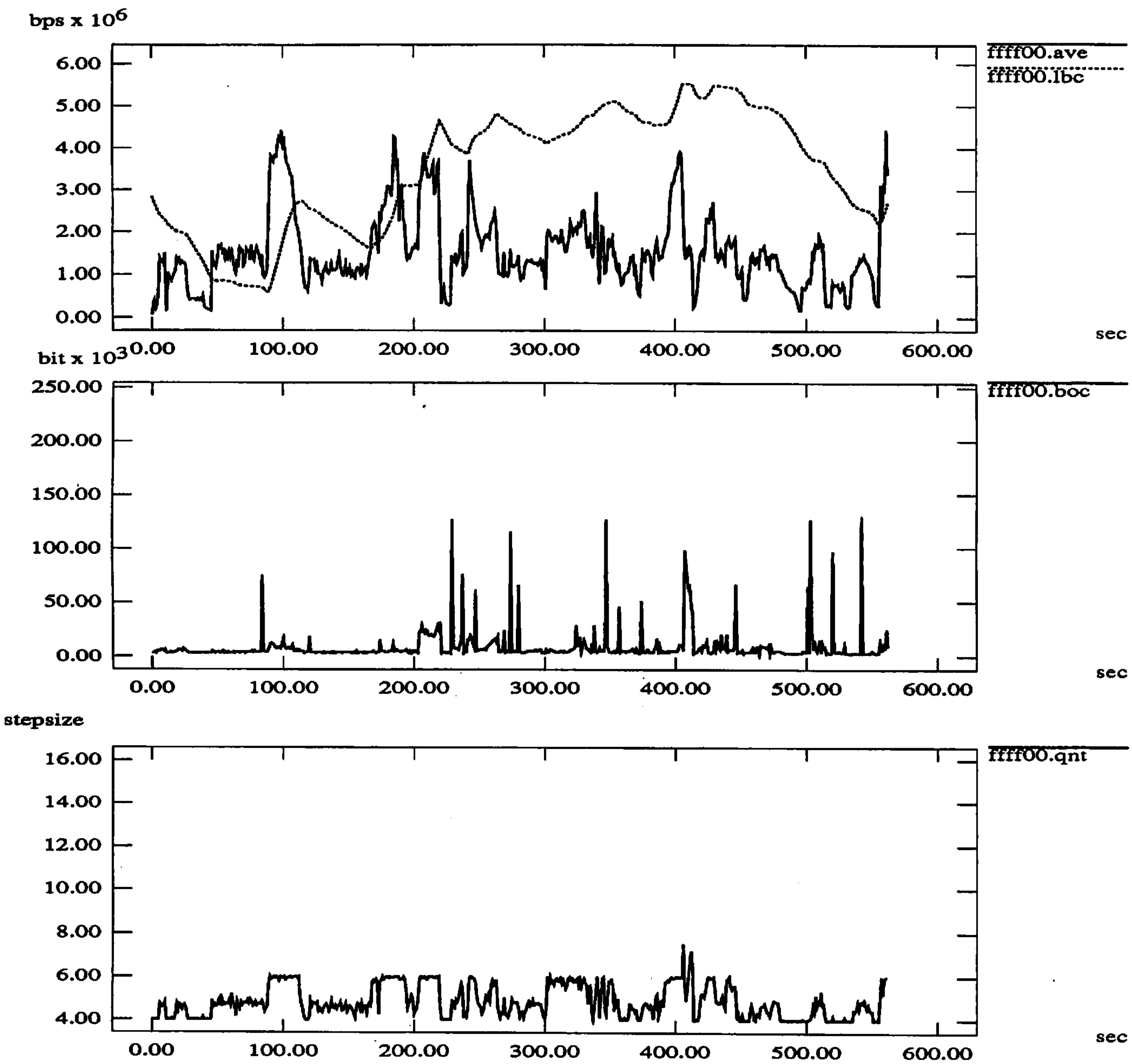
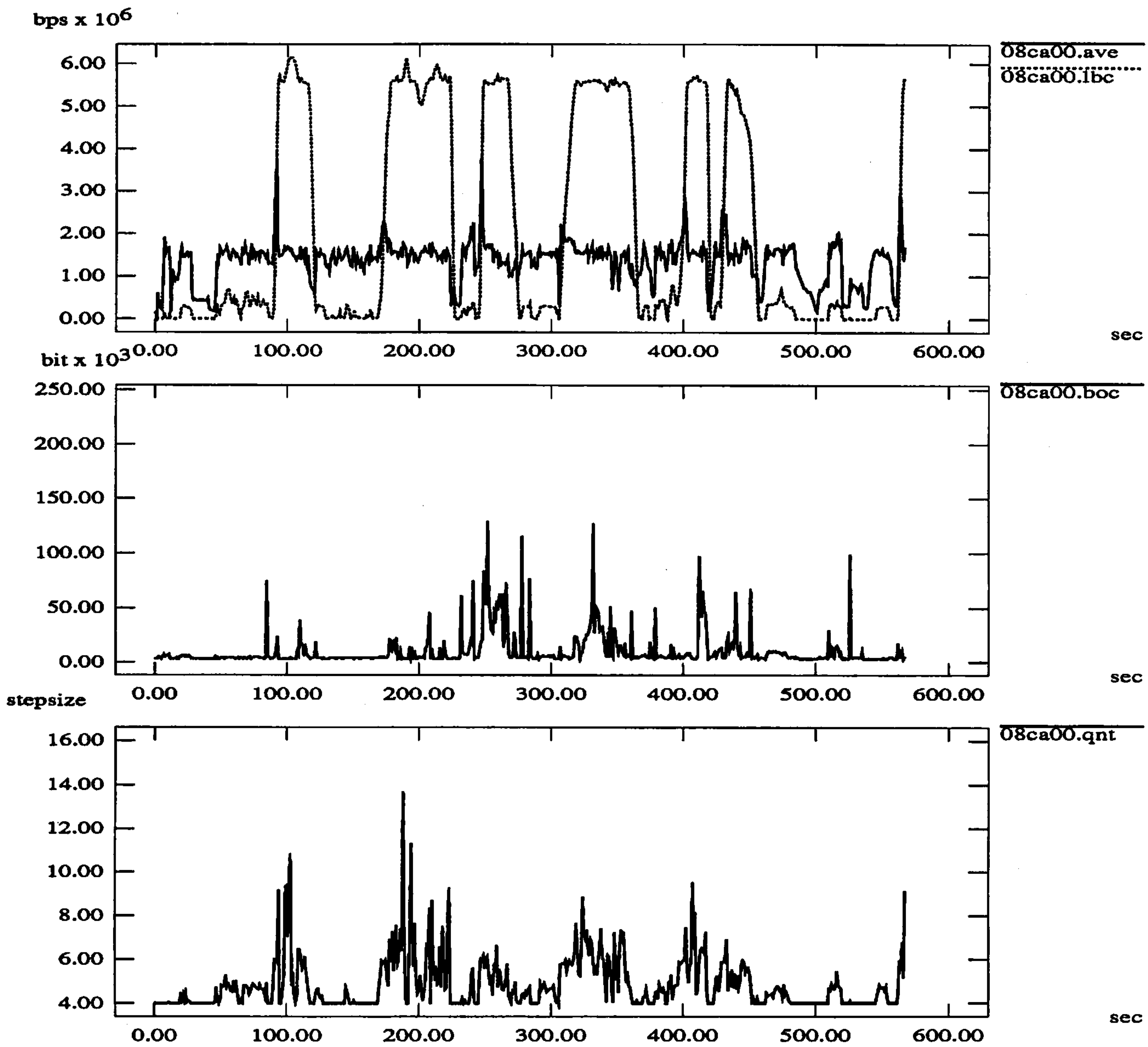


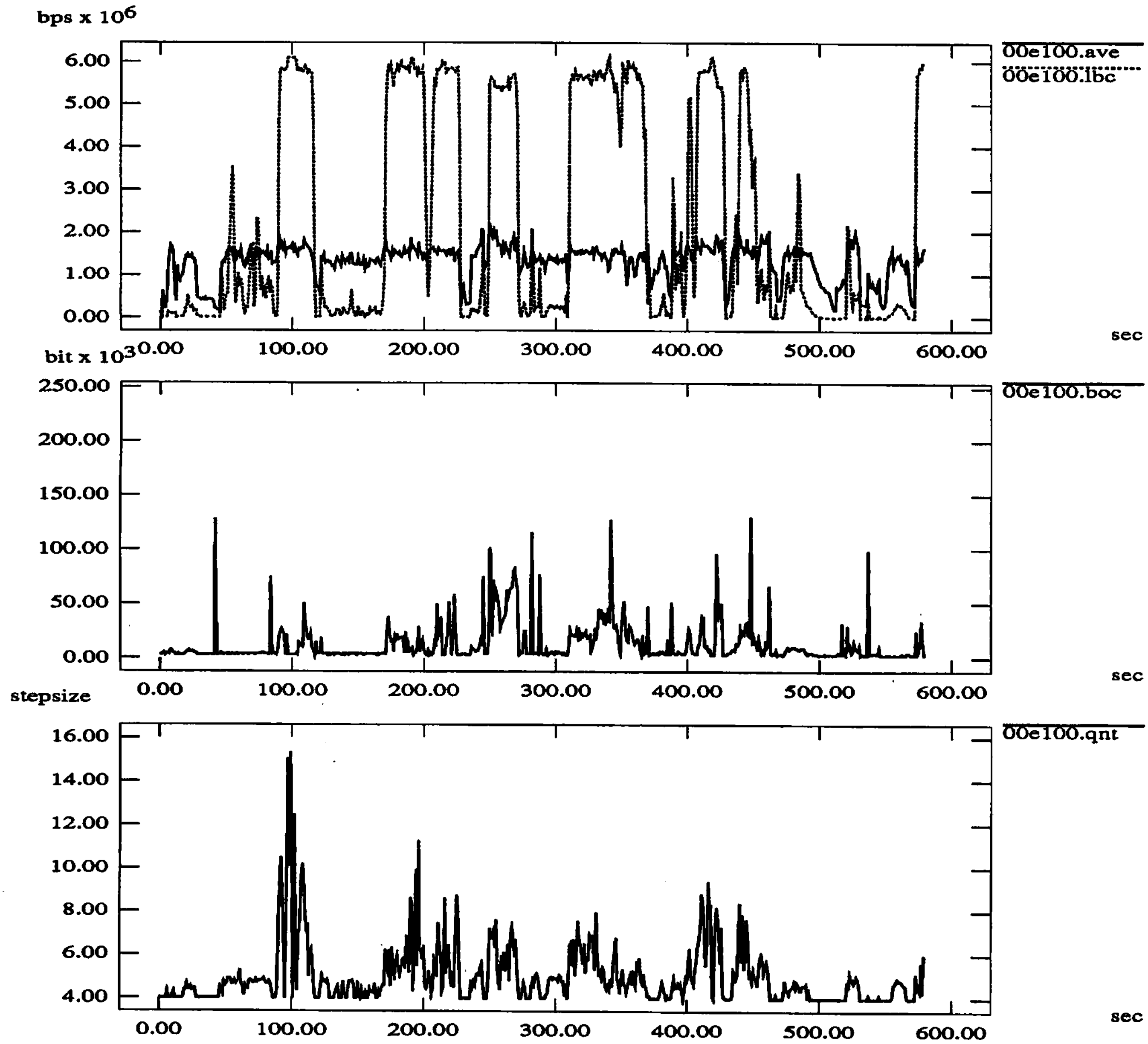
Figure 2: Average stepsize for different Leaky Bucket Counter sizes



(a) LBC size = 30 sec

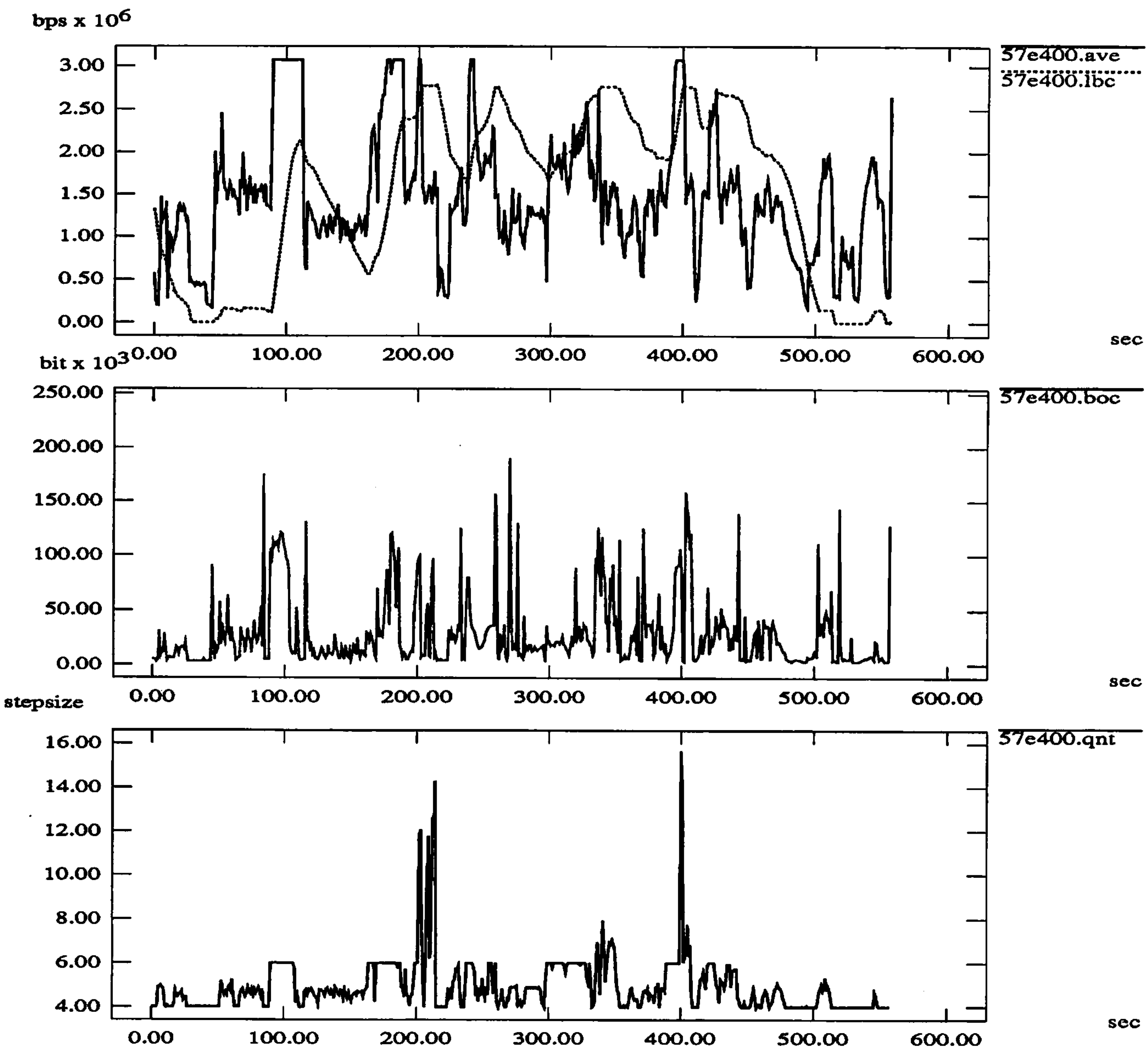


(b) LBC size = 1 sec

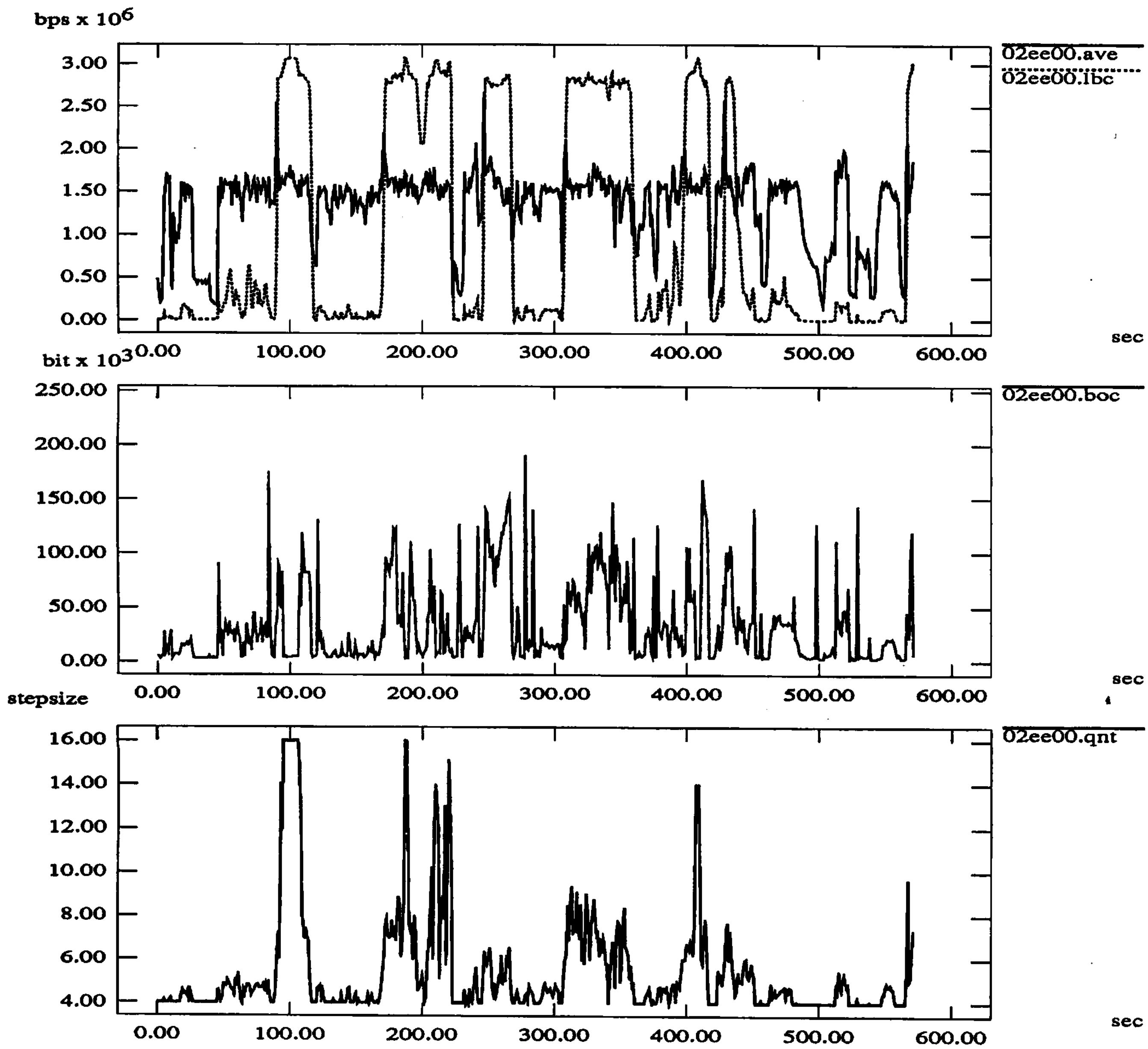


(c) LBC size = 0.1 sec

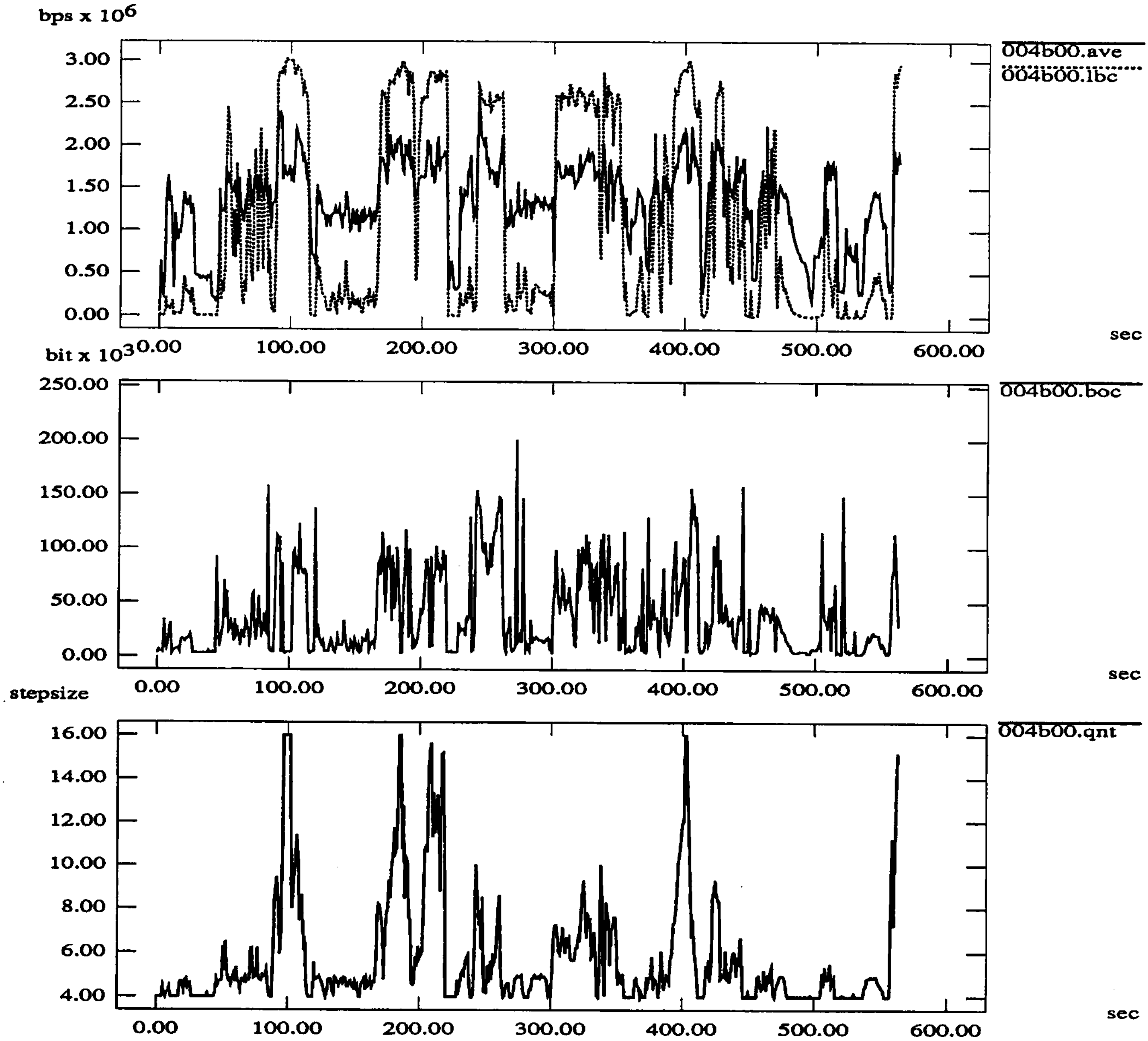
Figure 3: Every one second averaged bitrate, LBC transition, buffer occupancy and stepsize on a sequence with Peak/Average Bitrate of 6Mbps/1.5Mbps.



(a) LBC size = 30 sec



(b) LBC size = 1 sec



(c) LBC size = 0.1 sec

Figure 4: Every one second averaged bitrate, LBC transition, buffer occupancy and stepsize on a sequence with Peak/Average Bitrate of 3Mbps/1.5Mbps.