SOURCE : Japan
TITLE : VBR Coding under Usage Parameter Control
PURPOSE : Information

1. Introduction

This document reports a hardware experiment on VBR coding under Usage Parameter Control.

2. Experiment Parameters

- Coding Algorithm

  - H.261

- Picture Format and Picture Sequence Length

  - CIF and 10 minutes (18,000 frames)

- UPC method

  - Peak rate control: 6Mbps

  - Average rate control: 1.5Mbps with Leaky Bucket Control

  - Bucket Size: max 24bit, 16.38M Octet

  - Max duration for Peak rate: 30 sec (=16.38M Octet x 8 / (6Mbps-1.5Mbps))

- Coding parameters control method

  - VBR mode (if Leaky Bucket Occupancy $\leq$ 90% of Leaky Bucket Size)
    $\implies$ Constant Quantizer Stepsize and Constant Picture Quality.

  - CBR mode (otherwise)

Figure 1 shows the configuration of the experimental hardware.

3. Experiment Results

Experimental results are shown in Table 1 and in Figures 2 and 3 for various values of Leaky Bucket size ranging from 0sec to 30sec.

- 1 -

Sequence ID	Leaky Bucket Size						
	0 sec	0.1 sec	0.3 sec	1 sec	3sec	10 sec	30 sec
-A-	0%	77.1%	76.4%	80.1%	86.7%	91.5%	99.4%
-B-	0%	79.2%	80.0%	82.5%	86.5%	90.6%	95.3%

Table 1   Percentage of frames coded by VBR mode

Table 1 shows the percentage of the frames that is coded by a VBR mode and thus resulting in *good* picture quality.

Figures 2 and 3 shows instantaneous bitrate (averaged over one second) by solid lines and leaky bucket occupancy (normalized by its full size) by dotted lines. Note that there is a *difficult* scene starting from time $\simeq$ 80 sec (most easily recognizable in Fig. 2 (a)), and the duration in which Peak Bitrate is used for that scene decreases as the Leaky Bucket Size decreases, thus implying failing to offer constant picture quality.

4.   Discussions

It is said that VBR coding can offer two distinct advantages, namely:

1. Realization of Constant Picture Quality Coding

2. Reduction of End-to-end delay time by (almost) eliminating encoder output buffer.

For the first advantage to be meaningful, the duration in which Peak Bitrate can be maintained must be longer than the duration of the *difficult* scenes. From Fig. 3, we see that the Leaky Bucket Size must be quite long (possibly as long as several tens of seconds, and prohibitively long for a newtwork designers' point of view) to allow Constant Picture Quality Coding for most of the time during a long video program.

For the second advantage, the Leaky Bucket Size should be only as large as conventional CBR coders' output buffer size, typically several frames in time. From Fig. 3, we see that the Leaky Bucket Size of 0.1 sec is almost as effective as that of 1 sec.

5.   Conclusion

This document reports a hardware experiment on VBR coding under Usage Parameter Control.
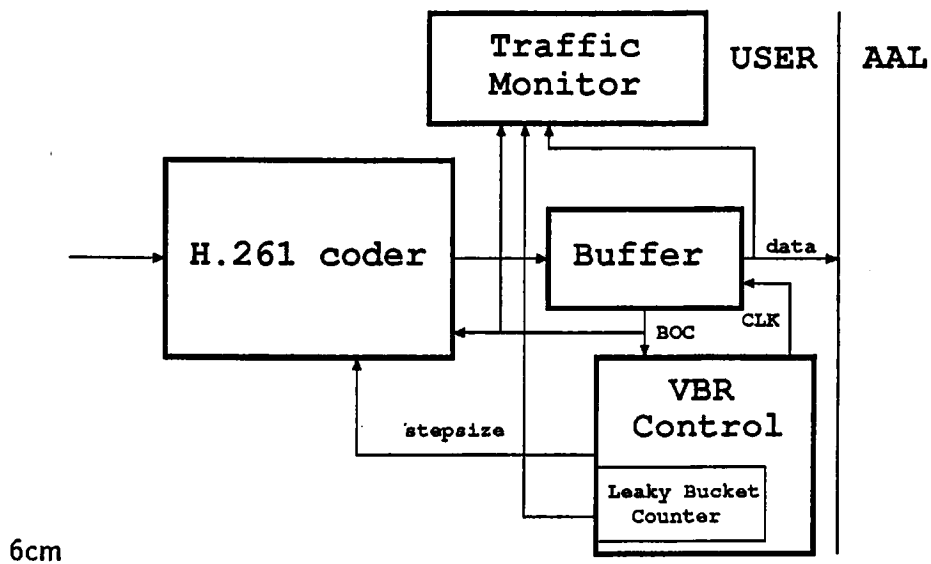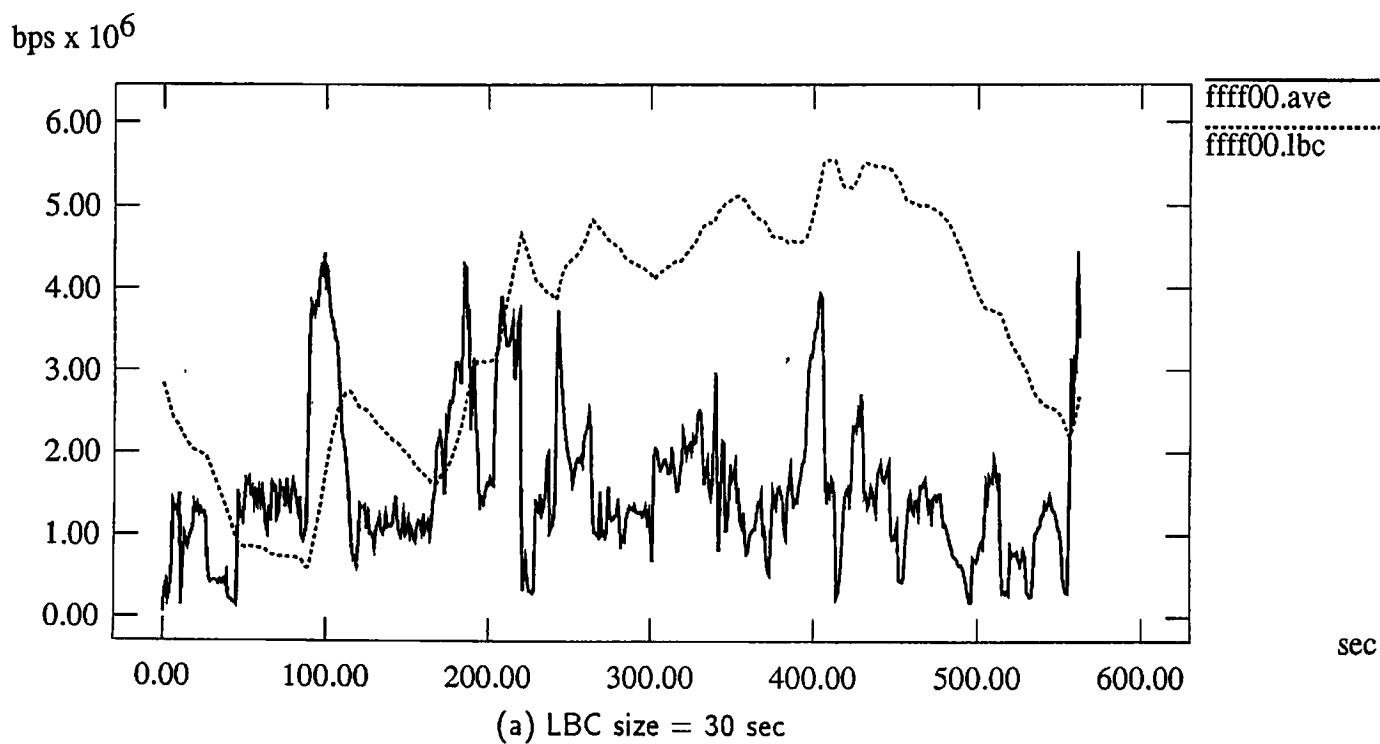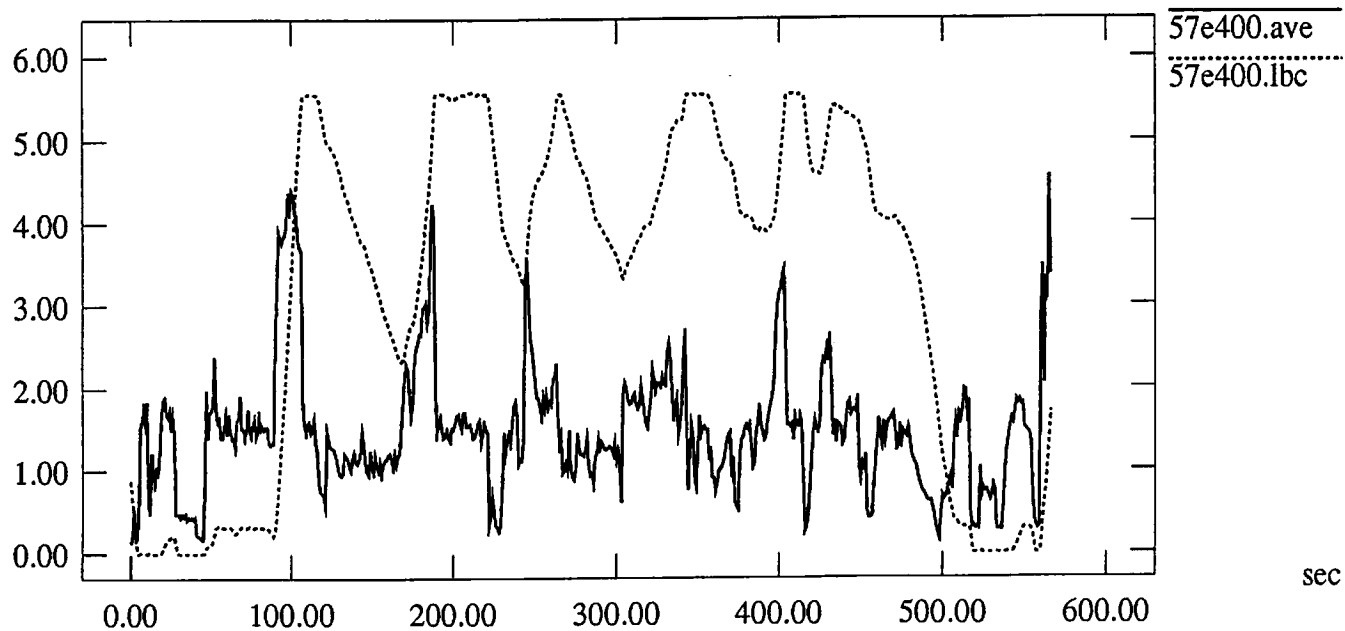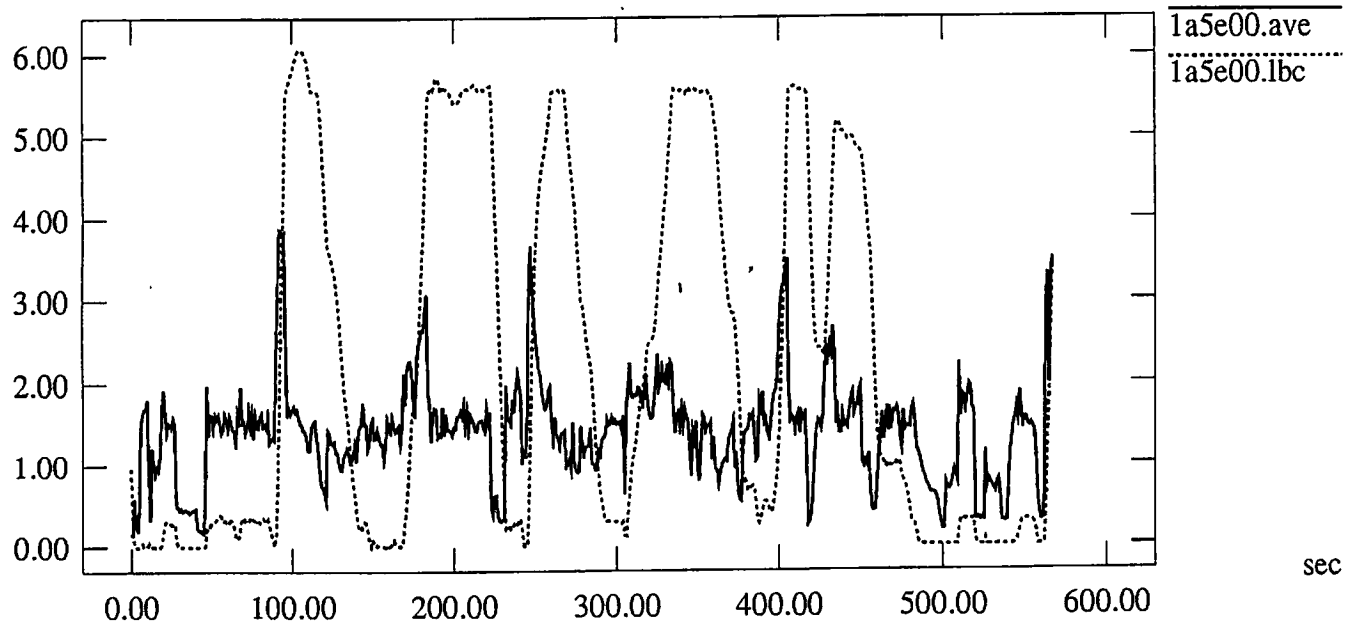
Figure 1: Experimental VBR coder configuration.

(a) LBC size = 30 sec

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bps x 10^6

57e400.ave
57e400.lbc

6.00

5.00

4.00

3.00

2.00

1.00

0.00

0.00   100.00   200.00   300.00   400.00   500.00   600.00

sec

(b) LBC size = 10 sec

bps x 10^6

1a5e00.ave
1a5e00.lbc

6.00

5.00

4.00

3.00

2.00

1.00

0.00

0.00   100.00   200.00   300.00   400.00   500.00   600.00

sec

(c) LBC size = 3 sec

- 4 -

bps x 10^6

08ca00.ave
08ca00.lbc

sec

(d) LBC size = 1 sec

bps x 10^6

02a300.ave
02a300.lbc

sec

(e) LBC size = 0.3 sec

bps x 10^6

(f) LBC size = 0.1 sec

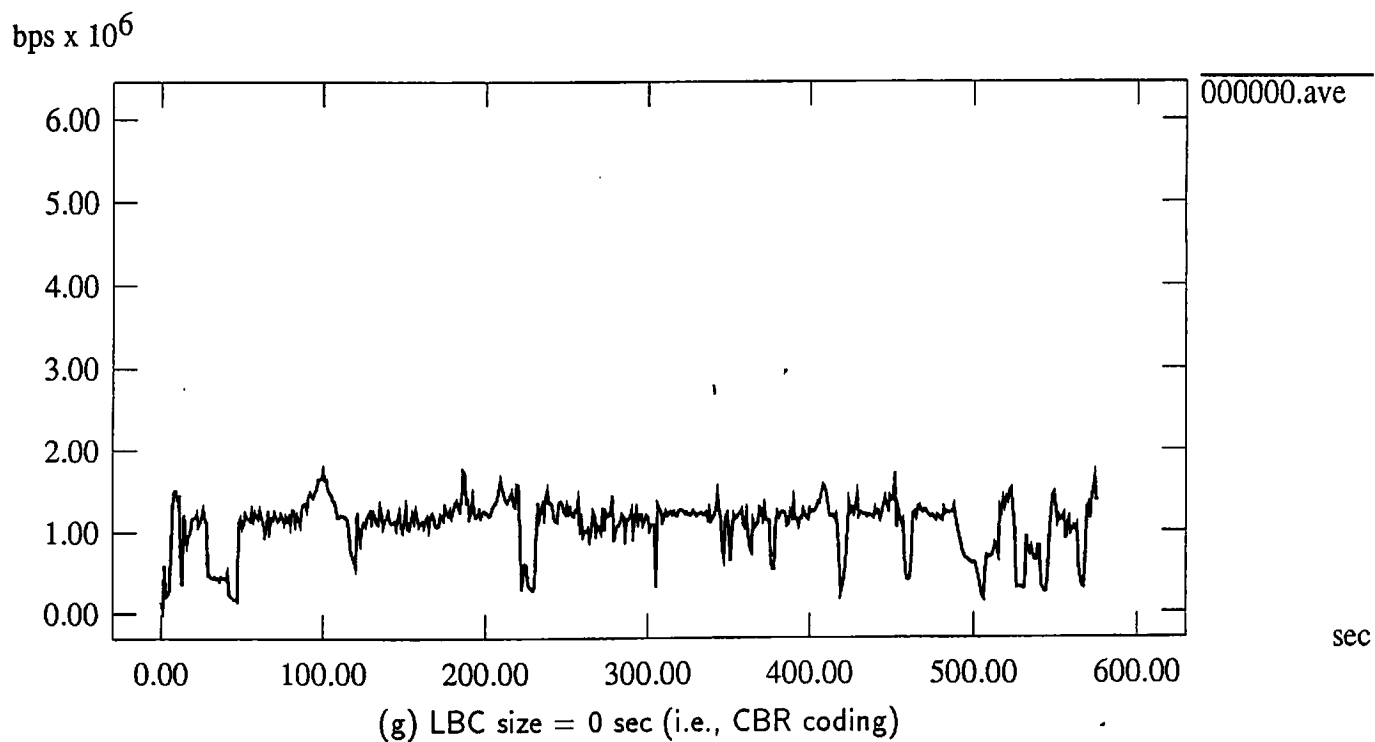bps x 10^6

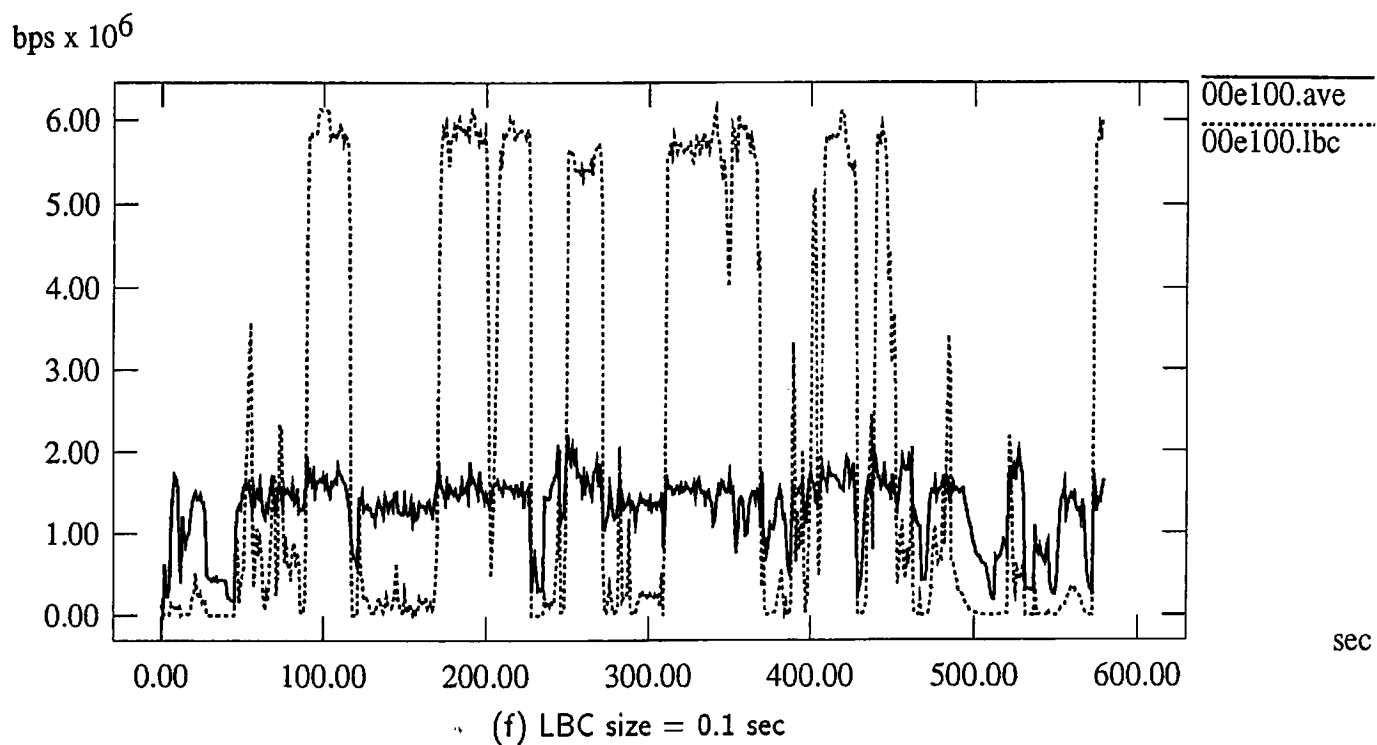(g) LBC size = 0 sec (i.e., CBR coding)
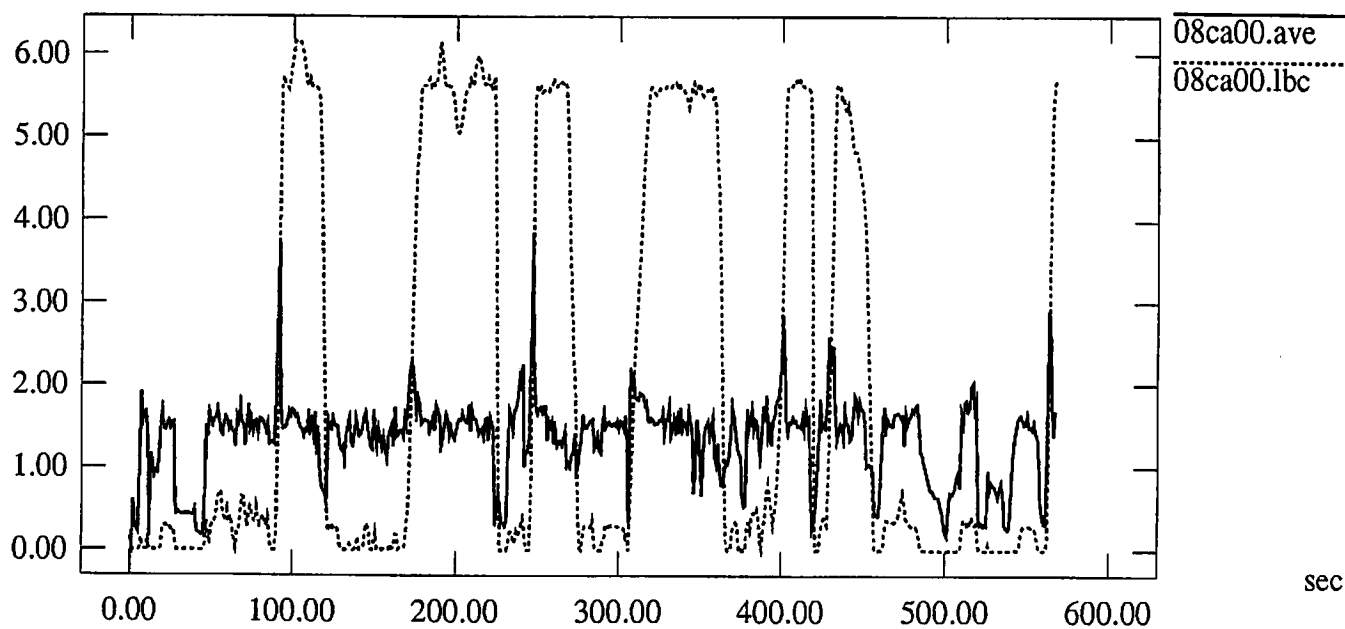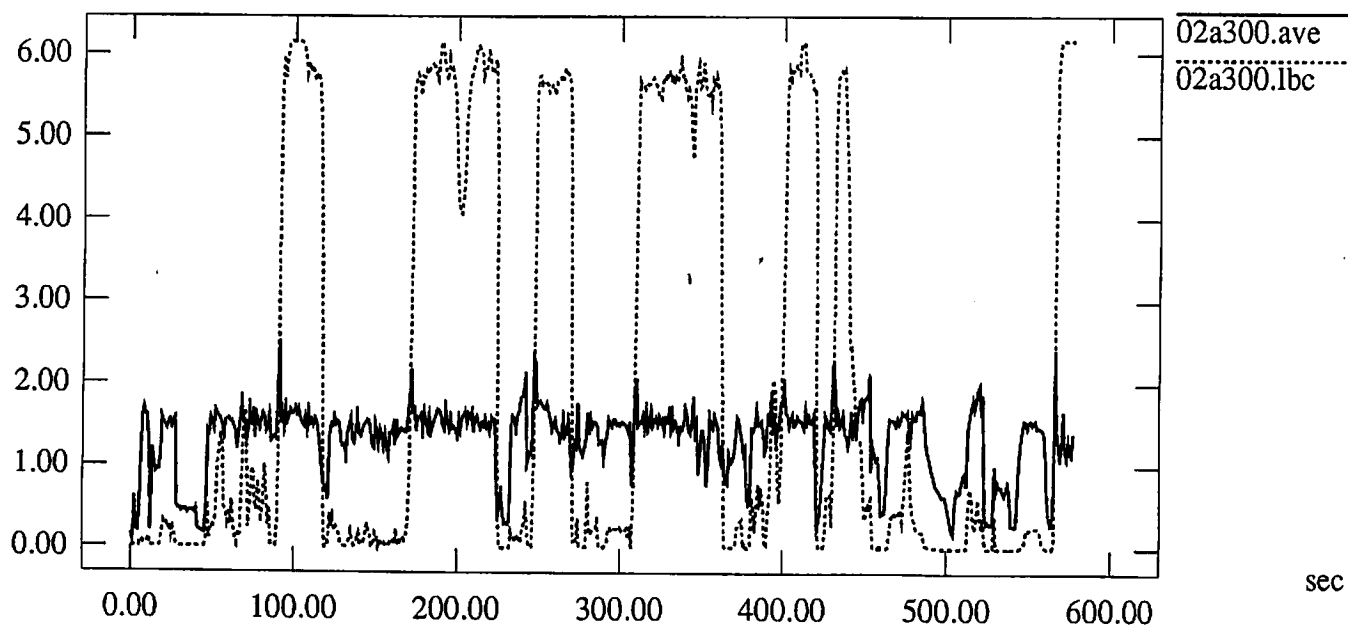
Figure 2: Every one second averaged bitrate and LBC transition on a sequence.
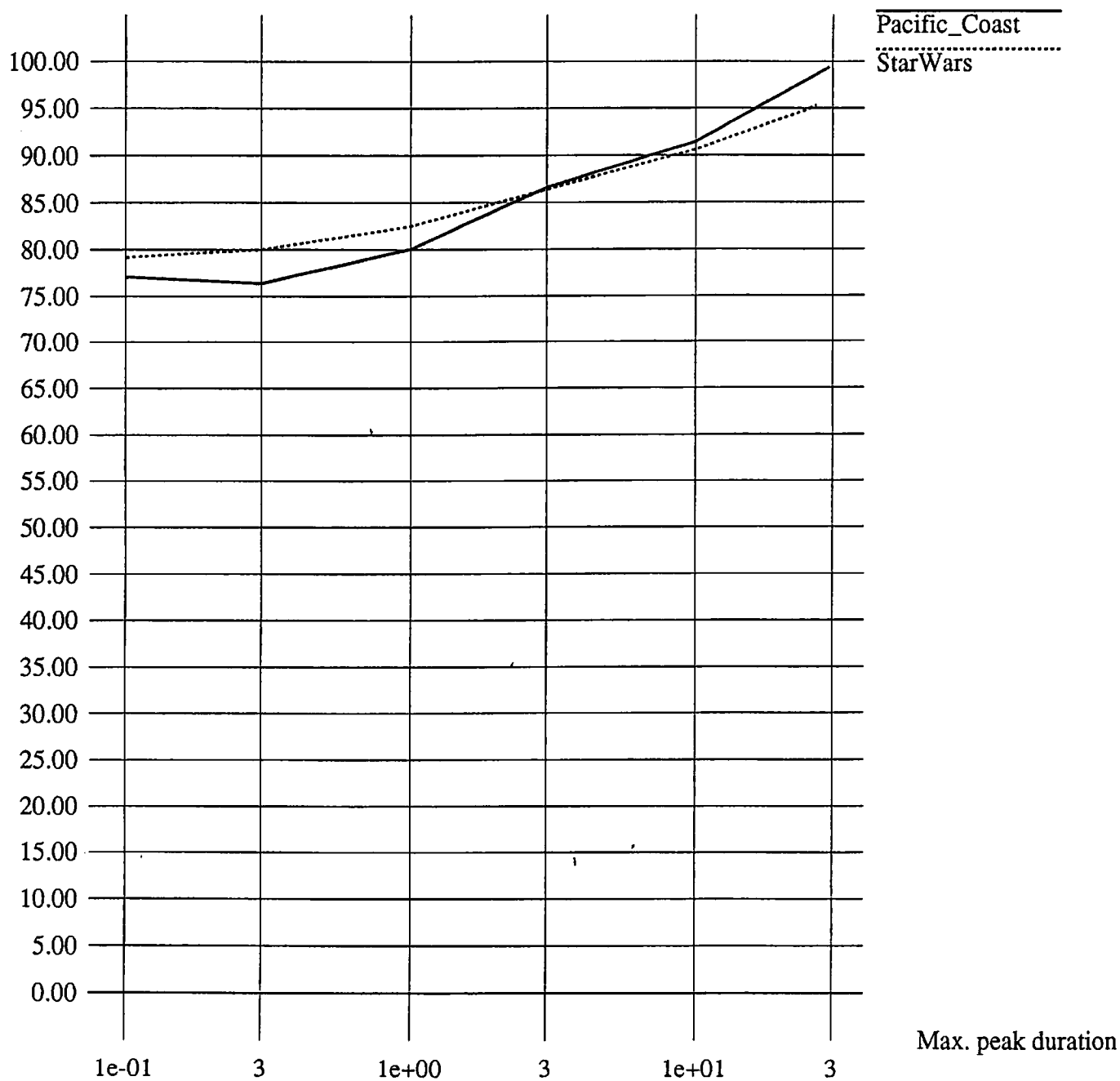
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Figure 3: Percentage of frames coded by VBR vs. Leaky Bucket Size.