7

MULTIMEDIA OPERATING SYSTEMS

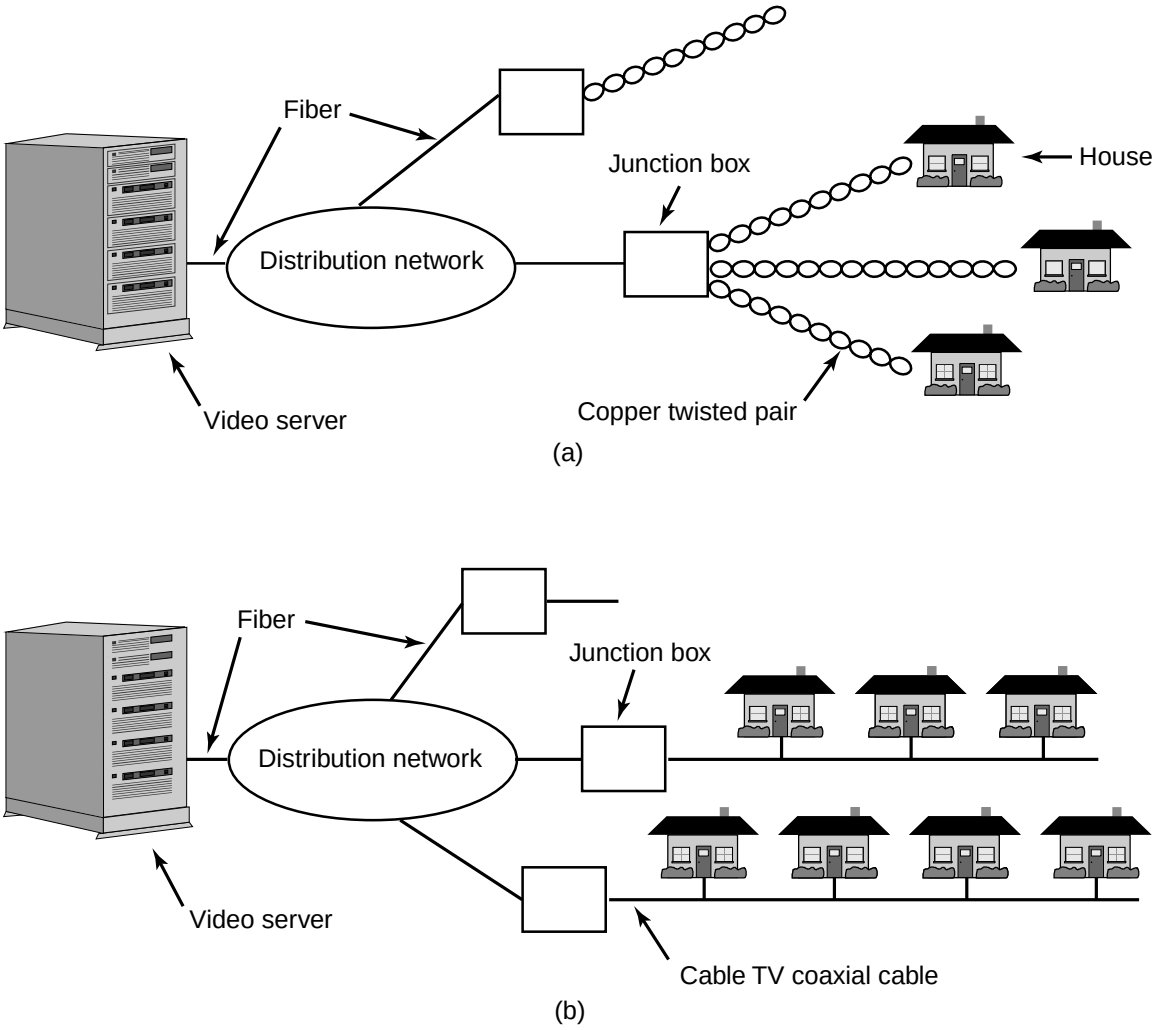

Fig. 7-1. Video on demand using different local distribution technologies. (a) ADSL. (b) Cable TV.

Source	Mbps	GB/hr
Telephone (PCM)	0.064	0.03
MP3 music	0.14	0.06
Audio CD	1.4	0.62
MPEG-2 movie (640×480)	4	1.76
Digital camcorder (720×480)	25	11
Uncompressed TV (640×480)	221	97
Uncompressed HDTV (1280×720)	648	288

Device	Mbps
Fast Ethernet	100
EIDE disk	133
ATM OC-3 network	156
SCSI UltraWide disk	320
IEEE 1394 (FireWire)	400
Gigabit Ethernet	1000
SCSI Ultra-160 disk	1280

Fig. 7-2. Some data rates for multimedia and high-performance I/O devices. Note that 1 Mbps is 10^6 bits/sec but 1 GB is 2^{30} bytes.

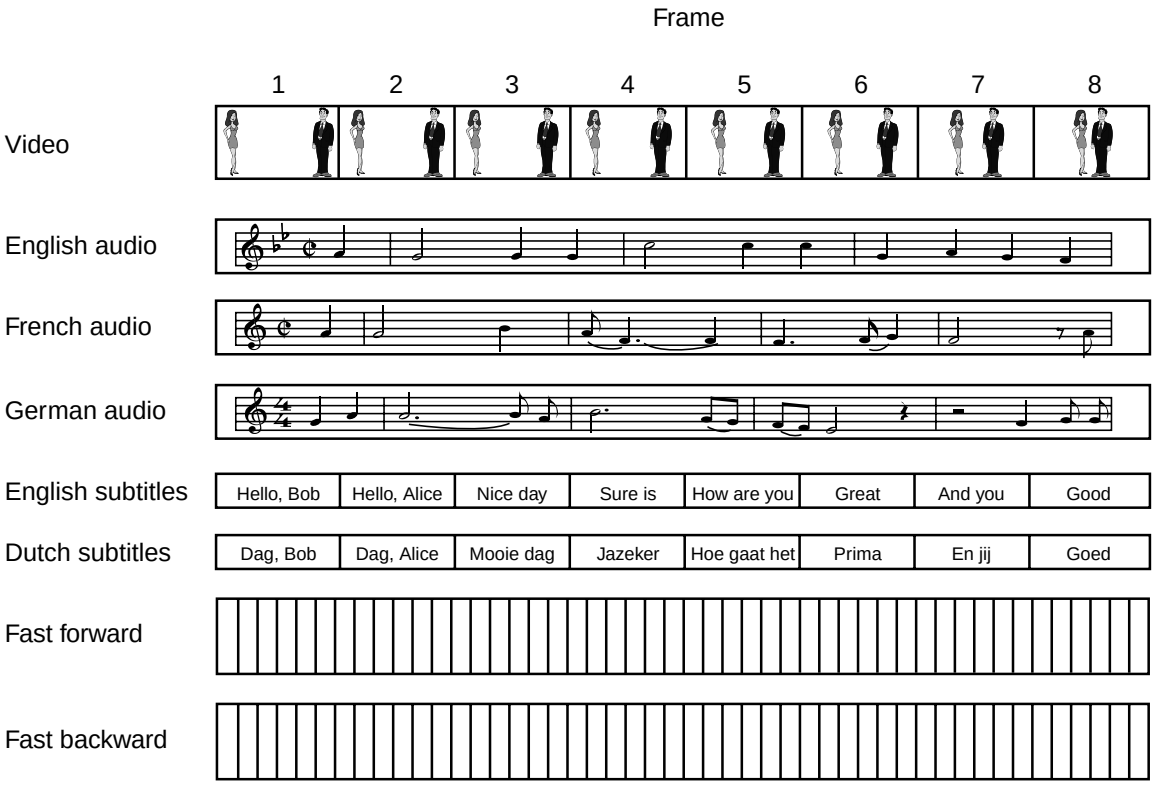

Fig. 7-3. A movie may consist of several files.

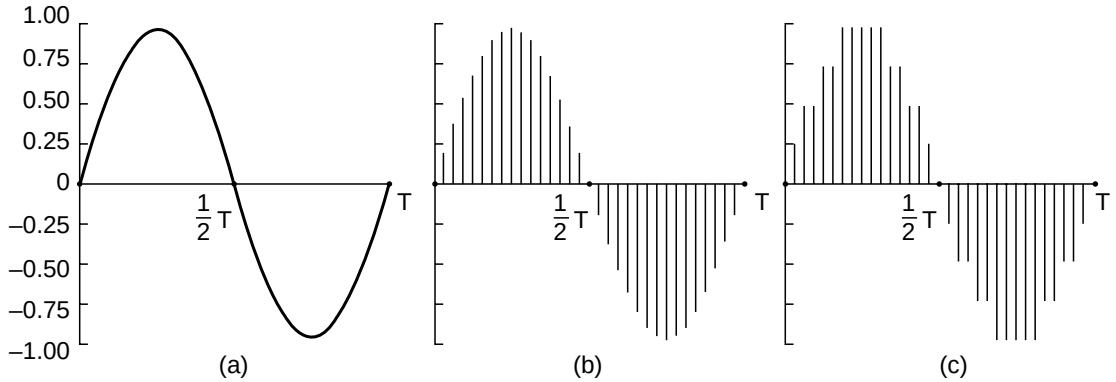

Fig. 7-4. (a) A sine wave. (b) Sampling the sine wave. (c) Quantizing the samples to 4 bits.

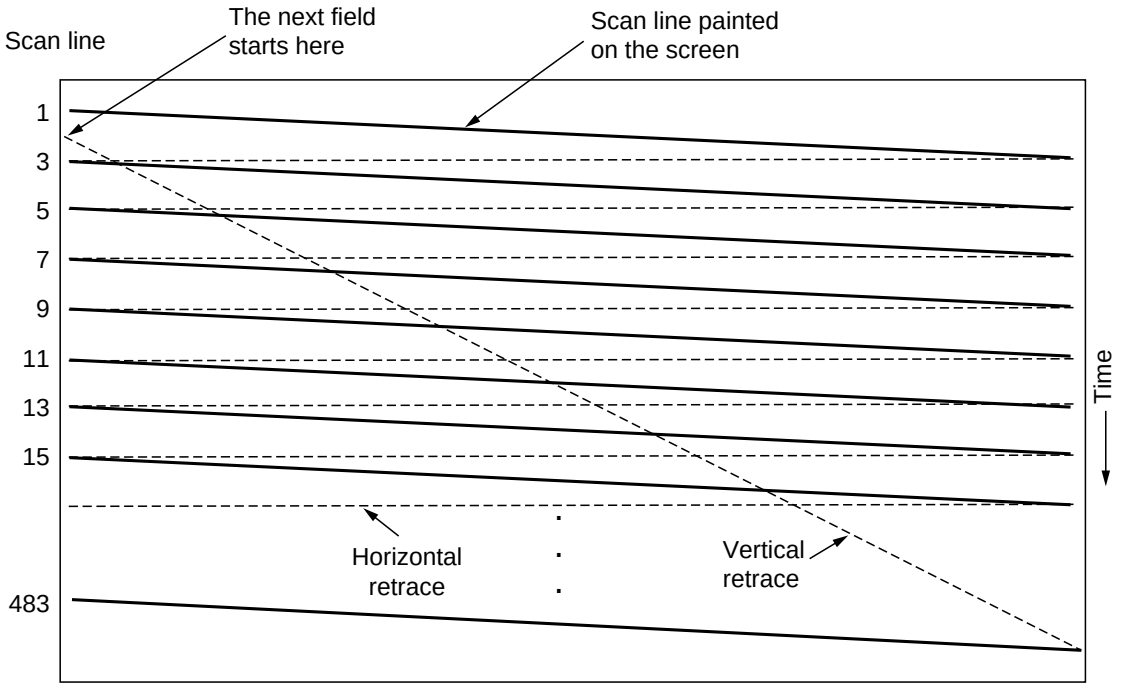

Fig. 7-5. The scanning pattern used for NTSC video and television.

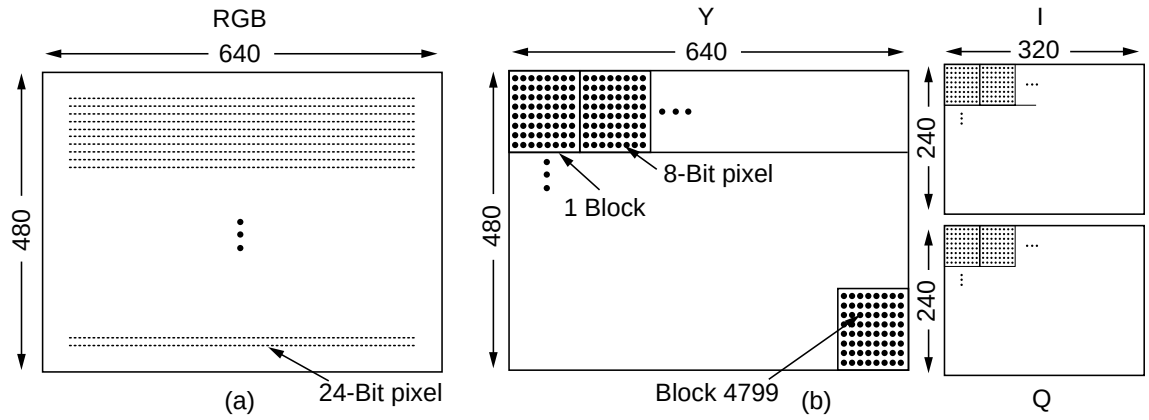

Fig. 7-6. (a) RGB input data. (b) After block preparation.

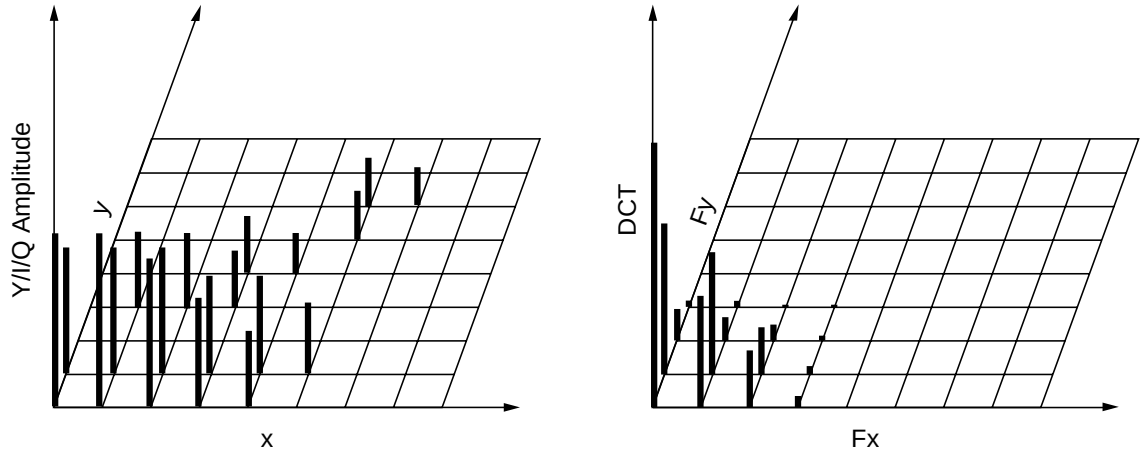

Fig. 7-7. (a) One block of the *Y* matrix. (b) The DCT coefficients.

DCT Coefficients

150	80	40	14	4	2	1	0
92	75	36	10	6	1	0	0
52	38	26	8	7	4	0	0
12	8	6	4	2	1	0	0
4	3	2	0	0	0	0	0
2	2	1	1	0	0	0	0
1	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0

Quantized coefficients

150	80	20	4	1	0	0	0
92	75	18	3	1	0	0	0
26	19	13	2	1	0	0	0
3	2	2	1	0	0	0	0
1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

Quantization table

1	1	2	4	8	16	32	64
1	1	2	4	8	16	32	64
2	2	2	4	8	16	32	64
4	4	4	4	8	16	32	64
8	8	8	8	8	16	32	64
16	16	16	16	16	16	32	64
32	32	32	32	32	32	32	64
64	64	64	64	64	64	64	64

Fig. 7-8. Computation of the quantized DCT coefficients.

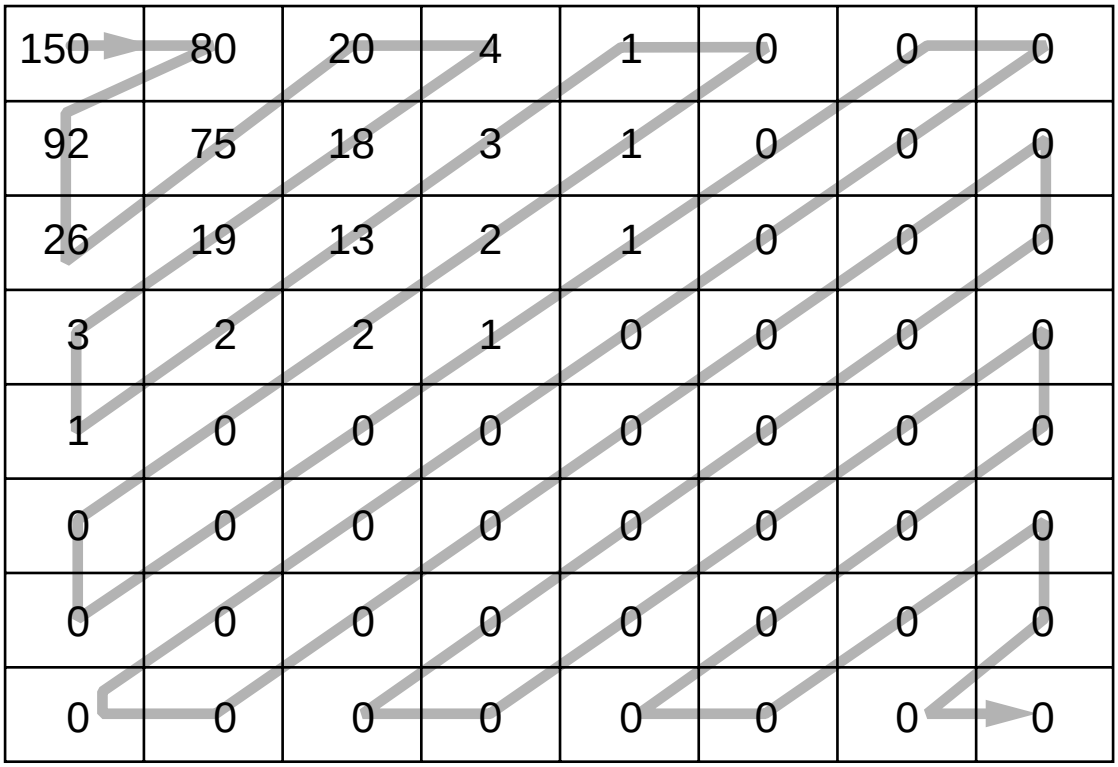

Fig. 7-9. The order in which the quantized values are transmitted.

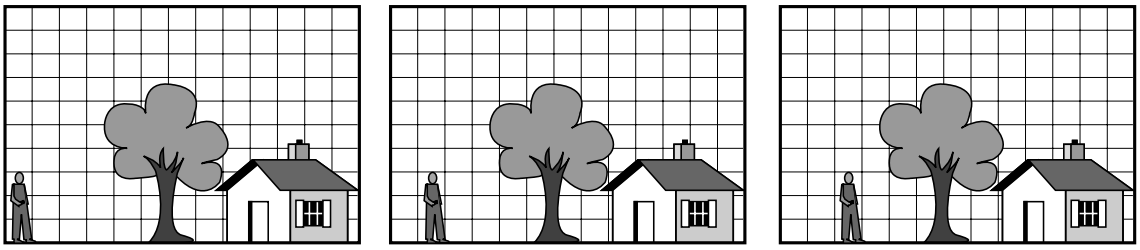

Fig. 7-10. Three consecutive video frames.

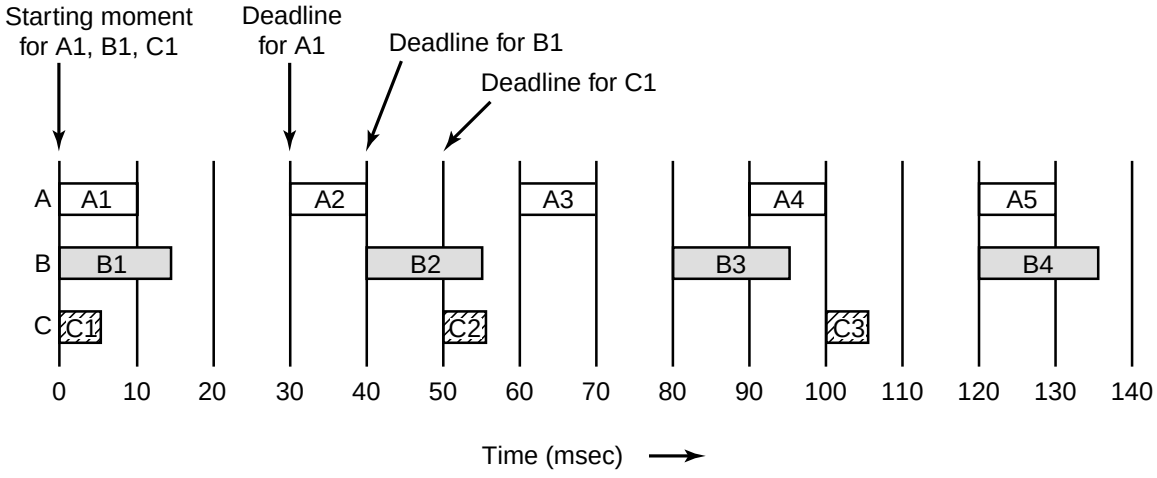

Fig. 7-11. Three periodic processes, each displaying a movie. The frame rates and processing requirements per frame are different for each movie.

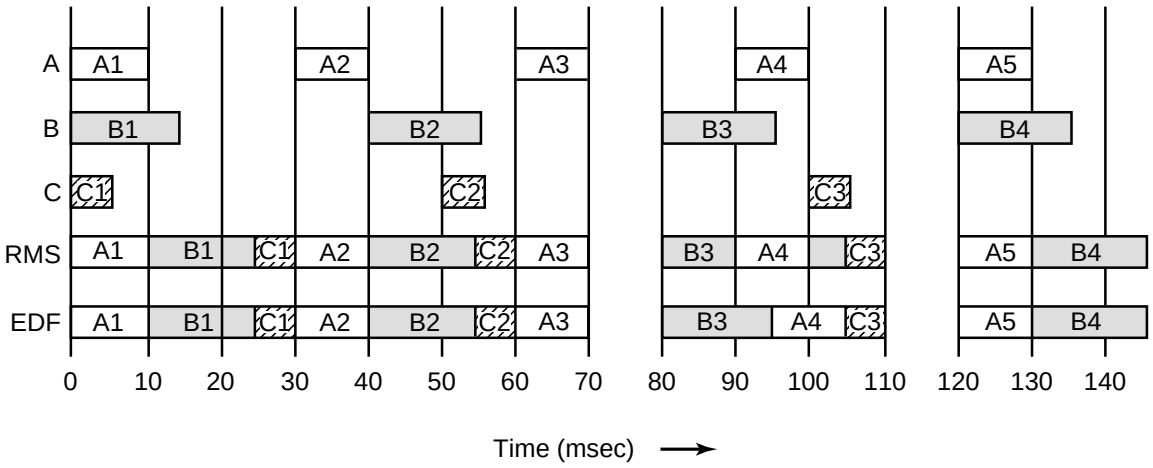

Fig. 7-12. An example of RMS and EDF real-time scheduling.

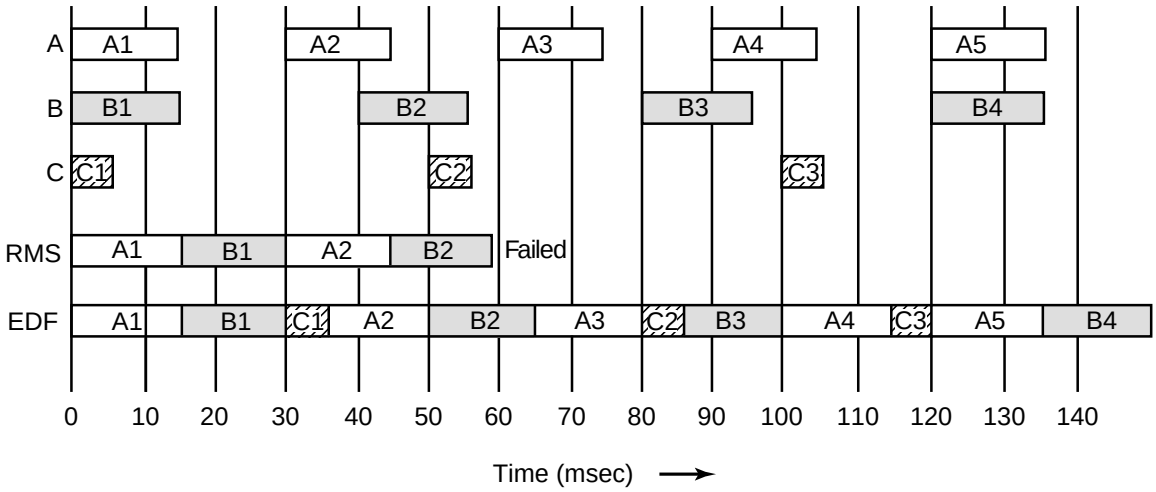

Fig. 7-13. Another example of real-time scheduling with RMS and EDF.

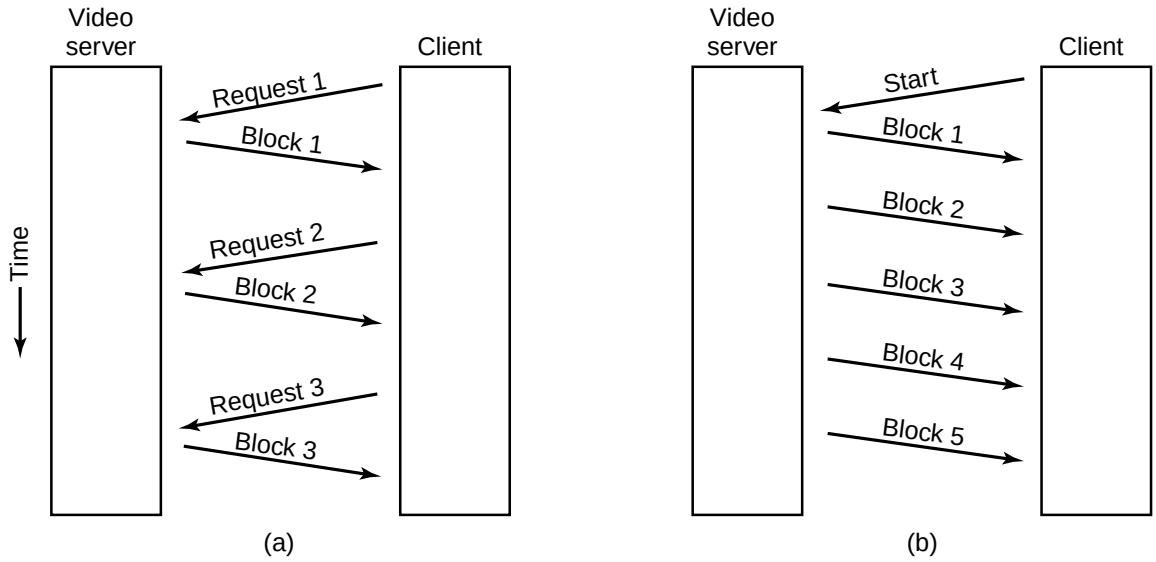

Fig. 7-14. (a) A pull server. (b) A push server.

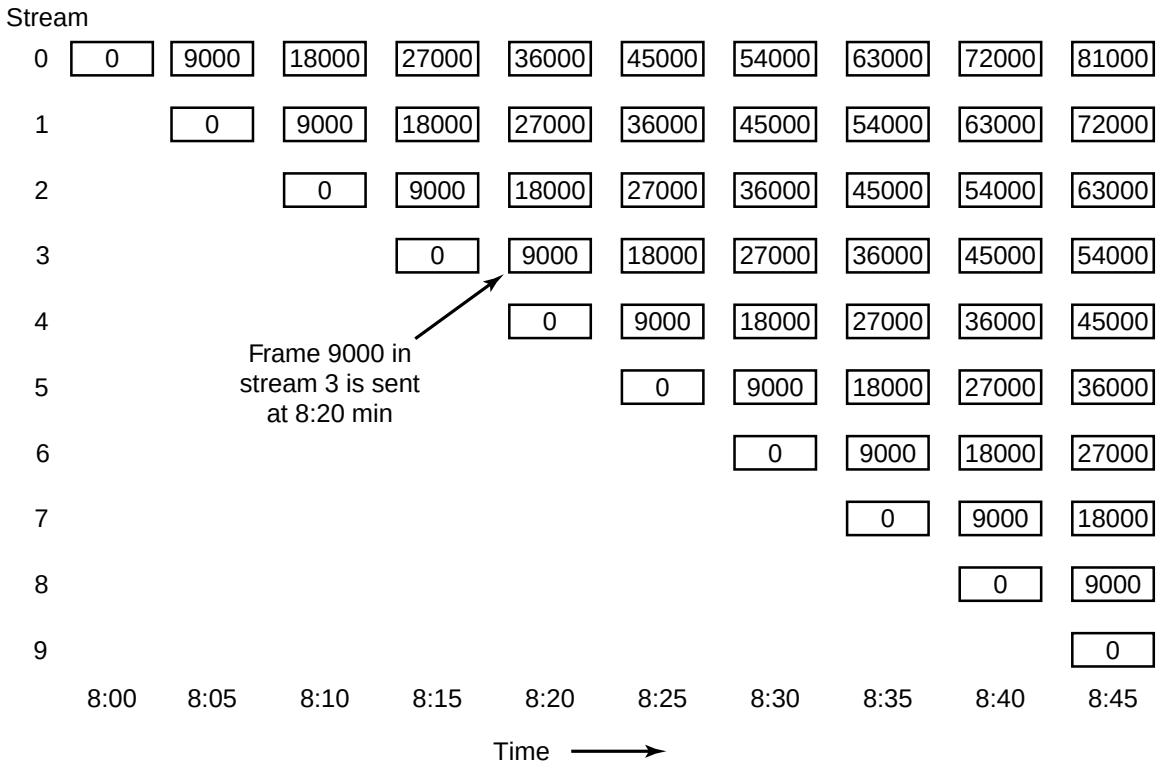

Fig. 7-15. Near video on demand has a new stream starting at regular intervals, in this example every 5 minutes (9000 frames).

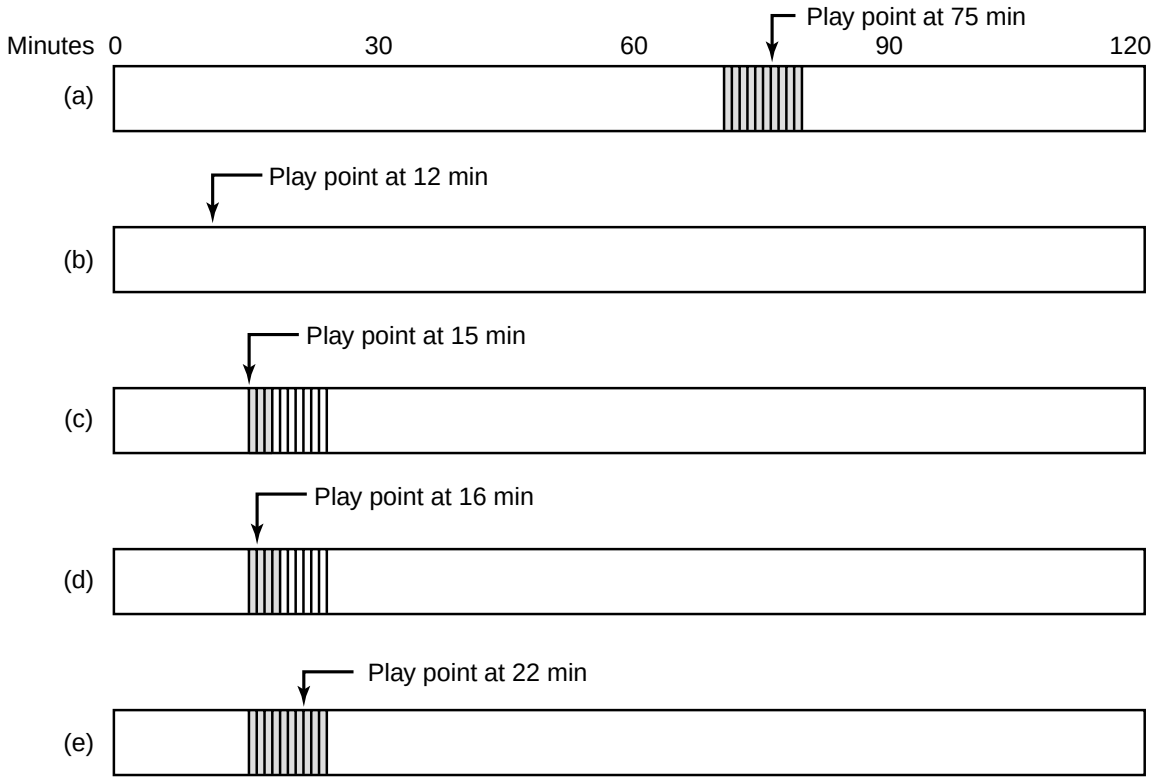

Fig. 7-16. (a) Initial situation. (b) After a rewind to 12 min. (c) After waiting 3 min. (d) After starting to refill the buffer. (e) Buffer full.

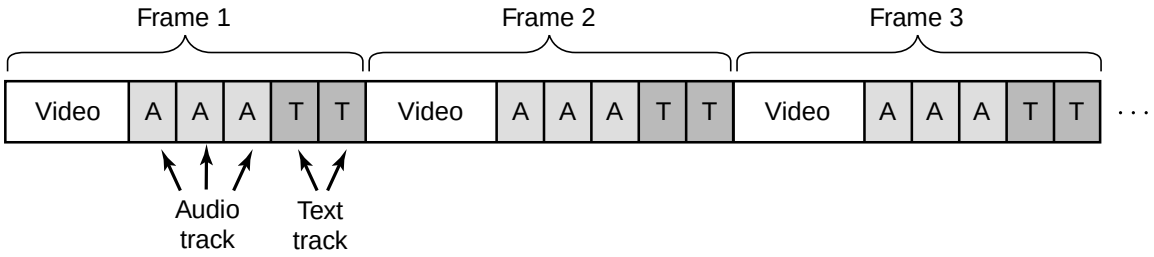

Fig. 7-17. Interleaving video, audio, and text in a single contiguous file per movie.

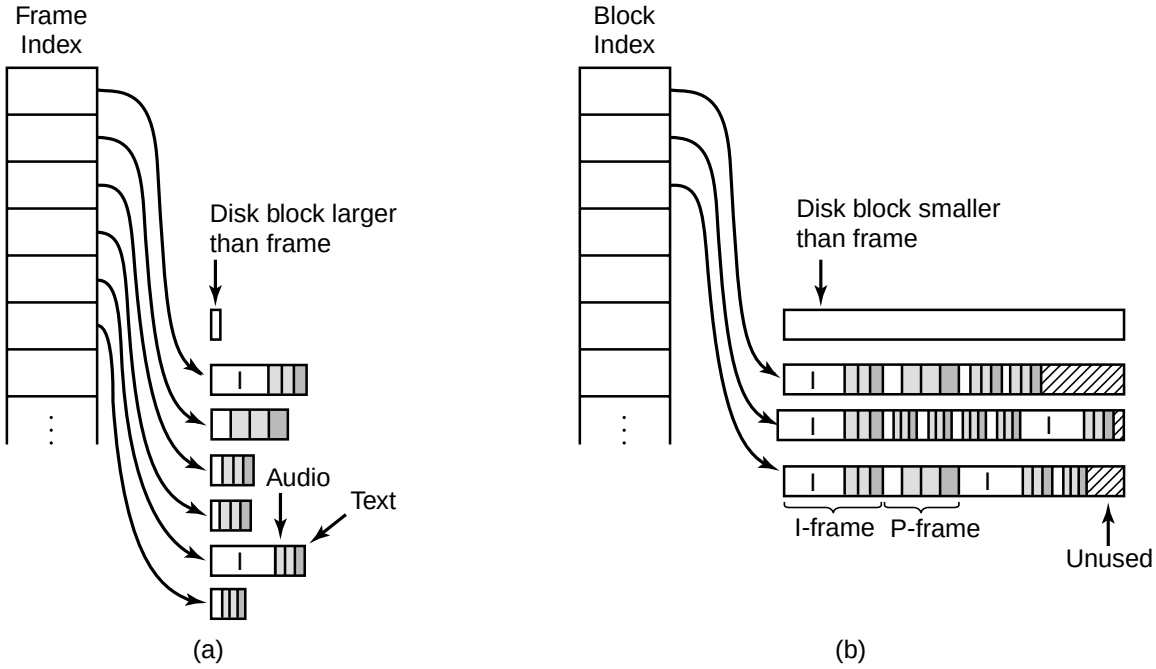

Fig. 7-18. Noncontiguous movie storage. (a) Small disk blocks. (b) Large disk blocks.

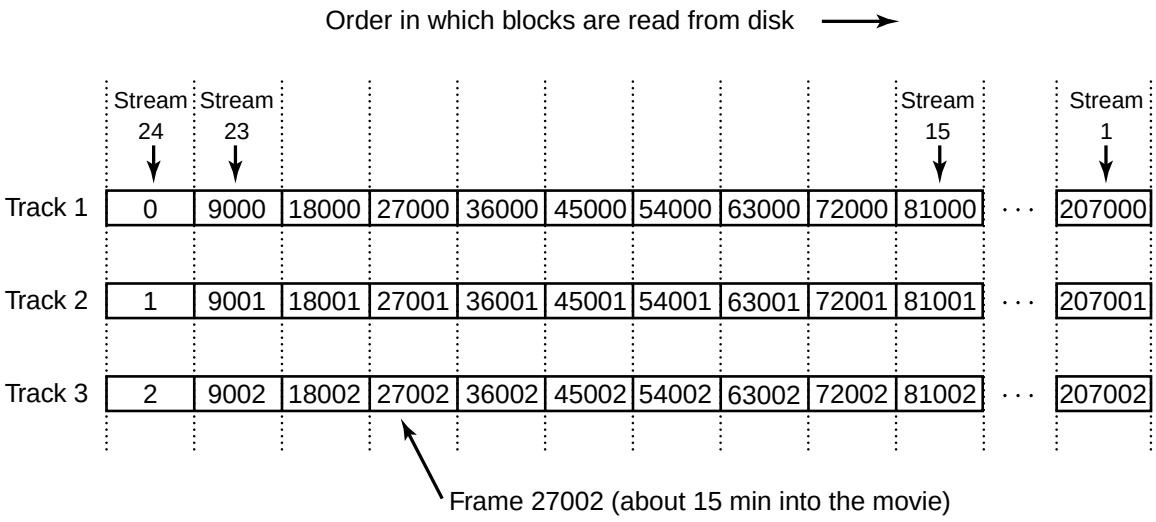

Fig. 7-19. Optimal frame placement for near video on demand.

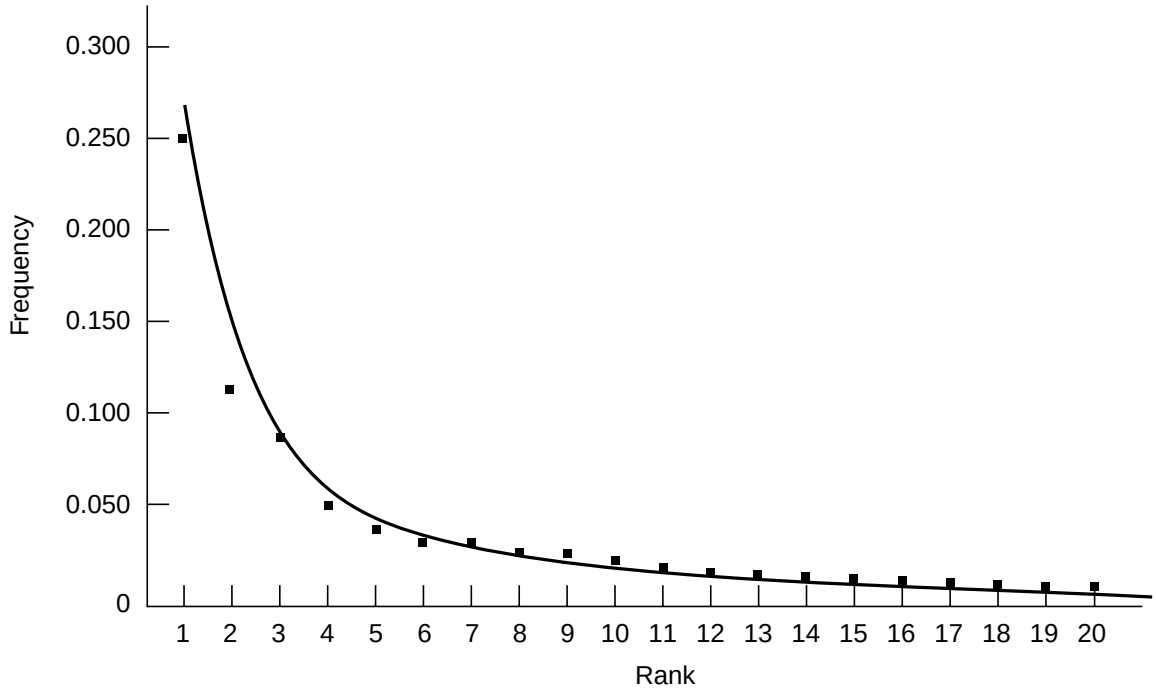

Fig. 7-20. The curve gives Zipf's law for $N = 20$. The squares represent the populations of the 20 largest cities in the U.S., sorted on rank order (New York is 1, Los Angeles is 2, Chicago is 3, etc.).

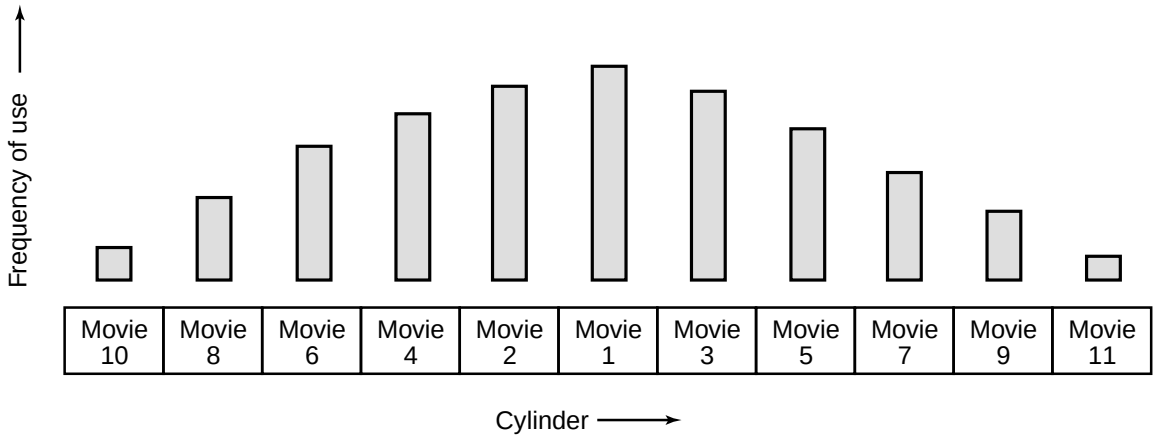

Fig. 7-21. The organ-pipe distribution of files on a video server

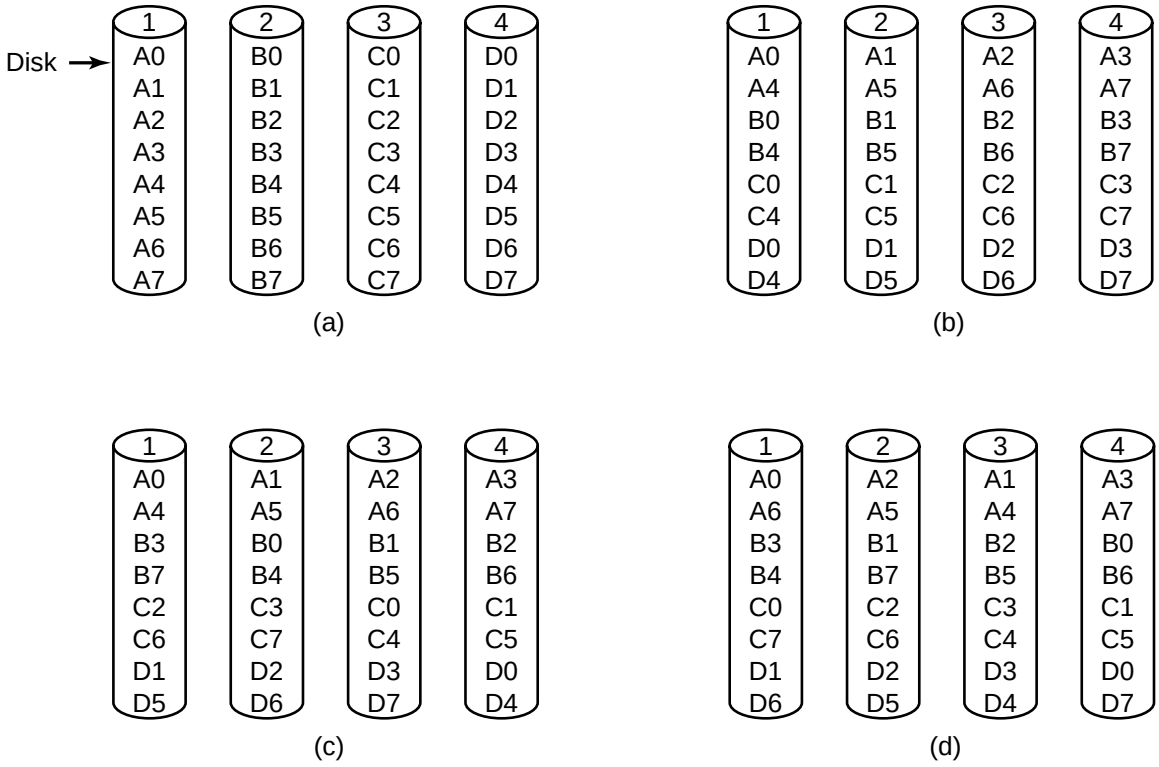

Fig. 7-22. Four ways of organizing multimedia files over multiple disks. (a) No striping. (b) Same striping pattern for all files. (c) Staggered striping. (d) Random striping.

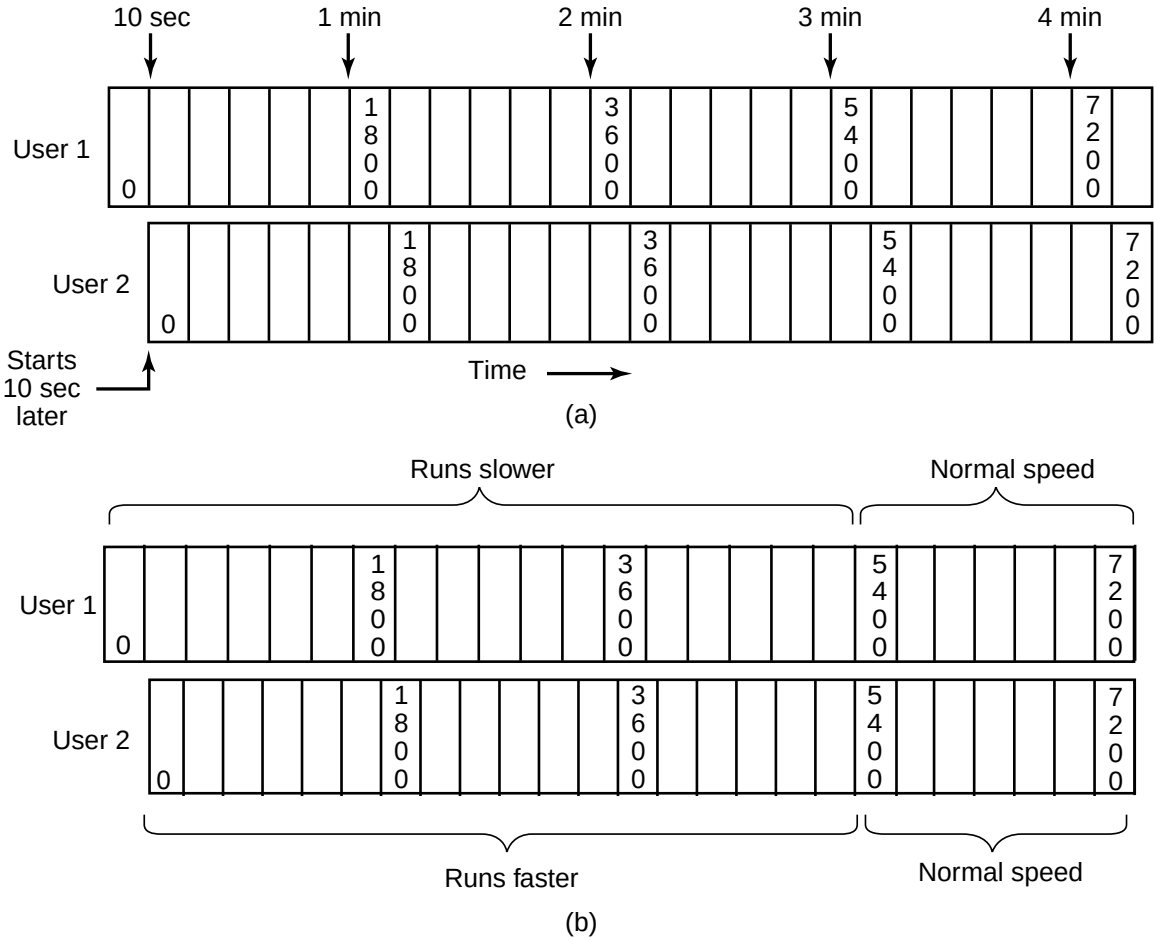

Fig. 7-23. (a) Two users watching the same movie 10 sec out of sync. (b) Merging the two streams into one.

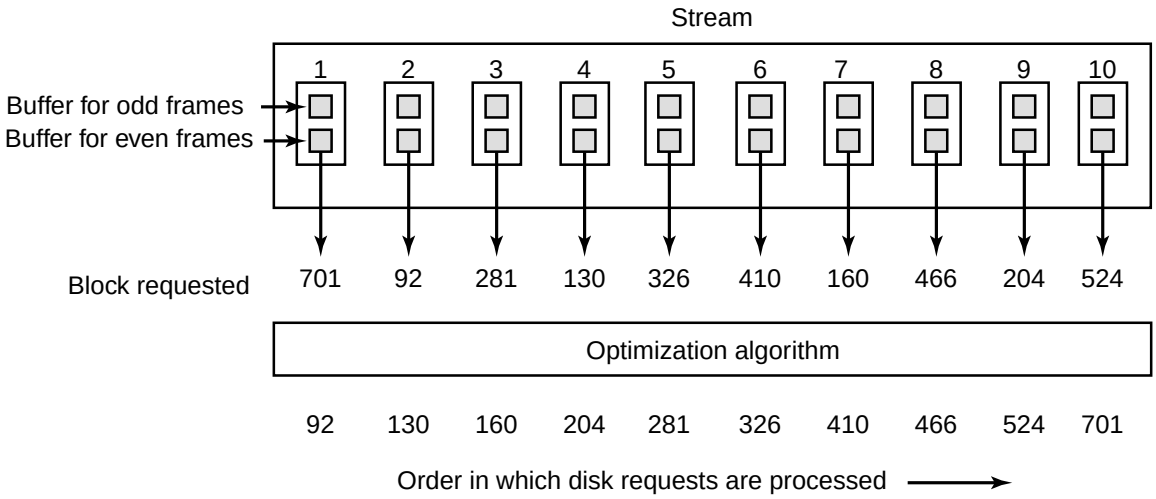

Fig. 7-24. In one round, each movie asks for one frame.

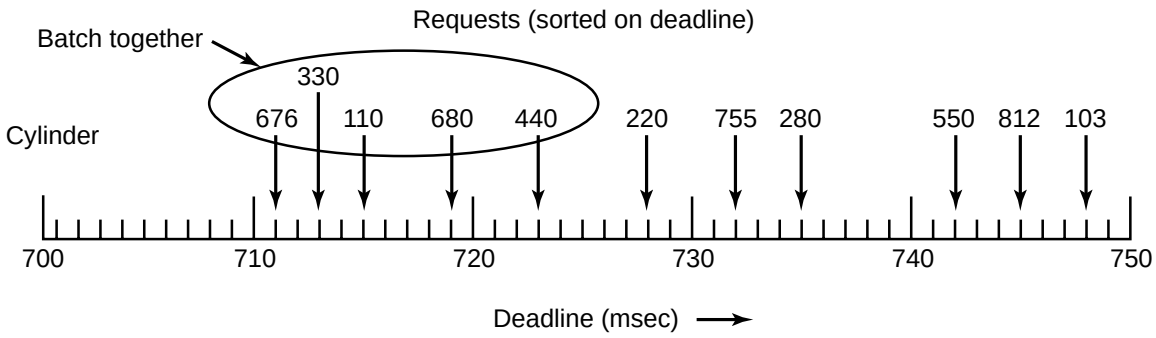

Fig. 7-25. The scan-EDF algorithm uses deadlines and cylinder numbers for scheduling.