Mass-Storage Structure

Practice Exercises

11.1 Is disk scheduling, other than FCFS scheduling, useful in a single-user environment? Explain your answer.

11.2 Explain why SSTF scheduling tends to favor middle cylinders over the innermost and outermost cylinders.

11.3 Why is rotational latency usually not considered in disk scheduling? How would you modify SSTF, SCAN, and C-SCAN to include latency optimization?

11.4 Why is it important to balance file-system I/O among the disks and controllers on a system in a multitasking environment?

11.5 What are the tradeoffs involved in rereading code pages from the file system versus using swap space to store them?

11.6 Is there any way to implement truly stable storage? Explain your answer.

11.7 It is sometimes said that tape is a sequential-access medium, whereas a hard disk is a random-access medium. In fact, the suitability of a storage device for random access depends on the transfer size. The term ***streaming transfer rate*** denotes the rate for a data transfer that is underway, excluding the effect of access latency. In contrast, the ***effective transfer rate*** is the ratio of total bytes to total seconds, including overhead time such as access latency.

Suppose we have a computer with the following characteristics: the level-2 cache has an access latency of 8 nanoseconds and a streaming transfer rate of 800 megabytes per second, the main memory has an access latency of 60 nanoseconds and a streaming transfer rate of 80 megabytes per second, the hard disk has an access latency of 15 milliseconds and a streaming transfer rate of 5 megabytes per second, and a tape drive has an access latency of 60 seconds and a streaming transfer rate of 2 megabytes per second.

a. Random access causes the effective transfer rate of a device to decrease, because no data are transferred during the access time. For the disk described, what is the effective transfer rate if an average access is followed by a streaming transfer of (1) 512 bytes, (2) 8 kilobytes, (3) 1 megabyte, and (4) 16 megabytes?

b. The utilization of a device is the ratio of effective transfer rate to streaming transfer rate. Calculate the utilization of the disk drive for each of the four transfer sizes given in part a.

c. Suppose that a utilization of 25 percent (or higher) is considered acceptable. Using the performance figures given, compute the smallest transfer size for a disk that gives acceptable utilization.

d. Complete the following sentence: A disk is a random-access device for transfers larger than _____ bytes and is a sequential-access device for smaller transfers.

e. Compute the minimum transfer sizes that give acceptable utilization for cache, memory, and tape.

f. When is a tape a random-access device, and when is it a sequential-access device?

11.8 Could a RAID level 1 organization achieve better performance for read requests than a RAID level 0 organization (with nonredundant striping of data)? If so, how?

11.9 Give three reasons to use HDDs as secondary storage.

11.10 Give three reasons to use NVM devices as secondary storage.