Department of Electrical and Computer Engineering

Computer Engineering

Course ECSE-322B

Problem Set 8

5 March 2008

1.Consider a file occupying sequential sectors over four consecutive tracks of a floppy disk. The floppy disk has a track-to-track time of 3 ms and a head settling time of 17 ms. The diskette is rotated at 300 rpm. Determine how long it takes the drive to read the entire file after positioning and settling of the head over the very first sector.

2. Consider a disk drive like the one discussed in question 1. The employed diskettes use a format based on 16 sectors. A particular file occupies one full track and two consecutive sectors of the adjacent track.

(a) Calculate how long it takes to read the entire file after positioning and settling of the head over the first sector of the file.
(b) How would you go about minimizing the file access time?

3. A two-sided diskette rotates at 360 rpm. Once the desired sector is located, data are provided/accepted at a rate of 500Kb/s. Determine its storage capacity in kilobytes given a total of 135 tracks per surface.

4. Derive an expression for the data rate R of a magnetic hard disk given that r is the radius of the innermost track, d is the recording density on the innermost track and L is the time taken for a full rotation of the disk.

5. Derive an expression for the recording density of track i in terms of the radius, r, and recording density, d, of the innermost track. Assume that the magnetic disk has a track density of D tracks per inch.

6. A floppy disk rotates the diskette at 360 rpm and has a track-to-track time of 3ms. The employed diskettes have a total of 77 tracks per surface.

(a) Determine the minimum, maximum, and average values of the latency time
(b) Repeat part (a) for the seek time.

7. A disk drive has 300 tracks, formatted into 32 sectors containing 512 data bytes each. What is the total storage capacity of this disk?

During data transfer operations, the disk controller cannot access adjacent sectors on a given track. After reading one sector, it must skip the next sector, using that time for error checking and for data transfer to or from the host. Assuming that the disk is completely empty, show how a 63K-byte file may be stored to minimize transfer time.

8. An I/O device is capable of accepting one byte of data every 100 microseconds. The data are transferred to the device in blocks of 256 bytes. Initially we consider designing the system such that the device will cause an interrupt whenever it is ready to accept another byte of data. It is estimated that the servicing of each interrupt will take a total of about 40 microseconds.

(a) What will be the improvement ratio (in terms of CPU time) if we employ DMA in the cycle stealing mode and interrupt the CPU only after transferring the whole block? Assume a total of 2 microseconds to gain the bus, transfer a byte, and return bus control to the CPU. Also assume that the CPU does no productive work while its bus is tied up.
(b) Suppose that such 256-byte blocks are transferred to the device at an average rate of one every 2 seconds. What fraction of CPU time is consumed for device service when employing interrupt-driven I/O?
(c) Assume blocks are transferred at a rate of 20 per second. What fraction of CPU time will we economize if we employ DMA?