

Exercise L12 I/O and External storage

1. Of programmed I/O, interrupt-driven I/O, DMA, or channel I/O, which is not suitable for processing the I/O of a:

- a) Mouse
- b) Game controller
- c) CD
- d) Thumb drive or memory stick

Explain your answers.

Ans.

Mice and game controllers are character-based, sequential devices. Either programmed I/O or interrupt-driven I/O is best. CDs and thumb drives are block-oriented devices that lend themselves to DMA. Channel I/O is suitable, but excessive for the small amount of data involved.

2. If an address bus needs to be able to address eight devices, how many conductors will be required? What if each of those devices also needs to be able to talk back to the I/O control device?

Ans.

Three conductors will be needed. To provide bidirectionality, add a single control line that indicated the “direction” of the signal on the other three.

3. Suppose a disk drive has the following characteristics:

- 4 surfaces
- 1024 tracks per surface
- 128 sectors per track
- 512 bytes/sector
- Track-to-track seek time of 5 milliseconds
- Rotational speed of 5000 RPM.

- 1. a) What is the capacity of the drive?
- 2. b) What is the access time?

Ans.

a) $4 \text{ surfaces} \times 1,024 \text{ tracks per surface} \times 128 \text{ sectors per track} \times 512 \text{ bytes/sector} =$

$$(4 \times 1024 \times 128 \times 512) / (2^{20} \text{ bytes/MB}) = 256 \text{ MB.}$$

$$\text{b) Rotational delay} = (60 \text{ seconds} / 5000 \text{ rpm}) \times (1000 \text{ ms/second}) / 2 = 6 \text{ ms}$$

$$\text{Seek time} = 5 \text{ ms}$$

$$\text{Access time} = 6 \text{ ms} + 5 \text{ ms} = 11 \text{ ms.}$$

4. How does the organization of an SSD differ from a magnetic disc? How are they similar to a disk?

Ans.

An SSD consists of memory, thus, data is access via address lines, just like memory instead of via a read-write head mounted on a disk arm. SSDs, particularly the NAND variety, are similar to magnetic disks because they are accessed in chunks: pages and sectors, respectively.

5. a) Which of the RAID systems described in this chapter cannot tolerate a single disk failure?

b) Which can tolerate more than one simultaneous disk failure?

Ans.

a) RAID-0.

b) RAID-1 and RAID-6. RAID-1 can tolerate multiple disk failures only if the failure does not involve a disk and its mirror image.