**NATIONAL UNIVERSITY OF SCIENCES & TECHNOLOGY**

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SUBJECT: Computer Organization and Architecture

## 1- Compare and Contrast the following: [20]

### a) SSD and HDD

SSD is used to speed up the performance of a computer even more then the fast CPU and Ram. On the other hand, HDD is cheaper but has a large storage up to 1TB. Some of the similarities and differences of both SSD and HDD are given below:

| HDD | SDD |
|---|---|
| HDD stands for Hard Disk Drive | SDD stands for Solid State Drive |
| HDD is slower because the data is transfer through sequential approach. HDD has higher latency rate (slow in speed) and support fewer Input/Output operations per seconds. | SDD is faster because the data is transfer through the random-access approach. SDD has lower latency rate and support more Input/Output operations per seconds. Over 10 times faster than the spinning disks in an HDD. |
| HDD has spanning platters that read/write data. The faster the platters move the quicker an HDD can perform. | SDD uses solid state memory chips to Read/Write data. In SDD there are many interconnected flash memory chips in which the data is stored instead of platters that's why SDD is faster. |
| HDD uses more electricity to rotate the platters | SDD uses less electricity because SDD has no platters |
| HDD is a traditional method of storage. | SSD is a new and advanced technology |
| HDD results in noise and vibration due to moving parts. | SSD does not have any noise or vibrations. |

## b) b. Real and Protected modes of OS

**Real mode:**

In Real mode the processor works as 8086/8088

Real mode only has 1mb addressing capability

Real mode controls only one task at a time

In real mode address translation is not required

In real mode the processor directly communicates with the ports

Real mode also not supporting memory management

**Example: Real mode is used by DOS and standard Dos applications**

**Protected mode:**

In protected mode the processor works with full capacity

Protected mode has more then 1mb even few GBs addressing capability

Protected mode handles multiple tasks at the same time, meaning having the operating system manage the execution of multiple programs simultaneously.

In this mode memory translation is required

In this mode the processor communicates with the ports through OS

Protected modes supporting memory management

**Example:**

All the major operating systems uses protected mode such as Windows, Linus

## c) Memory Mapped and Isolated I/O

As we know that CPU needs system bus to communicate with the I/O devices so there are three ways in which the system bus can be allotted to them:

1) Separate sets for control, data and address bus to I/O and Memory
2) Using common bus (data and address bus) for I/O and memory but separate set for control lines
3) Using common bus (data, address, and control) for memory and I/O

**Memory Mapped I/O:**

Memory mapped I/O uses the same address bus to connect both primary memory and memory of hardware devices (registers). Memory and registers of I/O devices gets assigned values, thus when CPU try to access an address value, it can either from memory or from registers of I/O devices. Memory mapped I/O thus helps in utilizing the same instruction for accessing or addressing both primary memory and I/O device memory locations.

**Isolated I/O:**

Isolated I/O uses separate instruction classes to access primary memory and device memory. In this case, I/O devices have separate address space either by separate I/O pin on CPU or by entire separate bus. As it separates general memory addresses with I/O devices, it is called isolated I/O. As the peripheral devices are slower than the memory devices, I/O operations can be slow. Isolated I/O accelerates I/O operations by using separate buses.

| Isolated I/O | Memory Mapped I/O |
|---|---|
| Different addresses are used for computer memory and I/O devices. | Same address is used for computer memory and I/O devices. |
| More complex and costly as it used more buses | Easier to built as its less complex |

| | |
|---|---|
| Computer memory and I/O devices use different control instruction for read and write | Computer memory and I/O devices uses |
| As it is using more buses, so it is larger in size | It is using common buses, so it is smaller in size |
| More efficient due to separate buses | Lesser efficient |

## d) Pentium and ARM Memory Management

| **Pentium** | **Arm** |
|---|---|
| Uses complex instruction set computing architecture (CISC) | Uses reduced instruction set computing architecture (RISC) |
| Executes complex instruction at a time and it takes more than a cycle | Executes single instruction per seconds |
| Hardware approach to optimize performance | Optimization of performance with software focused approach |
| Uses more registers | Requires less registers |
| Less pipelined | Pipelining of instruction is the unique feature |
| Time to execute is more | Faster execution of instructions |
| Decoding of instructions is handling is complex | Decoding of instructions is handling easily |
| Used in servers, desktop, laptops where high performance and stability matters | Used in mobile device where size ,power consumption speed matters |

Q2- A computer has a cache, main memory, and a disk used for virtual memory. If a referenced words in the cache, 20 ns are required to access it. If it is in main memory but not in the cache, 55 ns are needed to load it into the cache, and then the reference is started again. If the word is not in +main memory, 10 ms are required to fetch the word from disk, followed by 55 ns to copy it to the cache, and then the reference is started again. The cache hit ratio is 0.8 and the main memory hit ratio is 0.7. What is the average time in ns required to access a referenced word on this system? [10]

Date :-

| | Time | hit |
|---|---|---|
| Cache | 20ns | 0.8 |
| memory | 50ns | 0.7 |
| disk | 10ms → convert into ns = 10000000 | |

formula :-

$$T_{avg} = hit_{cache} \times time_{cache} + (1 - hit_{cache})(hit_{memory})[time_{cache} + time_{memory}] + (1 - hit_{cache})(1 - hit_{memory})[time_{cache} + time_{memory} + time_{disk}]$$

putting the values in the formula:

$T_{avg} = 0.8 * 20 + 0.2 * 0.7 * 75 +$
$0.2 * 0.3 + 10000000 75$

$T_{avg} = 16 + 60.5 + 60004.5$

$T_{avg} = 60031ns$

The required avgTime is 60031ns

3- Consider a magnetic disk drive with 16 surfaces, 512 tracks per surface, and 64 sectors per track. Sector size is 2 kB. The average seek time is 10 ms, the track-to-track access time is 1.5 ms, and the drive rotates at 4200 rpm. Successive tracks in a cylinder can be read without head movement.[10]

a. What is the disk capacity?

b. What is the average access time? Assume this file is stored in successive sectors and tracks of successive cylinders, starting at sector 0, track 0, of cylinder i.

c. Estimate the time required to transfer a 10-MB file.

Q3 :-

Data :-

No of Surfaces = 16

tracks per surface = 512

Sector per track = 64

Sector size = 2KB

Averge seek time = 10ms

track to track time = 1.5ms

drive rotates = 4200rpm.

① Disk capacity :-

Total no of Surfaces x No of tracks per Surface x no of sector per track x No of byte per Sector

$= 16 \times 512 \times 64 \times 2k$ bytes

$= 1073741824$

$= 1 \times 2^{30}$

$= 1$ GB.

**b) Rotational latency :-**

$= \frac{\text{Rotation time}}{2}$

drive rotation = 4200 per minute

$= \frac{60}{4200 \times 2}$

$= 7.2$ ms

**Average time :-**

Seek time + Rotational time + track to track time

140 = 1

10 =

Avg Time =

10ms + 7.2ms + 1.5ms

= 18.7 ms.

c) Estimate the time required to transfer a 10-MB file :-

| |
|---|
| Data transfer rate = no of heads x capacity of one track x no of rotation in one second |

→ no of heads = 16

→ capacity of one track =

track per sector x size ~~per~~ of sector

= 64 x 2 K

$= 64 \times 2^{10}$

= 131072

→ no of rotation in one second

(4200/60) = 7. rotation.

putting all the values in a formula

$16 \times 131072 \times 70$

$= 2^4 \times 2^{17} \times 70$

$= 2 \times 70 \times 2^{20}$

$= 140$ mb/sec

to transfer 140mb we need 1sec

to transfer 10mb we need $(10/140)$

$= 0.0714$.