**Deep Bodra**

**5801 1841**

**DBI Week 3 (1/20 - 1/24)**

**Detailed explanation of the topics covered in class**

**1/21/2020**

1. Secondary Storage Types
   1. Magnetic Tapes
      1. The tape is made of a paramagnetic material.
      2. The electromagnetic field is used to read/write from/to the tape using the head
      3. The amount of data that can be stored depends on the intricacy of the tracks designed
      4. They are used as cold storage devices. For eg. Facebook once used it for storing data
   2. Spindle Magnetic Drives
      1. It consists of a rod called spindle which holds circular discs called platter
      2. The head is used to read/write data to the platter. The head may or may not be on both sides of the platter(depends on the manufacturer)
      3. The platter is divided with concentric circles and each part is called a track
      4. Each track is further divided into sections called sectors
      5. The head moves to the correct track first. The time taken is called positional latency
      6. The platter then rotates to the correct sector. The time taken is called rotational latency. The platter rotates at about 7200RPM, 10000RPM, 15000RPM
      7. The data is then read/written. The time taken is called transmission latency
      8. The capacity is as high as 20-100TB
   3. SSD
      1. Unlike the previous one, there are no moving parts involved
      2. SSD’s are made of transistors
      3. They contain a group of memory units called SSD Cells
      4. Each SSD cell can store around 256KB
      5. They have unlimited read support even if the SSD fails
      6. It has limited writes about 2000-5000
      7. The smallest write that can be performed is of the size of each cell (You cannot just flip one bit. You have to rewrite the complete cell containing it)
2. Comparison of Secondary Storage Types

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Magnetic Tapes | Spindle Magentic Drives | SSD |
| Latency | In the order of minutes | Positional:2-5ms  Rotational  Transmission:10ms/100 IO’s per second | 10-100 micro seconds  900K IO’s |
| Throughput | Maximum of the controller + Bus density | 200-250MB/s | SATA 550 MB/s  M2 2.86 GB/s |
| Cost | Cheapest | 10-100 times more than Magnetic Tapes | 1TB $100 |

1. Direct Memory Access (DMA)
   1. Without DMA, if there is a request for a read/write then the CPU will initiate the request
   2. The CPU will stay idle until that request is served
   3. With the help of DMA, the CPU can initiate the request and keep working on other instructions.
   4. When the memory transfer is complete the DMA controller interrupts the CPU thereby informing the same

**1/23/2020**

1. Network Card
   1. It is connected to the PCI
   2. Ethernet
      1. Transfer rate is 400, 200, 100 Gbits/s and the latency is 100 micro seconds
      2. Ethernet was once superseded by Infiniband and then Ethernet took its place back
   3. Infiniband
      1. Latency 1.2 micro seconds but transfer rate is 56 Gbits/s

----------------------------------------------------------------------------------------------------------------------------------------

Rule of Thumb

Bandwidth increases by more wires

----------------------------------------------------------------------------------------------------------------------------------------

1. Redundant Array of Independent Disks (RAID)
   1. It uses multiple storage disks together
   2. This improves reliability, read/write performance and offers more storage
   3. RAID controller
      1. Hardware RAID:
         1. It has a RAID card
         2. OS is unaware of the RAID controller
         3. It often comes with a battery to handle pending writes during power failure
         4. The card is expensive
      2. Software RAID
         1. The card functionality is implemented by the software
         2. OS is aware
         3. It is expensive in the sense that the CPU utlization increase
   4. Levels
      1. RAID 0
         1. It requires a minimum of 2 disks
         2. Stripping: The data is stripped across the available disks
         3. There is no data redundancy
         4. If one drive fails then all the data is lost
         5. read/write performance is n times that of a single disk
      2. RAID 1
         1. It requires even number of drives with a minimum of 2
         2. The data stored on n/2 drives is mirrored in the remaining n/2 drives
         3. Read is fast but the write is as good as that of a single disk
         4. Data can be recovered from the mirrored drive in case of a failure
      3. RAID 5
         1. The data is stripped across multiple drives
         2. Instead of having a dedicated disk for parity (for recovery) we also distribute the parity data.
         3. The parity bit is the XOR of the data bits
         4. It can tolerate a failure of 1 disk
         5. Read is fast
         6. Slow for small writes because of the overhead of updating parity bit
      4. RAID 6
         1. It is same as RAID 5 but makes use of 2 disks for parity(distributed parity not dedicated)
         2. Fast reads but slow writes
      5. RAID 10
         1. It makes use of a combination of stripping and mirroring
         2. Good read and write performance
2. File System
   1. Linux
      1. EXT 3.4 | Page size=4KB
      2. XFS | Page size=64KB
3. Just a Bunch Of Drives (JBOD)
   1. Disks are combined into larger volumes
   2. There is no redundancy
   3. The cards are cheap
   4. No benefits of RAID

--THANK YOU--