**Tutorial 6:** WRES1201 – Computer System Architecture

1. Define the terms track, cylinder and sector?

On a magnetic disk, data is organized on the platter in a concentric set of rings, called **tracks**. Data are transferred to and from the disk in **sectors**. For a disk with multiple platters, the set of all the tracks in the same relative position on the platter is referred to as a **cylinder**.

1. Define the terms seek time, rotational delay (latency), access time, and transfer time.

**seek time**: the time it takes to position the head at the track.

**rotational delay**: The time it takes for the beginning of the sector to reach the head. **access time**: The sum of the seek time, if any, and the rotational delay which is the time it takes to get into position to read or write.

**transfer time**: the time for the transfer of the data.

1. What common characteristics are shared by all RAID levels?

**1.** RAID is a set of physical disk drives viewed by the operating system as a single logical drive.

**2.** Data are distributed across the physical drives of an array in a scheme known as striping.

1. How is redundancy achieved in a RAID levels?

For RAID level 1, redundancy is achieved by having two identical copies of all data. For higher levels, redundancy is achieved by the use of error-correcting codes.

1. Consider a single platter disk with the following parameters: rotation speed: 7200rpm; number of tracks on one side of platter: 30 000; number of sectors per track: 600; seek time: one ms for every hundred tracks traversed. Let the disk receive a request to access a random sector on a random track and assume the disk head starts at track 0.
   1. What is the average seek time?

149.995 ms

* 1. What is the average rotational latency?

4.167 ms

* 1. What is the transfer time for a sector?

0.01389 ms

* 1. What is the total average time to satisfy a request?

154.17 ms

1. Consider a magnetic disk drive with 16 surfaces, 512 tracks per surface, and 64 sectors per track. Sector size is 1KB. The average seek time is 6 ms, the track-to-track access time is 1ms, and the drive rotates at 3600 rpm. Successive tracks in a cylinder can be read without head movement.
   1. What is the disk capacity?

Capacity = 16 ×512 ×64 ×1 KB = 512 MB

* 1. What is the average access time?

14.3 ms

* 1. Estimate the time required to transfer a 5MB file.

All the single tracks which in the same position in each surface form a cylinder.

Thus, each track from 16 surfaces form a cylinder.

One cylinder has 16 tracks.

Each cylinder consists of 16 tracks ×64 sectors/track ×1 KB/sector = 1 Mbytes

5 MB requires exactly 5 cylinders to store the data.

The disk will need the seek time of 6 ms to find the first cylinder (first track in first cylinder).

Time to read the first sector, rotational delay = 8.3 ms.

Transfer time for 16 tracks = 16 x b/rN = 16 x 1/r = 16 x 60/3600 = 267.2 ms.

First cylinder **access** and **data transfer time** = 6 ms + 8.33 ms + 267.2 ms.

Still have 4 cylinder data to transfer.

4 x (8.33 ms + 267.2 ms + 1 ms)

1 ms is the time to move from track to track.

Thus,

Total time = 6ms + 8.33 ms +267.2 ms + 4 x (8.33 ms + 267.2 ms + 1 ms)

= 1387.65 ms

* 1. What is the burst transfer rate?

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1. Consider a 4 drive, 300GB per drive RAID array. What is the available data storage capacity for each of the RAID levels, 0, 1, 3, 4, 5, and 6?

RAID 0: 1200 GB

RAID 1: 600 GB

RAID 3: 900 GB

RAID 4: 900 GB

RAID 5: 900 GB

RAID 6: 600 GB