

# CS 411 I/O Devices and HDDs

(1)

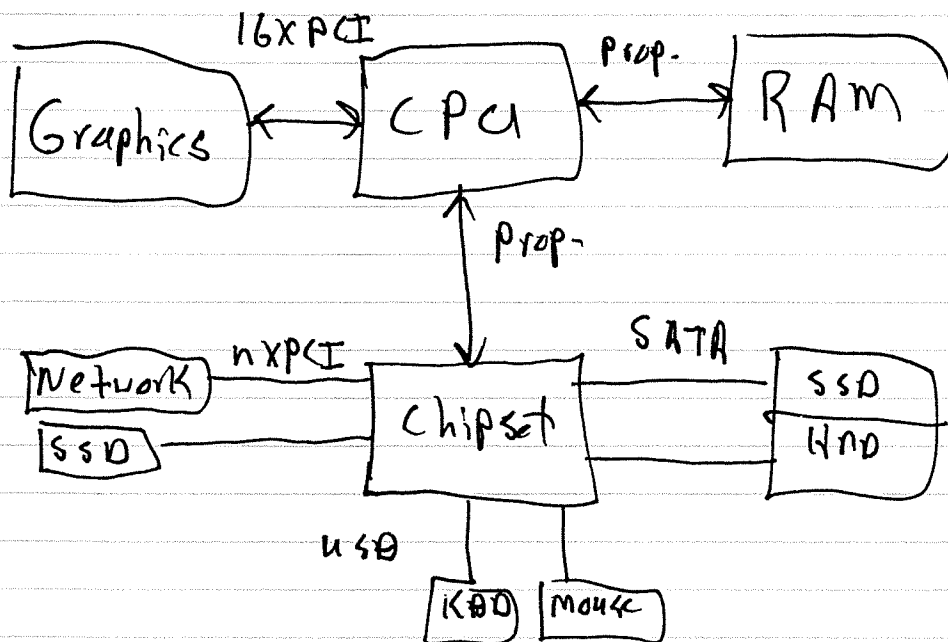
Persistence

Performance Review

CPU core:  $\approx 2 \text{ B ops/sec}$

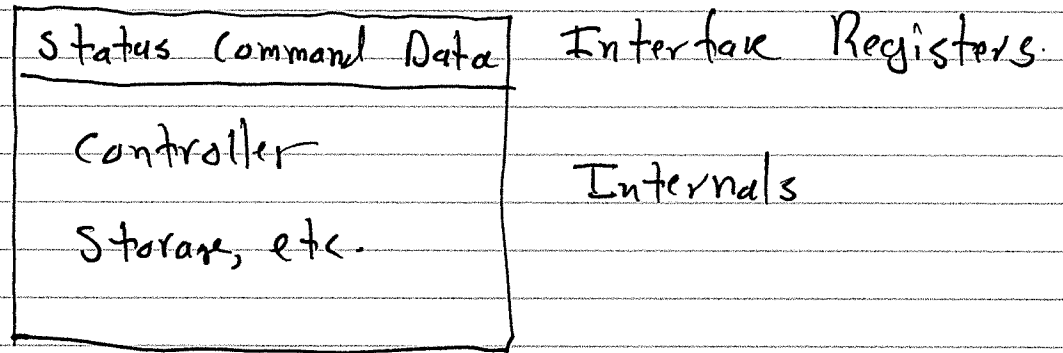
SSD:  $\approx 1 \text{ M ops/sec}$

HDD:  $\approx 100 \text{ ops/sec}$



(2)

## Canonical Device

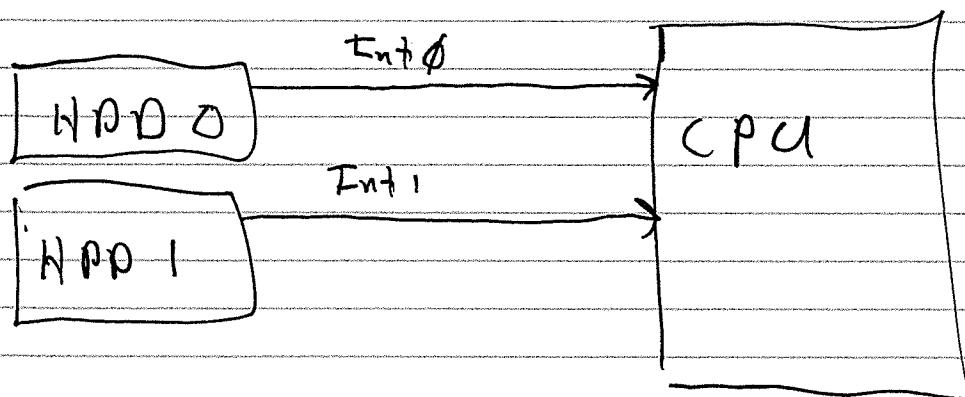


Refer to wrt transfer pseudo-code

Waste of CPU cycles

Improvement 1:

Interrupts - eliminate the busy-wait polling



The interrupt # is used to index into a table of

Interrupt Service Routine addresses

- No busy waiting, but CPU is interrupted once per unit of transfer

## Improvement 2

- Delegate data transfer work to Direct Memory Access Controller

- Resides in device or chipset

- OS sends details to DMA controller and initiates the transfer

DMA sends 1 interrupt upon completion

# Virtualization

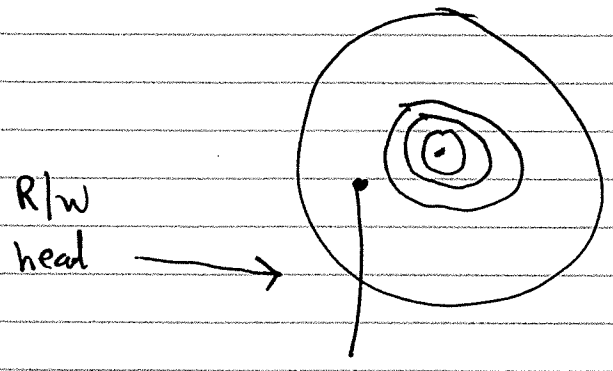
OS'es generally virtualize I/O devices as files

A device driver "makes up" the difference.

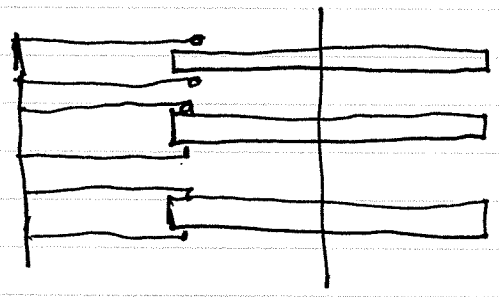
## HDD's

- mechanical storage devices
- Data stored as magnetic charges on oxide-coated disks
- Unit of transfer is a sector  
512 - 4K b

Top View:

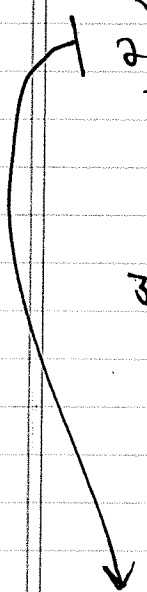


### Side View:



A data transfer has 3 components:

- 1) R/W heads "seek" to correct cylinder 5-10 ms.
- 2) Wait for correct sector to rotate under R/W heads
- 3) Data transfer occurs as sector passes under head.



HPD	RPM	4,500	7,200	15K
	mean latency	7ms	4ms	2ms