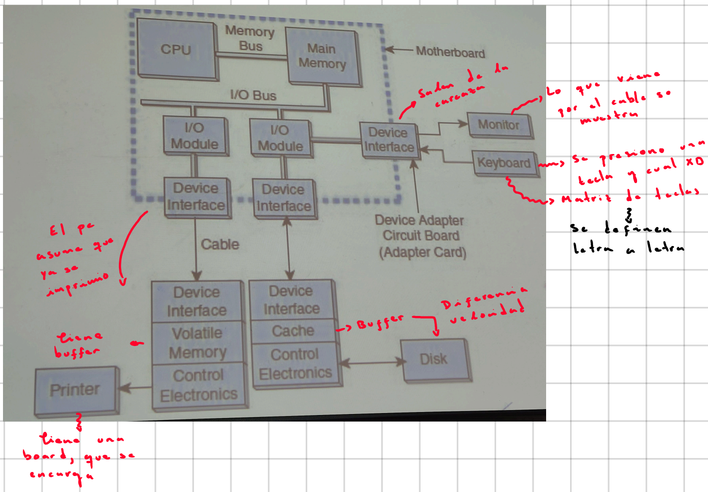
I/O Architectures

input/output as a subsystem of components that moves coded data between external devices and a host system (CPU and main memory)

- Blocks of main memory that are devoted to I/O functions
- Buses that provide the means of moving data into and out of the system → Mueve datos entre el dispositivo externo y memoria
- Control modules in the host and in peripheral devices
- Interfaces to external components such as keyboards and disks
- Cabling or communications links between the host system and its peripherals



I/O Control methods

- The manner in which control its I/O.
  - Programmed I/O
  - Interrupt-driven I/O
  - Memory-mapped I/O
  - Direct
  - Channel-attached I/O

Programmed I/O (1/2)

- Polled I/O (or port I/O)
- The CPU continually monitors (polls) a control register associated with each I/O port.
- When a byte arrives in the port, a bit in the control register is also set. The CPU eventually polls the port and notices that the "data ready" control bit is set
- The CPU resets the control bit, retrieves the byte, and processes it according to instructions programmed for that particular port
- When the processing is complete, the CPU resumes polling the control registers as before.

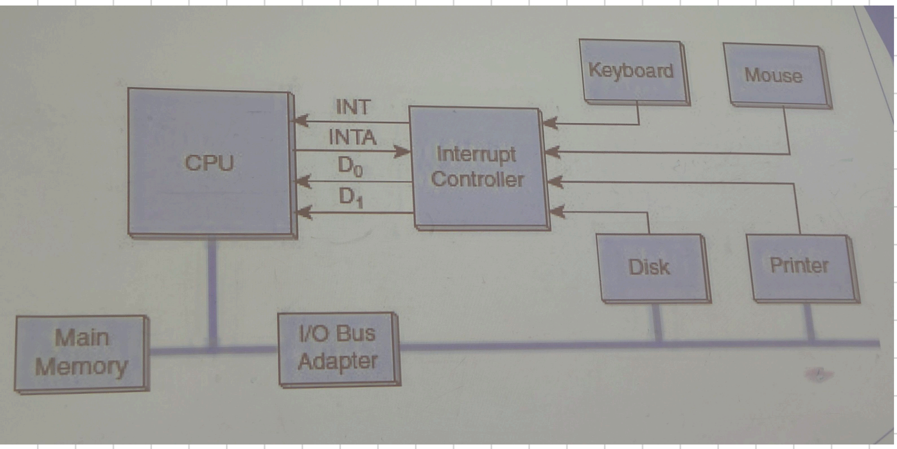
Programmed I/O (2/2)

- We have programmatic control over the behavior of each device
- The CPU is in a continual "busy wait" loop until it starts servicing an I/O request → Pregunta y espera...
- Another problem is in deciding how frequently to poll; some devices might need to be polled more frequently than others

- Util para dispositivos muy lentos (Teclados)
- Crótico con dispositivos muy rápidos (Discos...)

Interrupted-driven I/O

- Dice: cuando acabe, avisa :) → con una interrupción
- Opuesto al programado

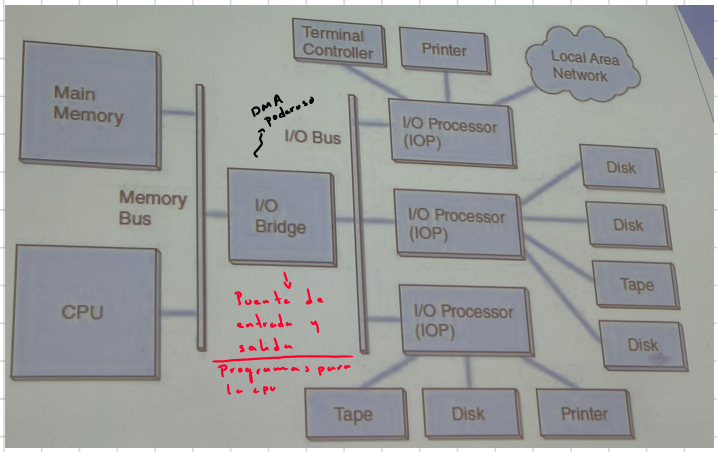


- Memory - mapped I/O
  - Comparte misma fracción del espacio de memoria
  - Cada dispositivo I/O tiene su propio bloque de memoria
  - Transferencia de datos de IO a dispositivo I/O requiere mover bytes de la fracción de memoria al otro dispositivo.
  - Podemos usar el mismo set de instrucciones para mover datos de la I/O y memoria, simplificando el diseño.

Program IO → Muy lento
Interrupted IO → Más rápido
Memory IO → Impresoras y ratón.

- Direct memory access (DMA)
  - La CPU se desentiende del IO.
  - La CPU le provee al controlador de DMA la ubicación de los bytes.

* Channel attached - IO:
  - La mayoría de sistemas lo usan.
  - Tan literalmente usado en mainframe computers.



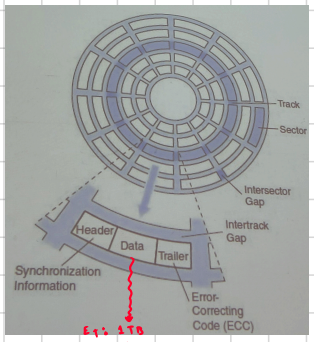
* Mayor escalamiento: Si queremos más entradas - salidas los añadimos.
* No es tan frecuente.

* Storage technologies
  - Magnetic Disk
    - RAID
  - Optical Disk
  - Magnetic tape

Magnetic Disk Technology

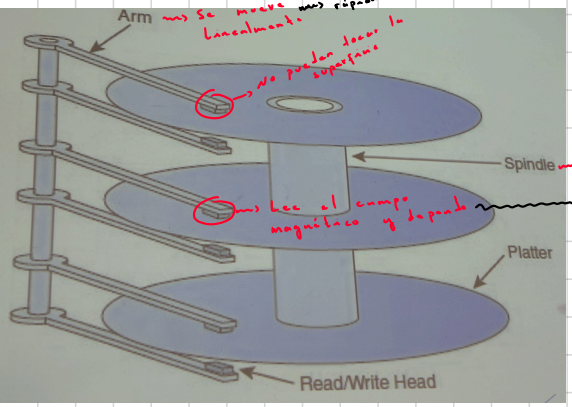
- Disk drives are called random (sometimes direct) access devices
- A circular surface (called platter) was coated on both sides with a magnetic oxide
- Each unit of storage on a disk, the sector, has a unique address that can be accessed independently of the sectors around it.
- Sectors are divisions of concentric circles called tracks.
- On most systems, every track contains exactly the same number of sectors.
- Each sector contains the same number of bytes.
- The data is written more "densely" at the center of the disk than at the outer edge.

The platter



- El cuanto se puede almacenar en un disco depende del track más pequeño.
  - Si el track es pequeño más espacio para almacenar.

Ej: 1TB → 960 GB - Los otros 40 gb es para Headers y Trailer



Arm → se mueve linealmente
se vuelve más rápido en el tiempo
no pueden hacer lo siguiente
Lee el campo magnético y depende

* Discos están al vacío !!

→ Giran !! → cambia la velocidad del giro !! → Dejamos el espacio para esto !
→ Para escribir: De electromagnetismo a electricidad
→ Para leer: De electricidad a electromagnetismo

El SO, necesita:

Terminology

- Seek time is the time it takes for a disk arm to position itself over the required track.
- Rotational delay is the time it takes for the required sector to position itself under a read/write head. (Cuanto tiempo hace 1 vuelta) → promedio de recorrer medio track
- Access time is the sum of the rotational delay and seek time. → Promedio de cuanto me demoro en llegar a un sector en especifico
- Transfer time is the access time plus the time it takes to actually read the data from the disk.
- Transfer time varies depending on how much data is read.
- Latency is a measure of the amount of time it takes for the desired sector to move beneath the read/write head after the disk arm has positioned itself over the desired track → Cuanto me demoro de verdad en el transfer dime yo
- Latency is a direct function of rotational speed

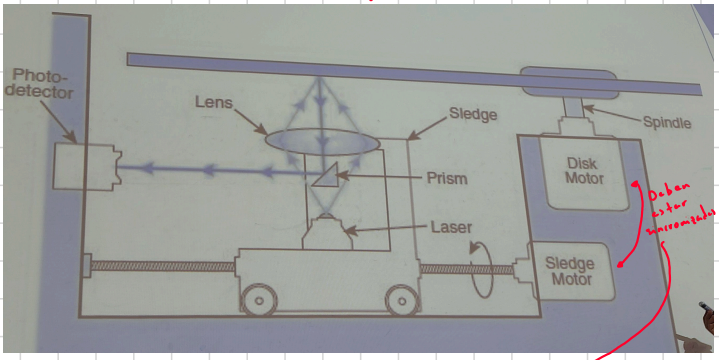
Optical Disks

- CD-ROM (compact disc-read only memory), which can hold more than 0.5GB of data
- CD-ROMs are a read-only medium, making them ideal for software and data distribution
- CD-R (CD-recordable) → nuevo
- CD-RW (CD-rewritable)
- WORM (write once read many) disks are optical storage devices often used for long-term data archiving and high-volume data output.
- For long-term archival storage of data, some computer systems send output directly to optical storage rather than paper or microfiche. This is called computer output laser disc (COLD).
- Robotic storage libraries called optical jukeboxes provide direct access to myriad optical disks.
- Jukeboxes can store dozens to hundreds of disks, for total capacities of 50GB to

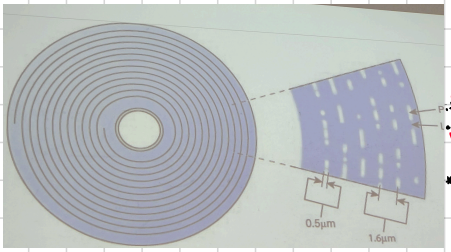
CD-ROM

- CD-ROMs are polycarbonate (plastic) disks 120mm (4.8 inches) in diameter to which a reflective aluminum film is applied.
- The aluminum film is sealed with a protective acrylic coating to prevent abrasion and corrosion.
- The aluminum layer reflects light that emits from a green laser diode situated beneath the disk.
- The reflected light passes through a prism, which diverts the light into a photodetector.
- The photodetector converts pulses of light into electrical signals, which it sends to decoder electronics in the drive

Funciona !!



Tienen que tener este patrón



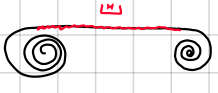
Reflejo Aluminio

Lado de franja aluminio

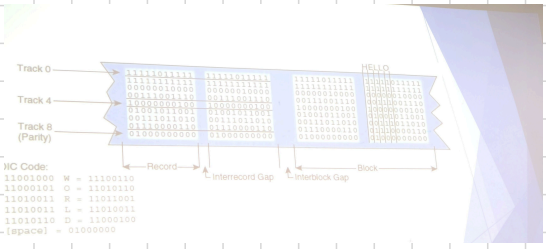
*Empieza en 1, luego 0's y Cuando cambia 1

Magnetic Tape

- A cellulose-acetate film one-half inch wide (1.25cm) was coated on one side with a magnetic oxide.
- Twelve hundred feet of this material were wound onto a reel, which then could be hand-threaded on a tape drive
- **Nine Track Format**: Data was written across the tape one byte at a time, creating one track for each bit.
- An additional track was added for parity, making the tape nine tracks wide
- Serpentine: Instead of the bytes being perpendicular to the edges of the tape, as in the nine-track format, they are written "lengthwise," with each byte aligning in parallel with the edge of the tape.
- A stream of data is written along the length of the tape until the end is reached; then the tape reverses and the next track is written beneath the first one

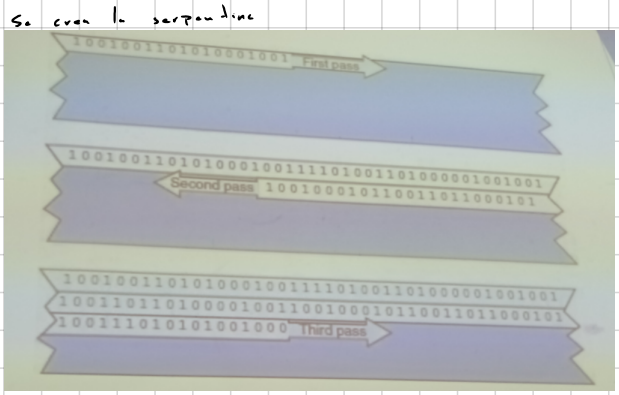


*Tecnología muy madura



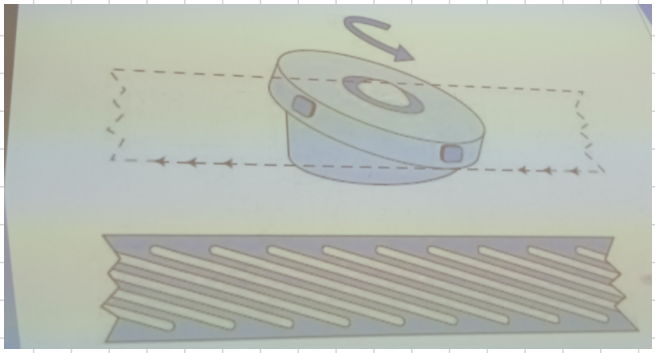
*Problemas de espacio !!

Se crean la serpentina



Pasamos al DAT

Serpentina



- LTO: Linear Tape Open:
  - Estándar
  - Usan compresión, hasta 2:1 (2,8 TB a 4 TB)