Computer Systems

Overview of current Computer Systems

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Types of Computers

- Mainframe
  - Supercomputer
- Mini Computers
  - PDP, DEC VAX, IBM AS/400
- Micro Computers
  - **PCs**
  - Apple
  - Sun
- Dedicated/Embedded
  - Processors in cars, washing machines, lifts, mobile phones, Video controller cards, etc

Types of Memory

- RAM
  - Read and write memory (stands for Random Access Memory – as opposed to old methods where data was saved only sequentially, e.g. in tapes)
  - used for temporary storage
  - Volatile

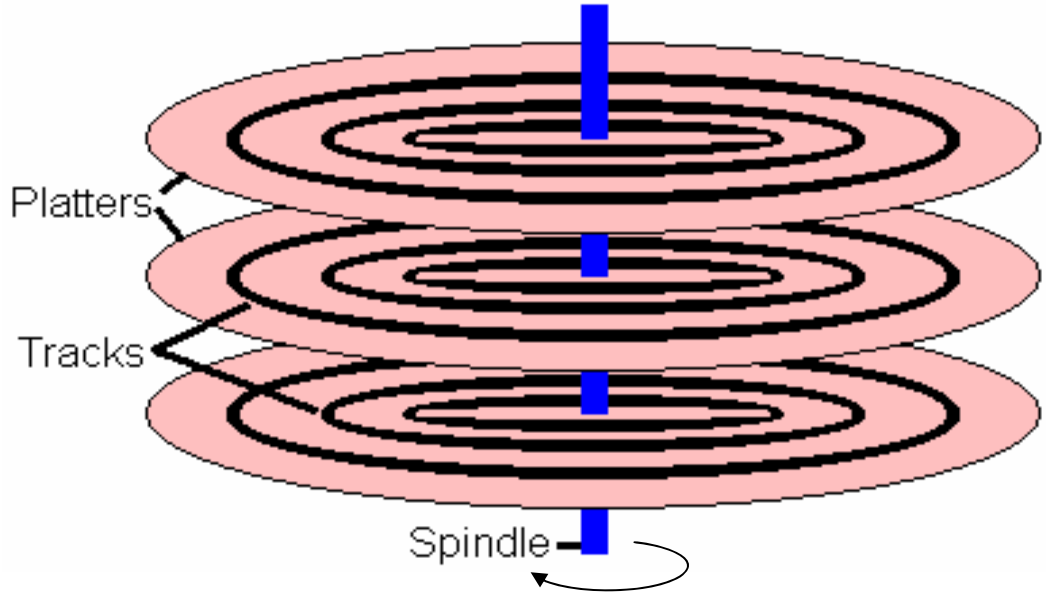
- ROM *(also a Random Access Memory !)*
  - Read Only Memory
  - used for permanent storage
  - Non-volatile

Types of Memory

- Memory chips - array of memory cells
- DRAM - dynamic RAM
  - used for main RAM
  - uses a single transistor for memory cell
    - needs refreshing regularly
  - refresh speed represents the speed of the RAM
    - e.g. 60 ns
- SRAM - static RAM
  - used for cache memory
  - does not require regular refreshing - faster access
  - uses two or more transistors per memory cell
    - flip-flop

Hard Disk Construction

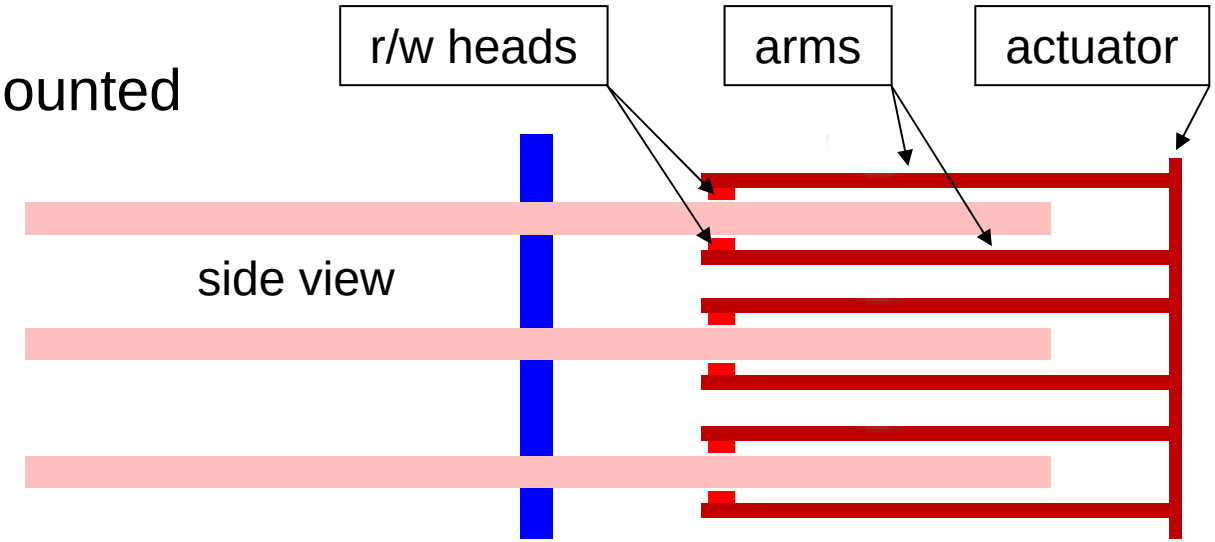
- A hard disk consists of a number of platters
  - made of aluminium or glass
  - with a thin magnetic film on the surface



  - common platter diameters range from 1.8 - 5.25 inches
- Information is stored magnetically on both surfaces (sides) of each platter
- The platters rotate at a fixed rate on the spindle
  - e.g. modern PC drives rotate at 7,200 rpm

Read / Write Heads

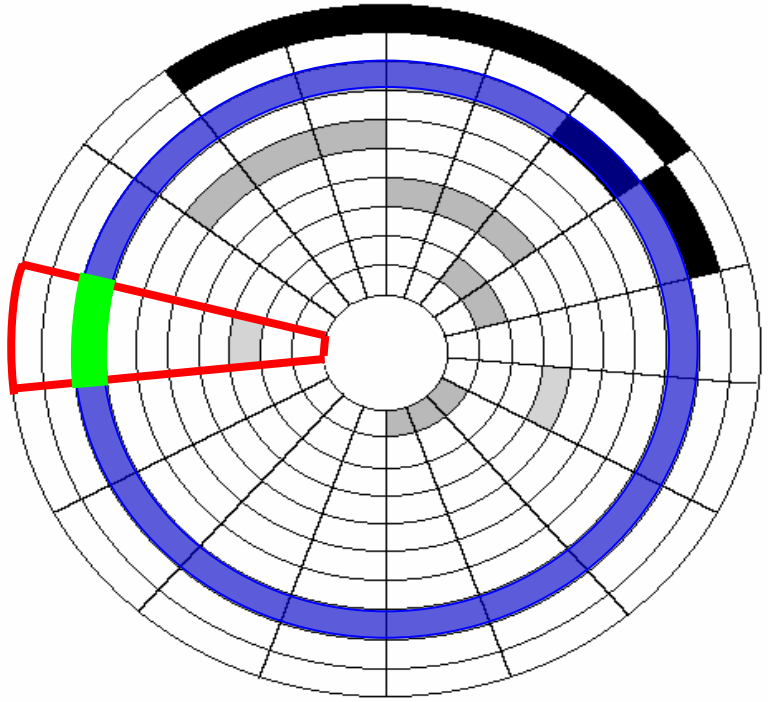
- Each surface has a *read/write head* to access the magnetic fields
  - the heads are mounted on *arms* and their movement is controlled by an *actuator*



    - all the heads move together
- The heads do not touch the surface, but *hover* a very small distance above the surface
  - the *fly height*
    - typically between around 0.2 to 0.07 mm

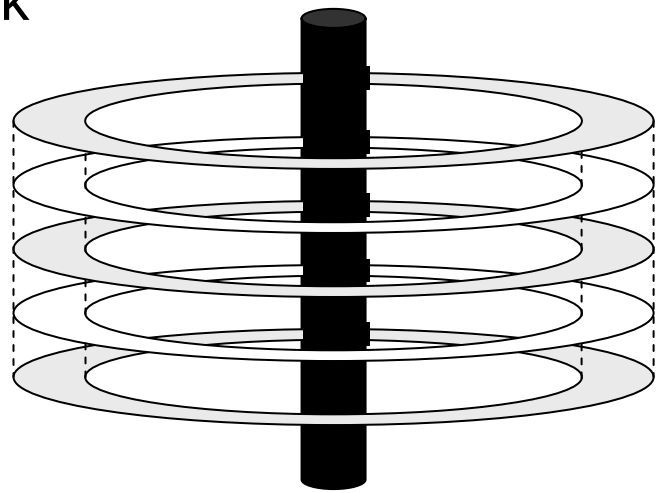
The Disk Surface

- The surface of a disk is logically divided into concentric circular *tracks*
  - 1,000's are common
- The surface is also divided into *segments*
  - a track through a particular segment is a *sector*
    - note: often the term sector is confusingly used to refer to both segments and sectors!
  - on typical PC disks, each sector holds 512 bytes



Cylinders

- A cylinder is a logical (imaginary) concept
  - is the set of tracks on the different surfaces of the disk
    - where the tracks are in the same position relative to the spindle of the disk

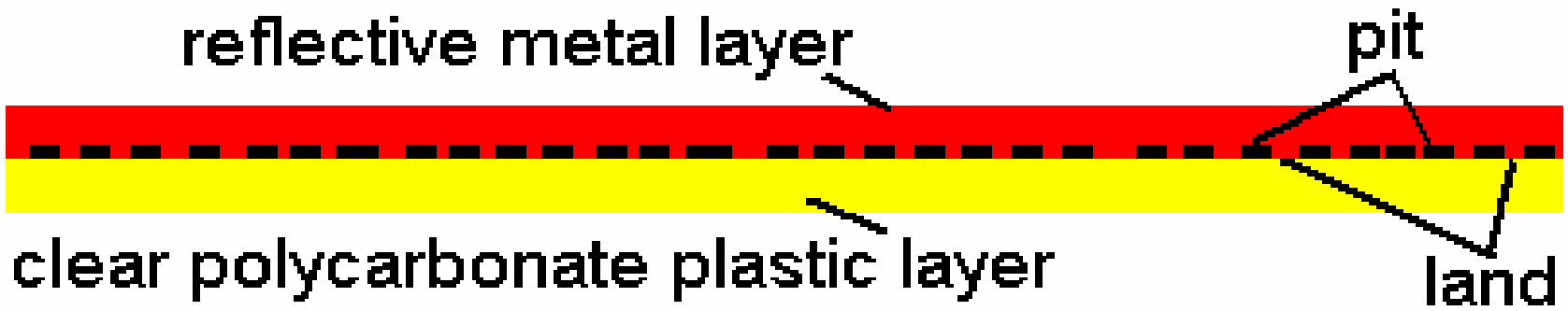


- The cylinder concept is important because it is the surface area of disk that is covered in one rotation when the disk heads are in a certain position

CD-ROM

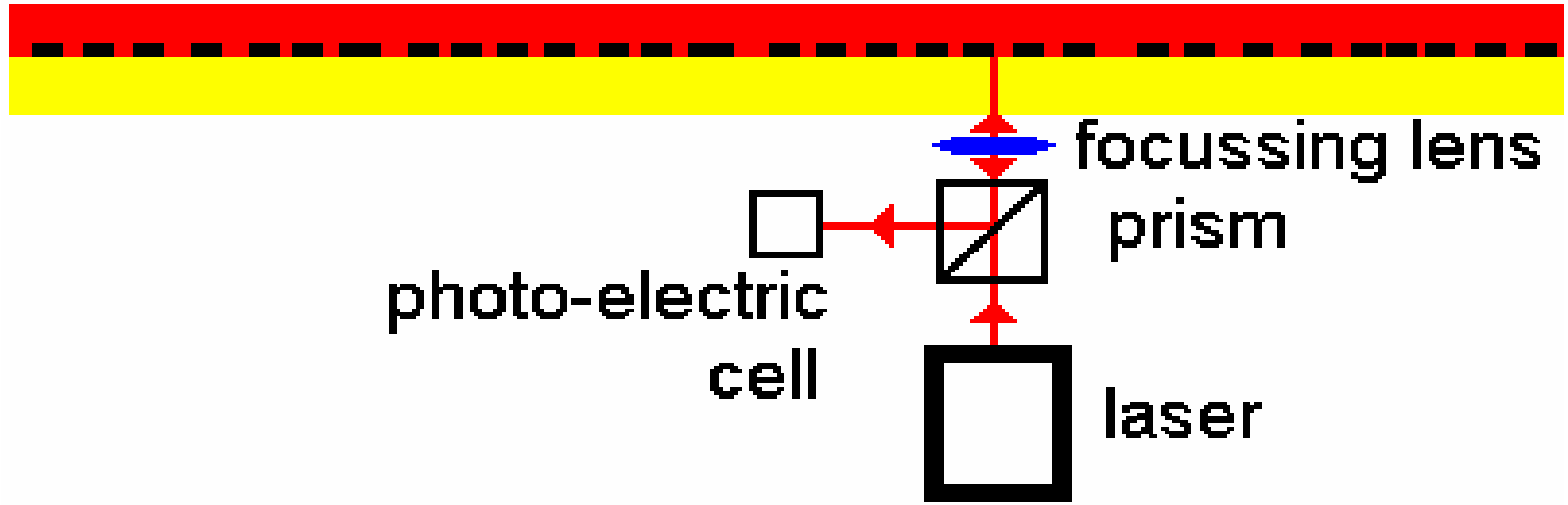
- Compact Disk - Read Only Memory
  - audio disks developed in 1981, data in 1984
  - 12 cm (4.72 inches) in diameter, ≈ 700 Mb capacity
- The CD-ROM spins while a laser beam is shone at the surface and reflections are measured
  - laser continuously refocused as disk spins
  - CD spins at different rates depending on the track
- Speed is measured relative to original audio CD
  - 48 X players spin at 12,000 rpm
  - transfer rates currently up to 7 Mb / sec
    - vibration and ‘noise’ decrease data rate

CD-ROM Structure



- Three layer sandwich, 1.2mm thick
  - data is stored on the middle, reflective, aluminium layer as a series of holes
    - surface called *land(s)*, holes are called *pits*
  - pits are around 0.5 microns wide by 1-2 microns long
    - micron = 10 -6 metres
  - pitch (distance between tracks) = 1.6 microns

CD-ROM Structure



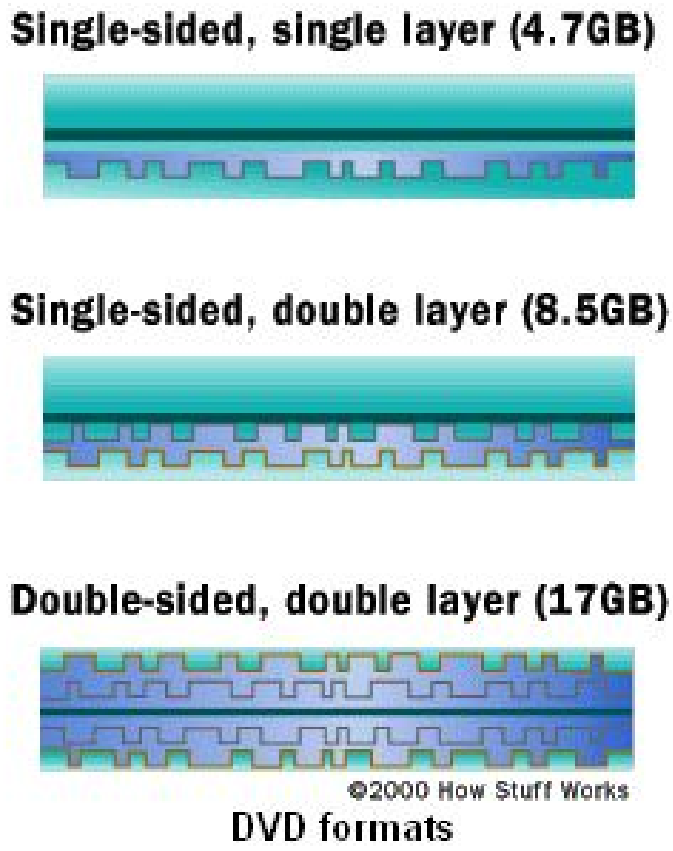
- Data is read by infrared laser beam
  - the lands reflects the beam, the pits do not
    - sensor cell looks for reflected beam from lands
  - 780 nanometres wide (0.78 microns)
- Track is spiral, read from centre outwards

Digital Versatile Disk

- Digital versatile disk (DVD) looks similar to CD, but with higher capacity and higher transfer rates
  - designed to have sufficient capacity to store films
- Improvements over CD
  - smaller tolerances than CD
    - pitch = 0.74 micron, pits = 0.4 micron, laser = 0.65 micron
  - single or double-layer: refocus laser for each layer
  - double sided disks
  - double-layer, double-sided has 16 Gb capacity
- As CDs, also available in recordable (DVD-R) and read-writeable (DVD-RW) formats

Digital Versatile Disk

- On a CD, there is a lot of extra information encoded on the disc to allow for error correction
- The error correction scheme that a CD uses is quite old and inefficient compared to the method used on DVDs.
- The DVD format doesn't waste as much space on error correction, enabling it to store much more real information.



DVD formats

Universal Serial Bus

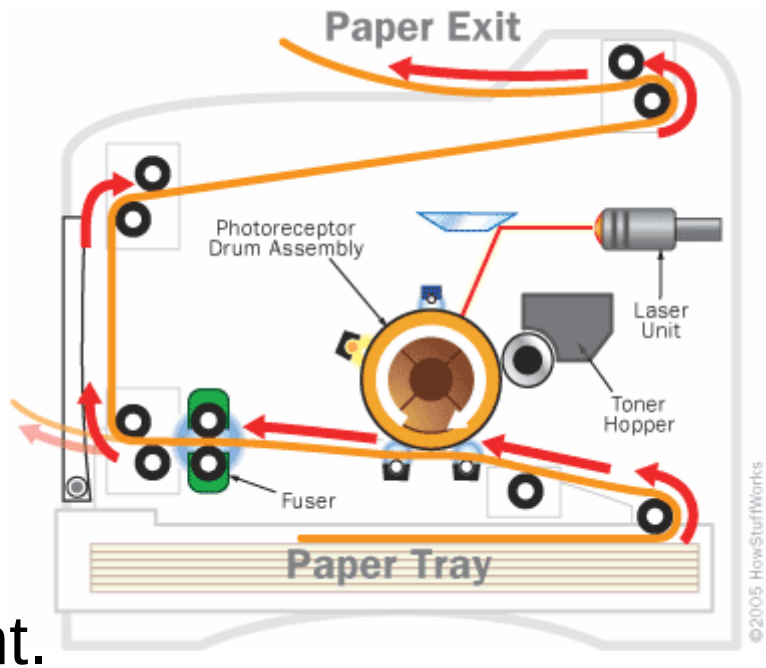
- The computer acts as the **host**.
- Up to **127 devices** can connect to the host, either directly or by way of USB hubs.
- Individual USB cables can run as long as 5 meters; with hubs, devices can be up to 30 meters (six cables' worth) away from the host.
- With USB 2.,the bus has a maximum data rate of **480 megabits per second**.
- A USB cable has two wires for power (+5 volts and ground) and a twisted pair of wires to carry the data.
- On the power wires, the computer can supply up to 500 milliamps of power at 5 volts.

USB

- Low-power devices (such as mice) can draw their power directly from the bus. High-power devices (such as printers) have their own power supplies and draw minimal power from the bus. Hubs can have their own power supplies to provide power to devices connected to the hub.
- USB devices are **hot-swappable**, meaning you can plug them into the bus and unplug them any time.
- Many USB devices can be put to **sleep** by the host computer when the computer enters a power-saving mode.

Printers: e.g. Laser

- The principle at work in a laser printer is static electricity
- Static electricity is an electrical charge built up on an insulated object
- Oppositely charged objects are attracted to each other
- A laser printer uses a **photoreceptor**, typically a revolving drum or cylinder.
- This **drum** is made out of **photoconductive** material that can be discharged by light.



Printers: the process

- The application you are using sends the data to be printed to the printer driver
- The driver communicates with printer's own configurations registers and translates the data into a format that the printer can understand
- The printer receives the data from the computer
- It stores a certain amount of data in a buffer (e.g. typically ranges from 512 KB to 16 MB of RAM)
- Buffers are useful because they allow the computer to finish with the printing process without having to wait for the actual page to print
- If the printer has been idle for a period of time, it will normally go through a short head cleaning (inkjet) or warming (laser) cycle

Printers: the process

- The control circuitry activates the paper feed motor. This engages the rollers, which feed a sheet of paper from the paper tray/feeder into the printer
- A small switch in the tray/feeder can detect whether there is paper available. If the switch is not depressed, the printer sends an alert to the computer (out of paper) and stops

Printers: the process

- Once the paper is fed into the printer and positioned at the start of the page, the printing process starts
  - In an inkjet, the paper pauses for a fraction of a second each time that the print head sprays dots of ink while scanning a line on the page and then advances a bit before stopping again.
  - In a Laser, the paper is rolled over the drum which transfers static electricity in a pattern created by the laser, the toner sticks to the static charged areas only and a heater sets the toner.