L40

- Portions To Cover
  - ✓ Secondary storage--- Optical disks

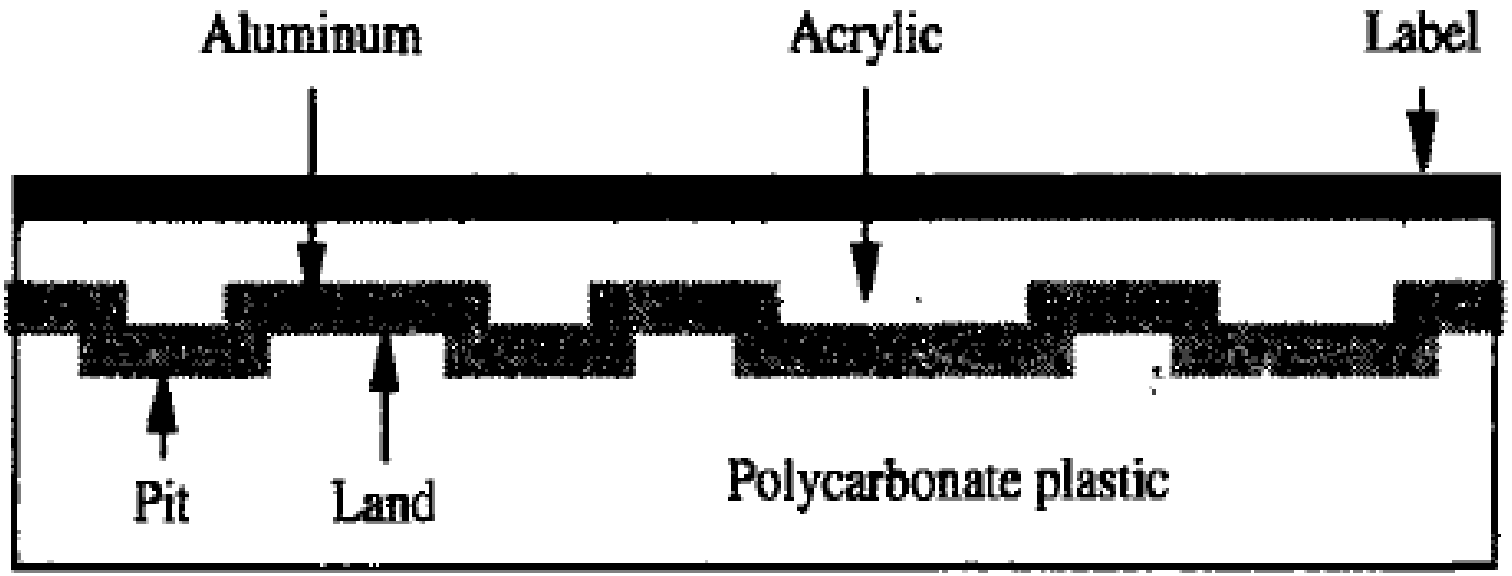
Continued…

- Large storage devices can be implemented using optical means
- CD was the first application of this technology
- Optical technology provides high capacity read only storage called CD-ROM
- First generation of CDs was developed in 1980 by sony and philips
- The technology exploited digital rep of analog signals
- Audio CDs were designed that can hold 75 mins of music
- Video CDs have more bit storage capacity than audio CDs
- Multimedia CDs are used to store large amount of computer data

Continued…

- CD technology:
- Optical technology used for CD is based on a laser light source (infrared light laser is used whose wavelength is 780nm)
- Laser beam is directed to the surface of rotating disk
- Physical indentations (pits, ***land***) are arranged along the tracks
- They reflect the beam toward a photodetector that detects the stored binary pattern
- We represent 0 and 1 optically
- This binary pattern is the encoded data not the rep of original data
- Cross section of small portion of CD is shown

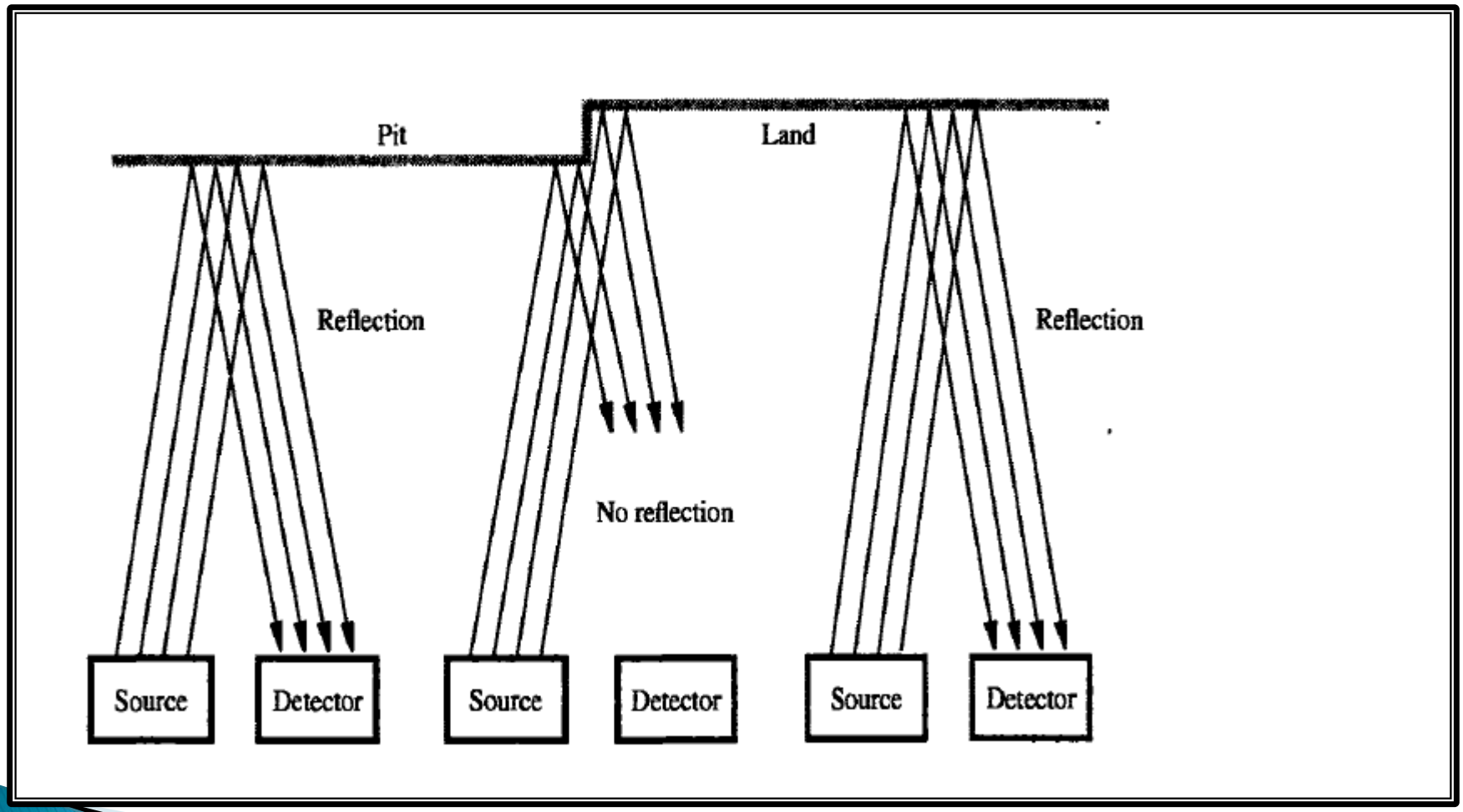
Continued…



Continued…

- Bottom layer is polycarbonate plastic
- You can see physical indentations on the surface
- Pits and **lands**
- **Unindented parts are called lands**
- The surface is programmed to store data by indenting with pits
- A thin layer of aluminum is placed on disk
- It is covered by acrylic and in turn covered with label
- Laser source and photodetector are positioned below the polycarbonate plastic
- The emitted beam travels through the plastic and may or may not come back to photodetector (depends on the position)
- When reflection or no reflection happens?

Continued…


Pit
Land
Reflection
No reflection
Reflection
Source
Detector
Source
Detector
Source
Detector

Continued…

- From the diagram it is very clear that when it is purely pit or land the beam comes back to photodetector (reflection). The detector will see it as a bright spot
- But when it is a transition point (transition from pit to land and vice versa) there would be no reflection. The detector would see it as a dark spot
- ?
- The reflected waves from pit will be 180 degree out of phase with the waves reflected from land. They will cancel each other
- So no reflection and will be interpreted as dark spot
- Let’s look at the stored data which is in encoded form

Continued…

- Stored binary pattern (encoded info)

- Here the transition detected as dark spot denotes binary 1 and the bright spots denote binary 0
- How many dark spots and bright spots?
- CDs use complex encoding scheme that is out of the scope
- Problem:
- CD is 120mm in diameter. There is a 15mm hole in the center. Inter track distance is 1.6 microns. How many

Continued…

- In general, track density of CD would be higher than that of magnetic disks
- CD-ROM:
- In CDs info is stored in binary
- The problem with pits is they are very small
- It is impossible to implement all pits perfectly
- Some errors may occur
- These errors are tolerable if the applications is audio or video
- But in critical applications it is necessary to provide bits for error checking and correcting
- Again here tracks are divided into sectors
- Sectors have pits and lands
- The material used for pits and lands may differ (for ex: organic dye is used in CD-R whereas alloy is used in CD-RW)
- A typical sector is 2352 bytes
- There will be 16 byte header that identifies the sector followed by 2048 bytes of data followed by 288 bits for error detecting and correcting
- Single-bit errors are corrected by the **encoding scheme itself**
- Burst errors are corrected by the error correcting bits
- CD-ROM drives operate at diff speeds

Continued…

- Basic speed--1X, 75 sectors /sec
- It provides data rate of 150KB/s
- This speed affects the data rate not the storage capacity
- Speed—40X, 40*150KB/s
- The transfer rate is lower than that of magnetic disks
- The seek time of CD-ROM is higher by a significant factor than seek time of magnetic disks
- CD-ROMs are inferior
- Low cost, Portable, Large storage capacity
- Low transfer rate, high seek time
- CD-R
- This can be easily recorded by a user
- Evolved in 1990
- The material used for pits and lands is organic dye
- Recording can be done by burning pits into organic dye
- These burnt spots are heated and they become opaque
- So they reflect less light when read

Continued…

- CD-RW:
- These are flexible CDs because they can be written multiple times by the user(1000 times)
- It is similar to CD-R
- Instead of organic dye, the material used is alloy of silver and 3 other elements
- The interesting feature is that when it is heated above its melting point 500C and cooled down it goes to an amorphous state
- If it is heated to 200C (maintained for some time)it leaves the alloy to crystalline state (Annealing)
- If this crystalline state represents land then pits can be created by heating the portions to about 500C and cooling down
- If I want the stored data to be erased I will heat to 200C and the alloy is returned to uniform crystalline state
- CD-RW uses 3 diff laser powers
- Highest power for recording pits
- Second highest for putting alloy in crystalline state
- The lowest power to read data
- CD-RW drives deal with CD-ROM, CD-R also
- Low cost storage medium

Continued…

- DVD (Digital Versatile Disk) technology:
- First DVD standard came in 1996
- The objective is to store a full length movie on a one sided DVD disk
- Physical size of DVDs is the same as CDs
- Its storage capacity is made much larger than CDs
- ?
- By reducing the length of pits to 0.4 micron whereas in CDs it may range from 0.8 to 3 microns
- Is this sufficient?
- No, We need a laser light source that can be focused to smaller spots (red light laser whose wavelength is 635nm is used)
- Even intertrack distance is reduced to 0.74 microns
- Obviously, DVDs will have greater capacity than CDs
- Typical DVD capacity 4.7 GB

Continued…

- Further improvements in storage can be achieved if we go for 2 layered or 2 sided or both 2 layered, 2 sided
- DVD-5:
- Single-layered single sided disk
- DVD-9:
- A double layered disk use 2 layers on which tracks are arranged on top of each other
- First layer is covered by translucent material (instead of aluminum) that semi reflects
- Second layer is covered by reflective material
- The disk is read by focusing beam on the layer
- The layer on which beam is not focused reflects a much smaller amount of light which is eliminated by detector
- Capacity: 8.5 GB

Continued…

- DVD-10:
- Single layered 2 sided disks
- Capacity: 9.4 GB
- DVD-18:
- Double layered 2 sided disks
- Capacity: 17 GB
- When DVD rotates at the same speed as CD data transfer rate will be higher because of higher pit densities
- DVD-RAM:
- Rewritable DVD
- ADV:
- Large storage capacity
- DISADV:
- High price
- Slow writing speed