

Computer Displays I

DM2112

Digital Entertainment Systems



Computer Displays

- 4 main types
 - CRT (Cathode Ray Tube)
 - Plasma
 - LCD (Liquid Crystal Display)
 - LED



Lecture 9
Computer Display

THE CRT

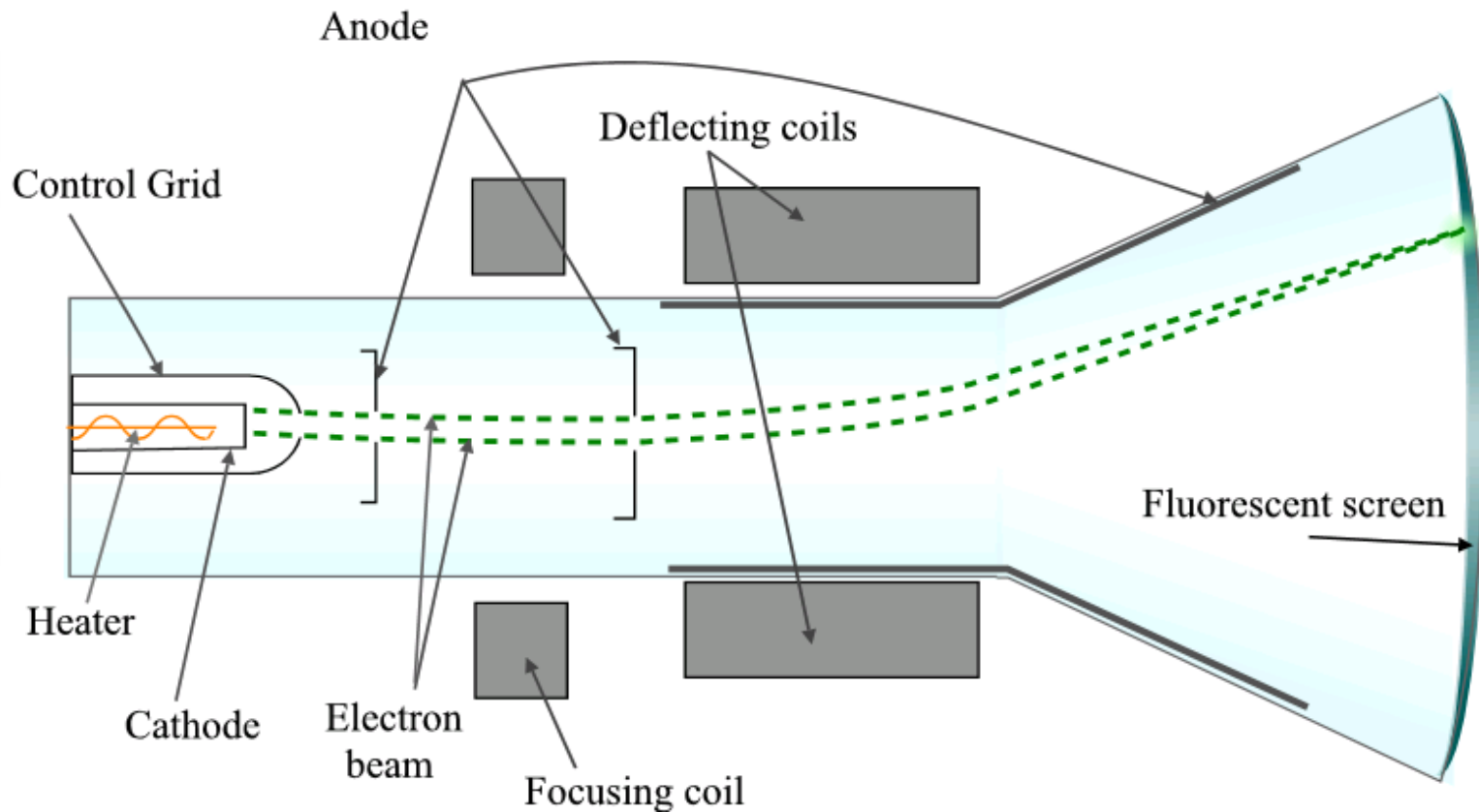


The CRT

- Is a vacuum-filled glass envelope
- Contains
 - Electron gun to provide a source of electrons (electron beam)
 - Fluorescent screen (coated with a material called phosphor)
- When electrons strike the phosphor, light is emitted.
- The electron beam can be guided to hit certain points on the screen. This is how an image is displayed.

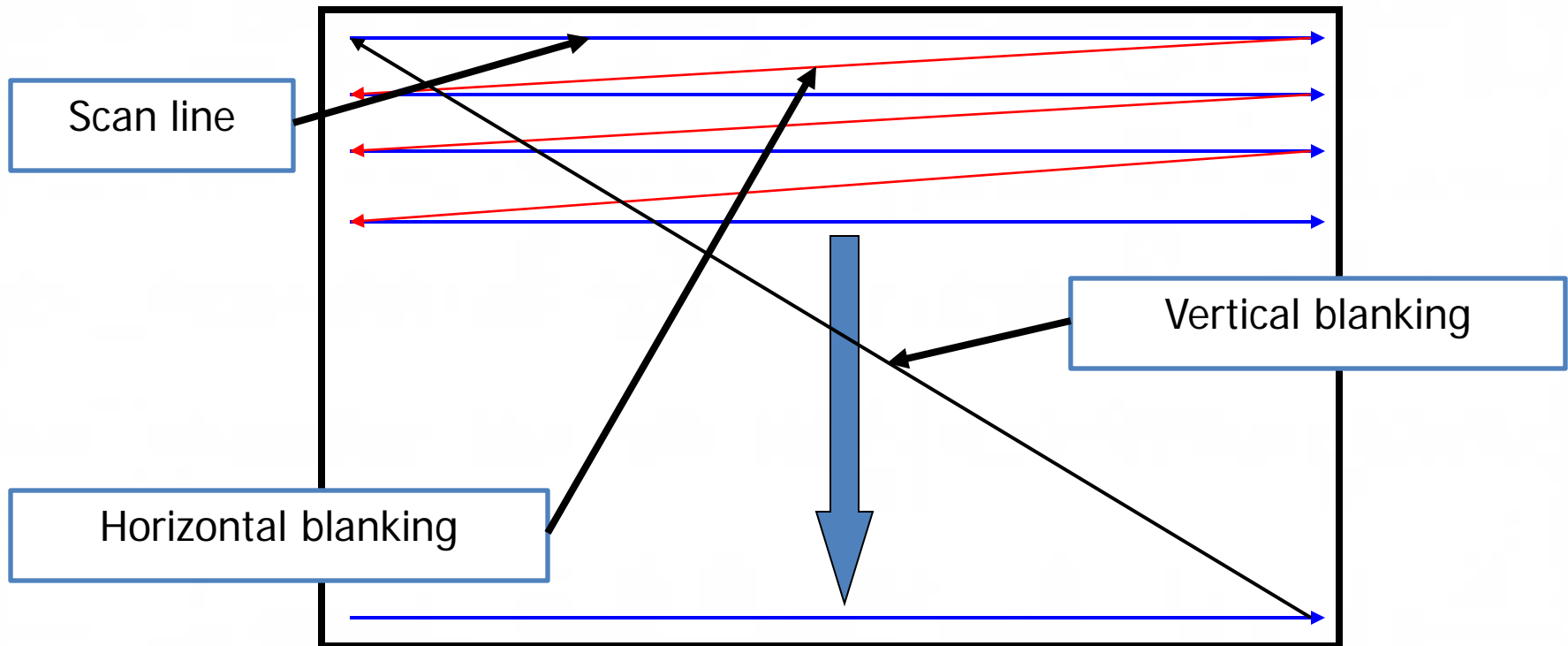


Mechanics of a CRT



Raster Scanning Pattern

- In CRT display, electron beam is systematically moved from top to bottom of the screen in a fixed pattern called a 'raster'.



Colour CRT Displays

- There are 2 main technologies for producing colour CRT displays
 - Shadow mask
 - Aperture grille
- For each method, 3 phosphors which emit red, green, and blue light are used.
- There are 3 electron guns that shoot electrons onto each of the coloured phosphors



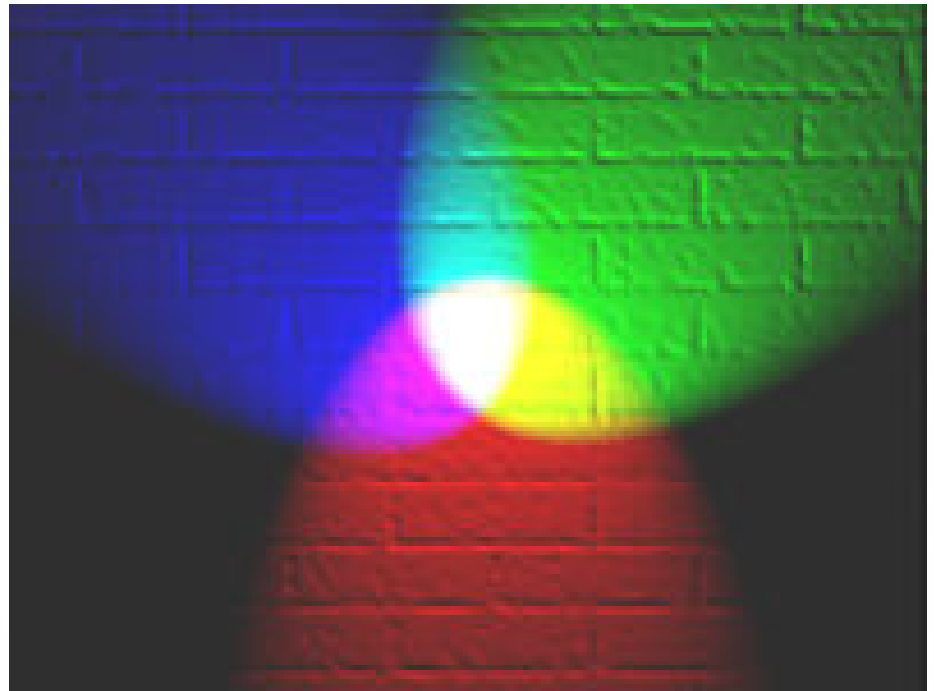
Additive VS Subtractive Colours

- An additive colour system
 - Light that is emitted directly from a source, e.g from a computer monitor or television
 - RGB system – Red, Blue, Green, (Alpha)
- A subtractive colour system
 - Light that reaches our eyes due to reflection, e.g inks, dyes and pigments
 - There is no source sending the colours directly into our eyes
 - CMYK system – Cyan, Magenta, yellow, K (Black)



Mixing of Colors in Additive System

- **Red** + **Green** = **Yellow**
- **Red** + **Blue** = **Magenta**
- **Green** + **Blue** = **Cyan**



Additive VS Subtractive Colours

- Images can be saved as RGB or CMYK
 - Play around with Photoshop! 😊
- Commonly,
 - Image for computer screen display
 - RGB
 - Image for printing (i.e. by commercial printers)
 - CMYK



'Death' of the CRT

- Plasma TVs never really took off in large numbers (too expensive)
- Cheap LCD TV eventually phase out CRT
 - Japan phased out broadcast of analog (non-HD) TV signals.
 - Taiwan recently too
 - Effectively means a CRT is useless in the country now



Screen Tearing and VSync



Image from [http://en.wikipedia.org/wiki/File:Tearing_\(simulated\).jpg](http://en.wikipedia.org/wiki/File:Tearing_(simulated).jpg)



Lecture 9
Computer Display

THE PLASMA DISPLAY

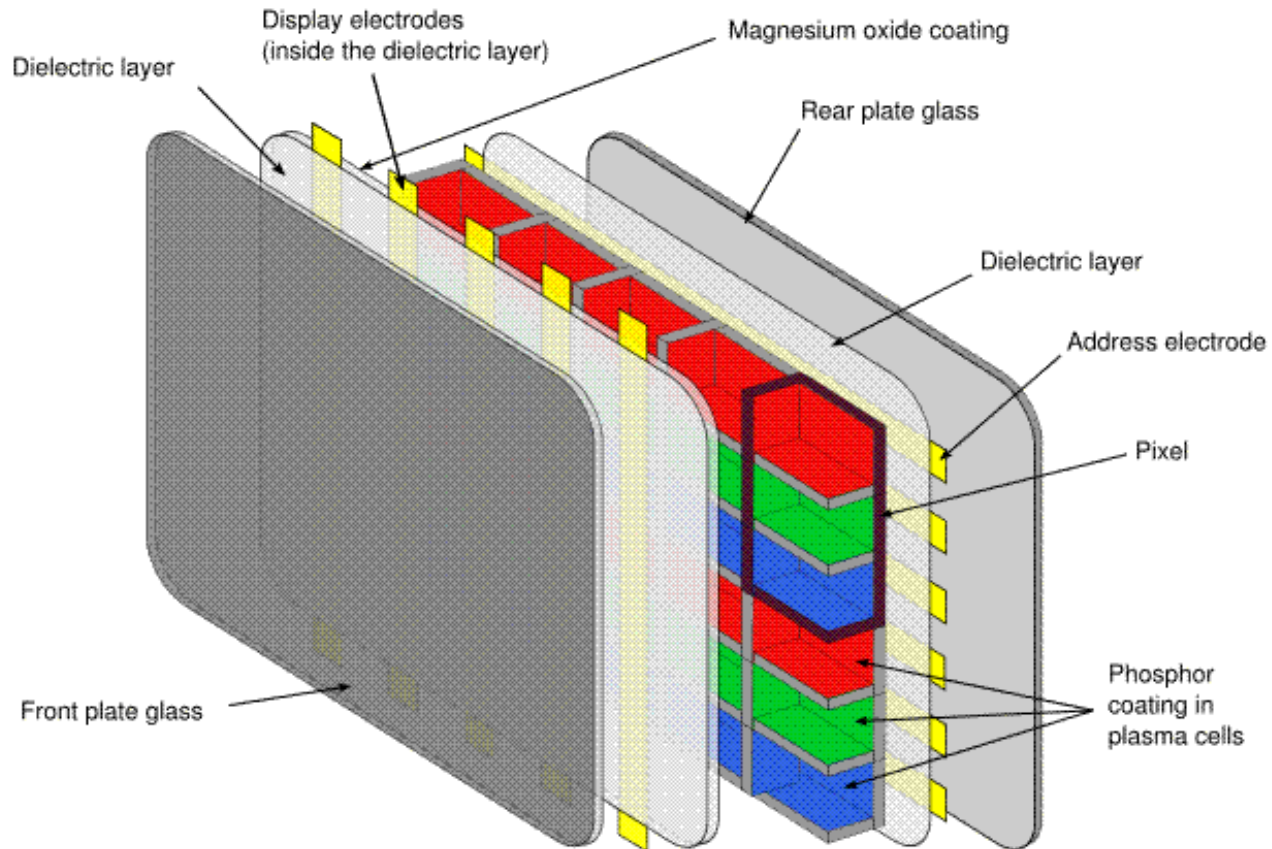


The Plasma Display

- A type of flat panel display.
- Consists of many tiny cells located between 2 panels of glass.
- Each cell holds a mixture of neon and xenon gases, and cells are coated with phosphor.
- Electricity can be run through a cell to turn the gas inside into a plasma (the gas breaks down into charged particles called ions).
- The plasma reacts with the phosphor to create coloured light.



Inside a Plasma Display



Advantages of Plasma Display

- Slim Profile
 - Compared to CRT
- More accurate colour display than LCD
- Almost no motion blur
 - Due to high refresh rates



Disadvantages of Plasma Display

- Prone to screen burn-ins
- Does not come in sizes smaller than 37"
- Far heavier than LCD TVs
 - Due to glass holding the plasma gas
- Uses more electricity than LCDs



Lecture 9
Computer Displays

THE LCD

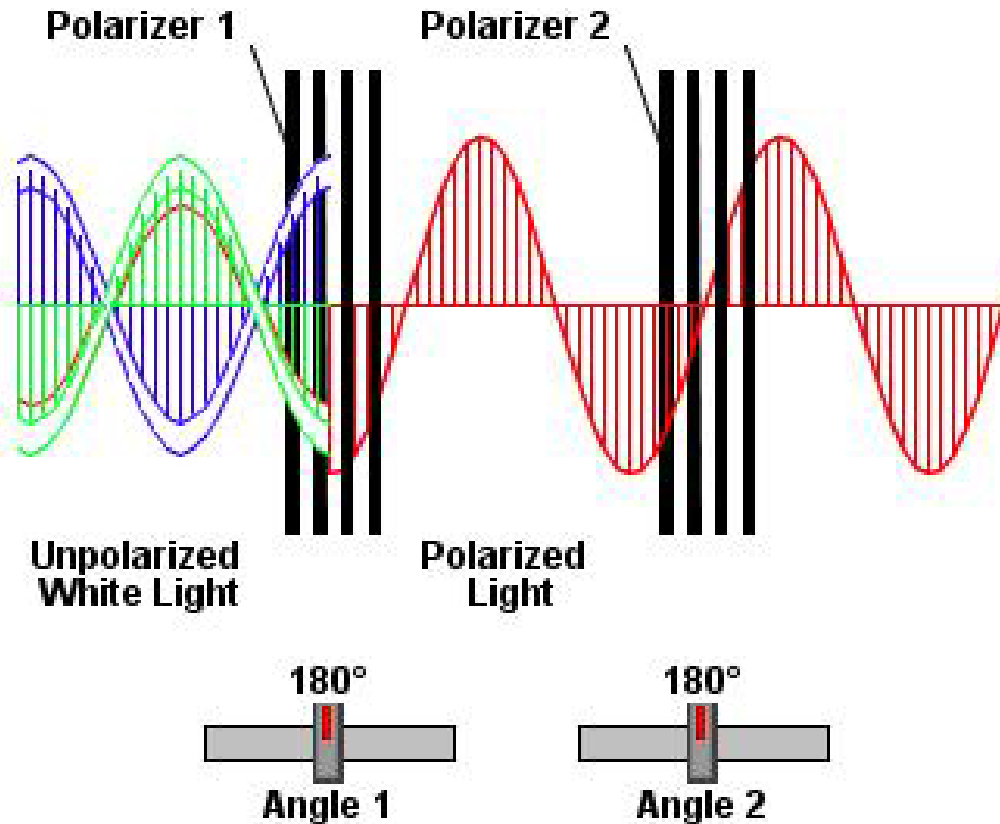


The LCD

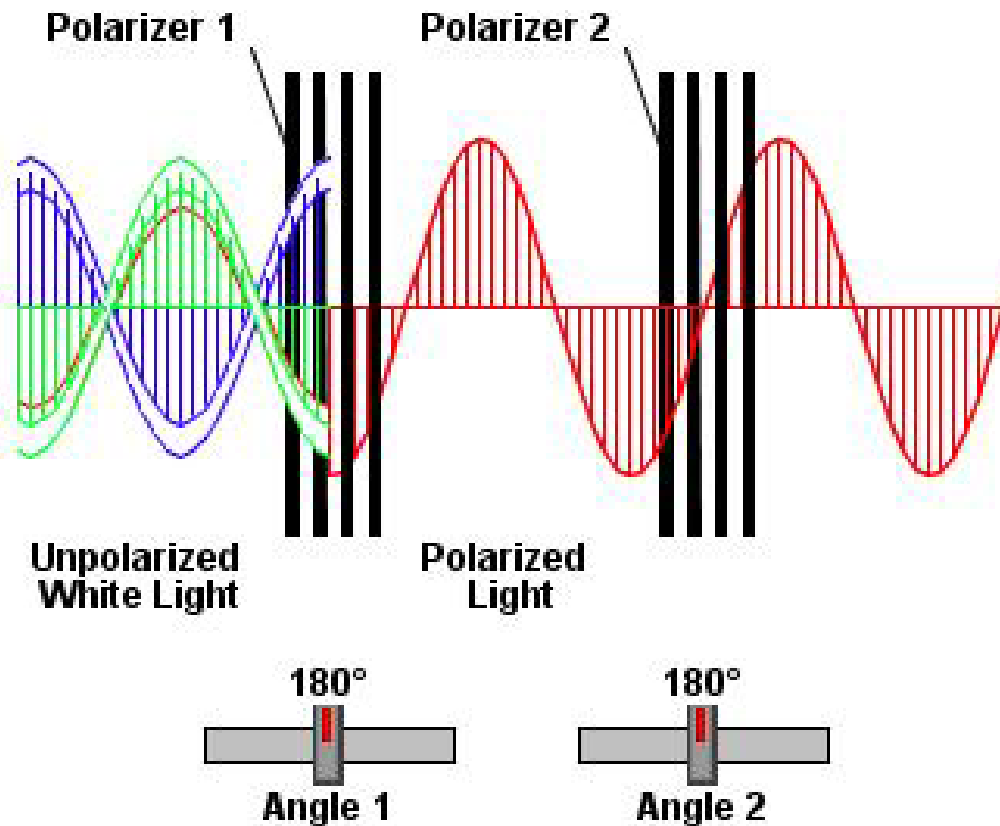
- Thin and flat display device that uses very small amount of electric power
- Works by polarisation of light
- Liquid crystal molecules are sandwiched between 2 polarising filters. These filters are perpendicular to each other. i.e. without any liquid crystal, light passing through one filter is blocked by the other.
- The alignment of the liquid crystal molecules can be controlled using electrical voltages.
- By varying the alignment of the molecules, light can pass through both filters in different amounts



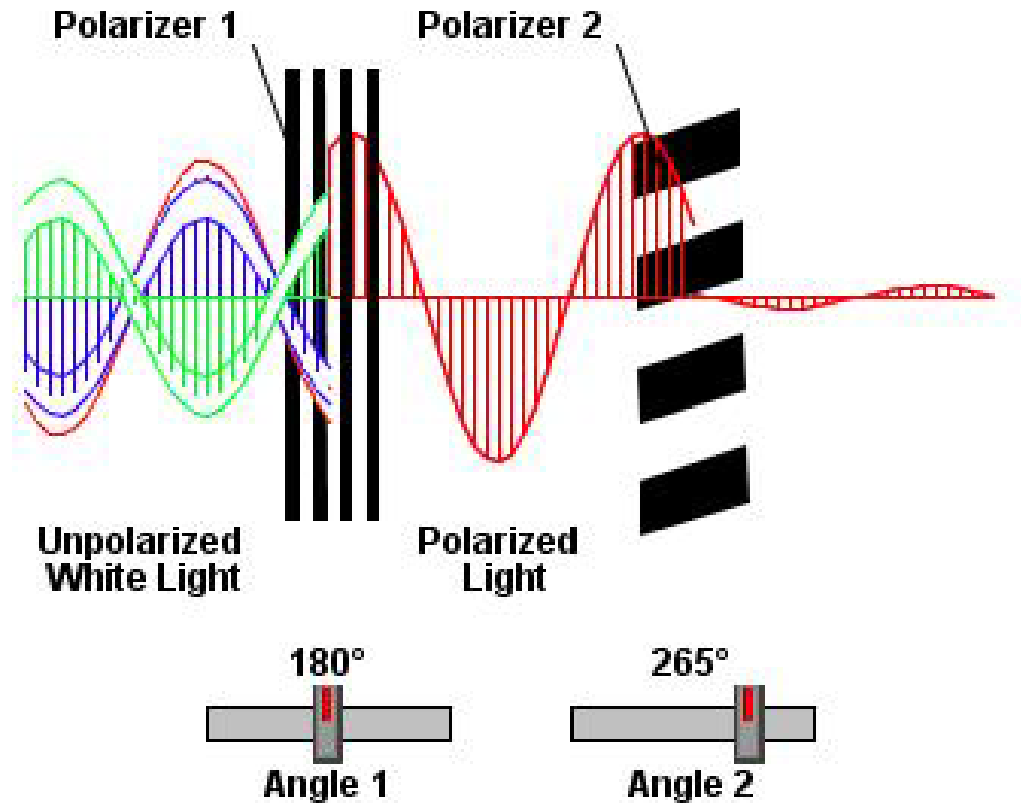
Polarisation of Light



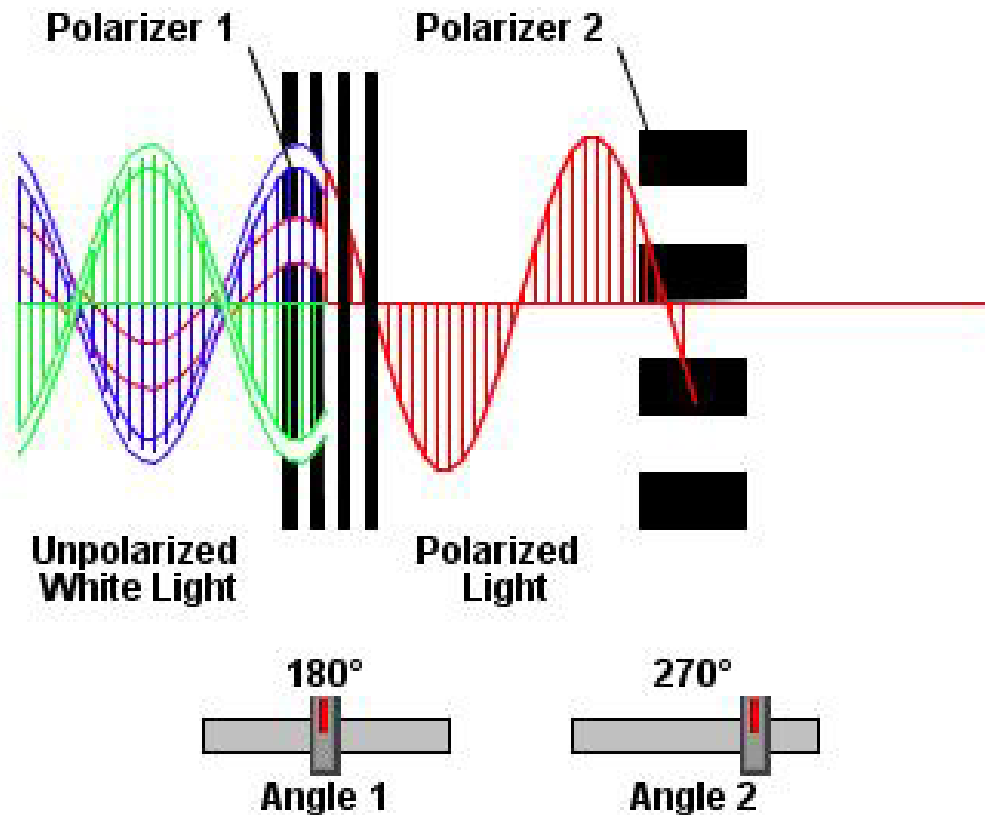
Polarisation of Light



Polarisation of Light



Polarisation of Light



Use of Polarisation

- In photography, polarising filters can be used to correct for overly-light skies. Notice that the colours also become more saturated.

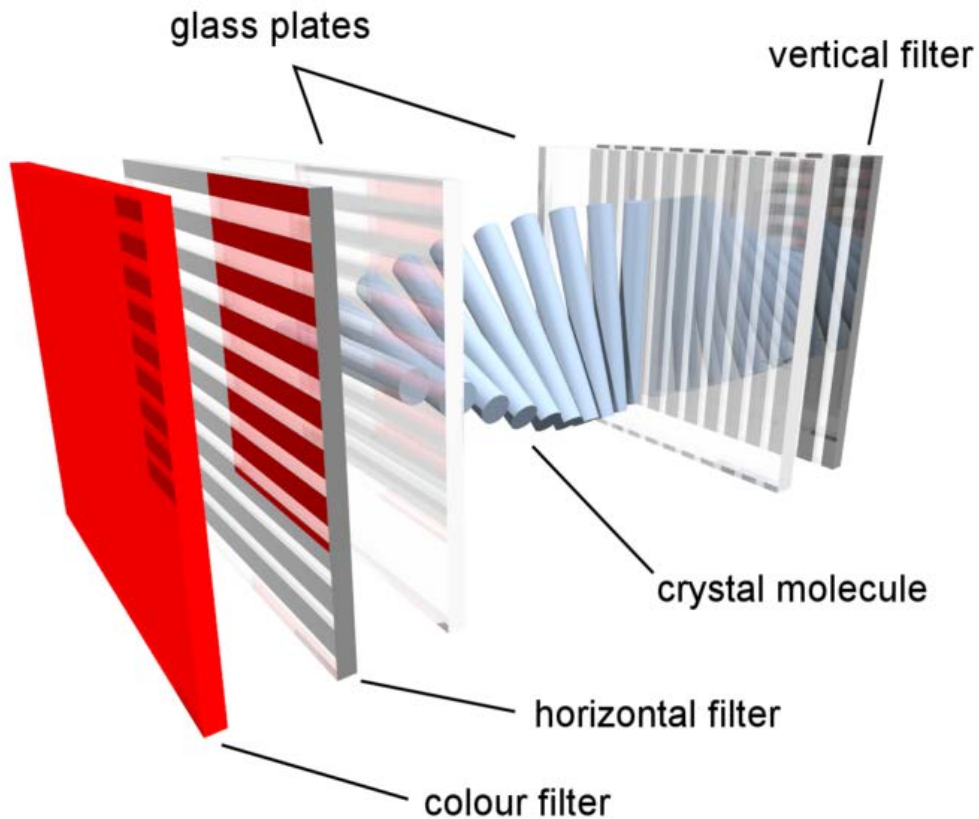


Unpolarised

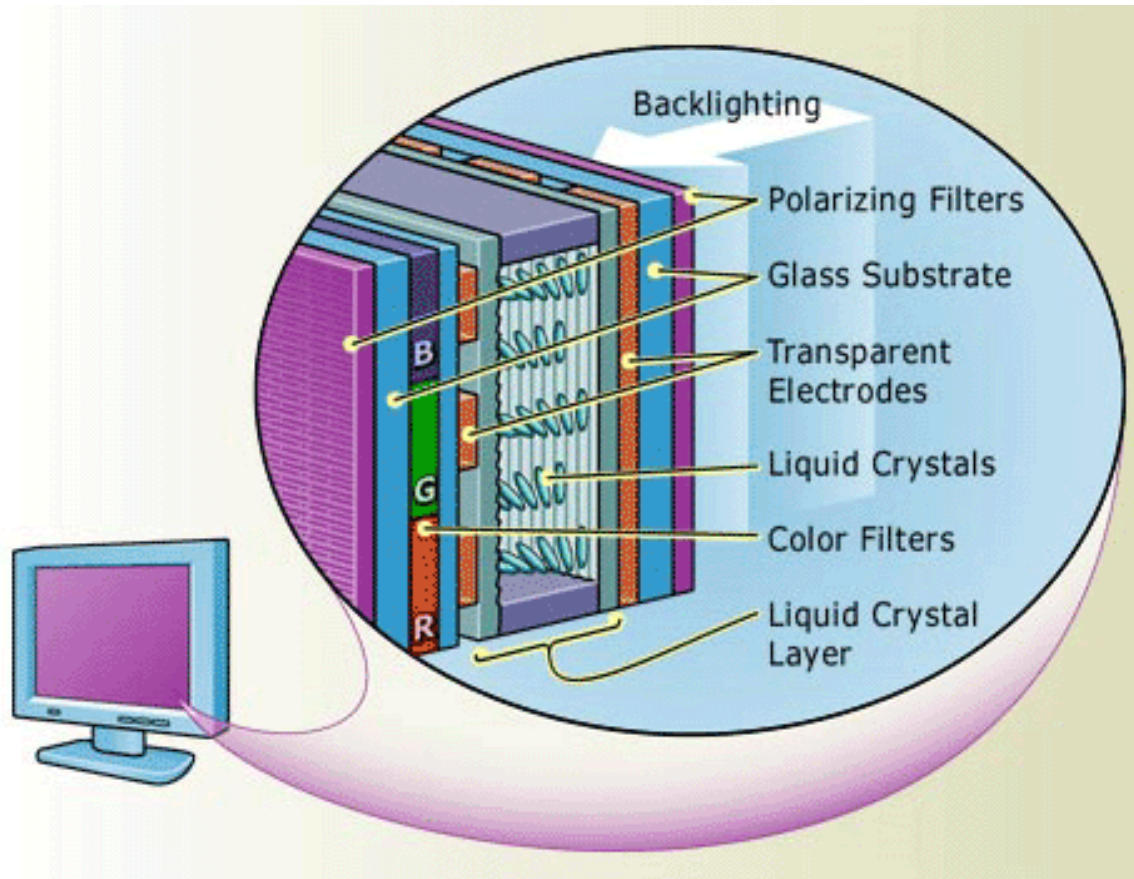
Polarised



Inside an LCD



Inside An LCD



Advantages of LCD Display

- Slim profile and lighter weight
 - vs small screen size plasma
- No Burn-ins
- Runs at cooler temperature



Disadvantages of LCD Display

- Lower contrast ratio
 - Not very good at displaying black
- Individual pixels may burn-out
 - Dead pixel problem
- Motion blur can be a problem with older generation LCD TVs



Contrast Ratio

- Measure of luminance that the screen is capable of producing
 - Ratio of brightest to darkest

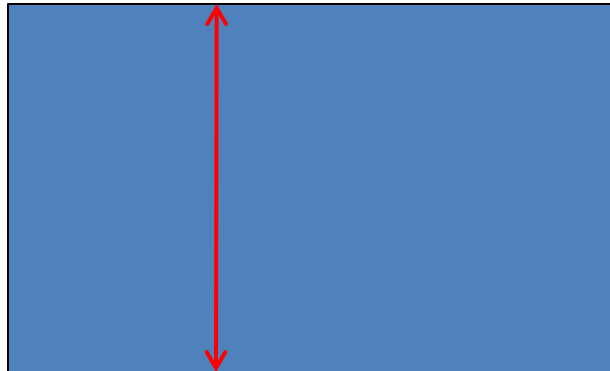


- A Screen capable of contrast ratio of 5000:1 would be better than one that is only capable of 1000:1

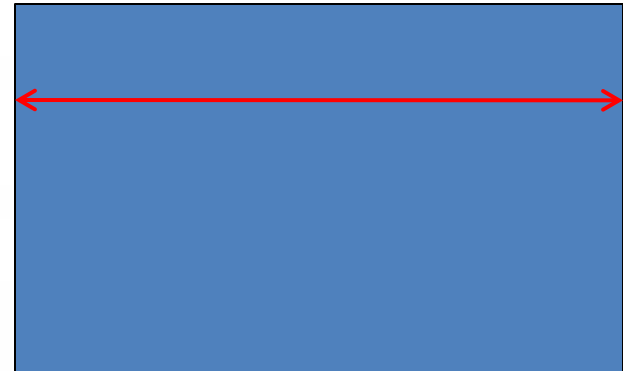


Question!

- How do you count inches on a computer display/TV?

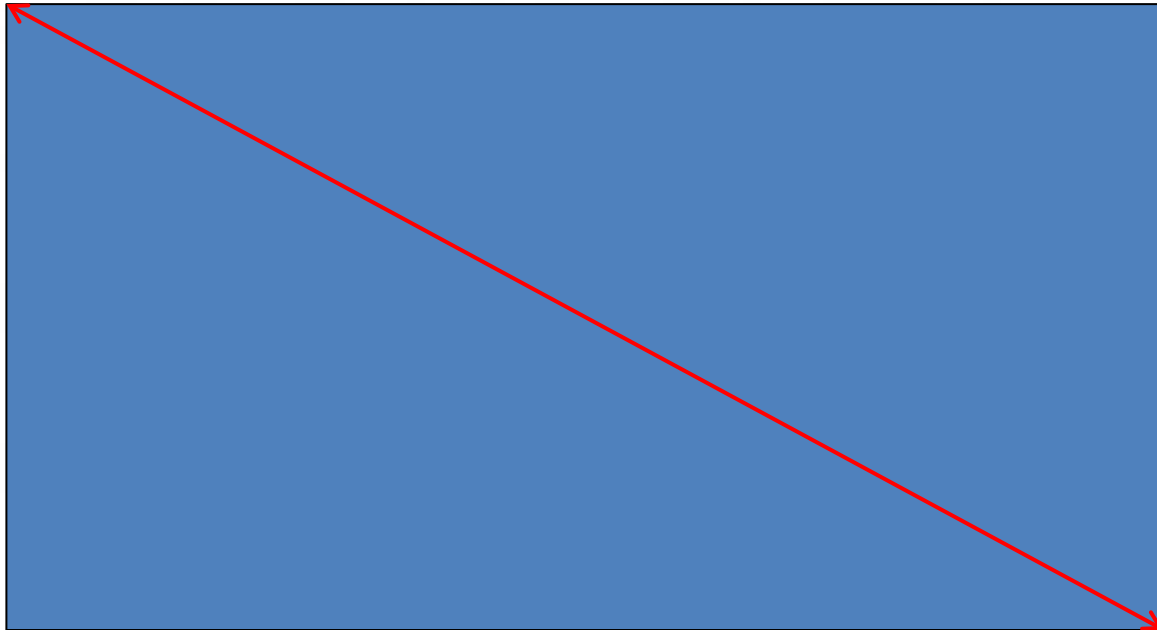


or



Answer!

- Neither is correct!



Trends in Mobile LCDs

- The old



176 x 220

176 x 220



176 x 220



240 x 320

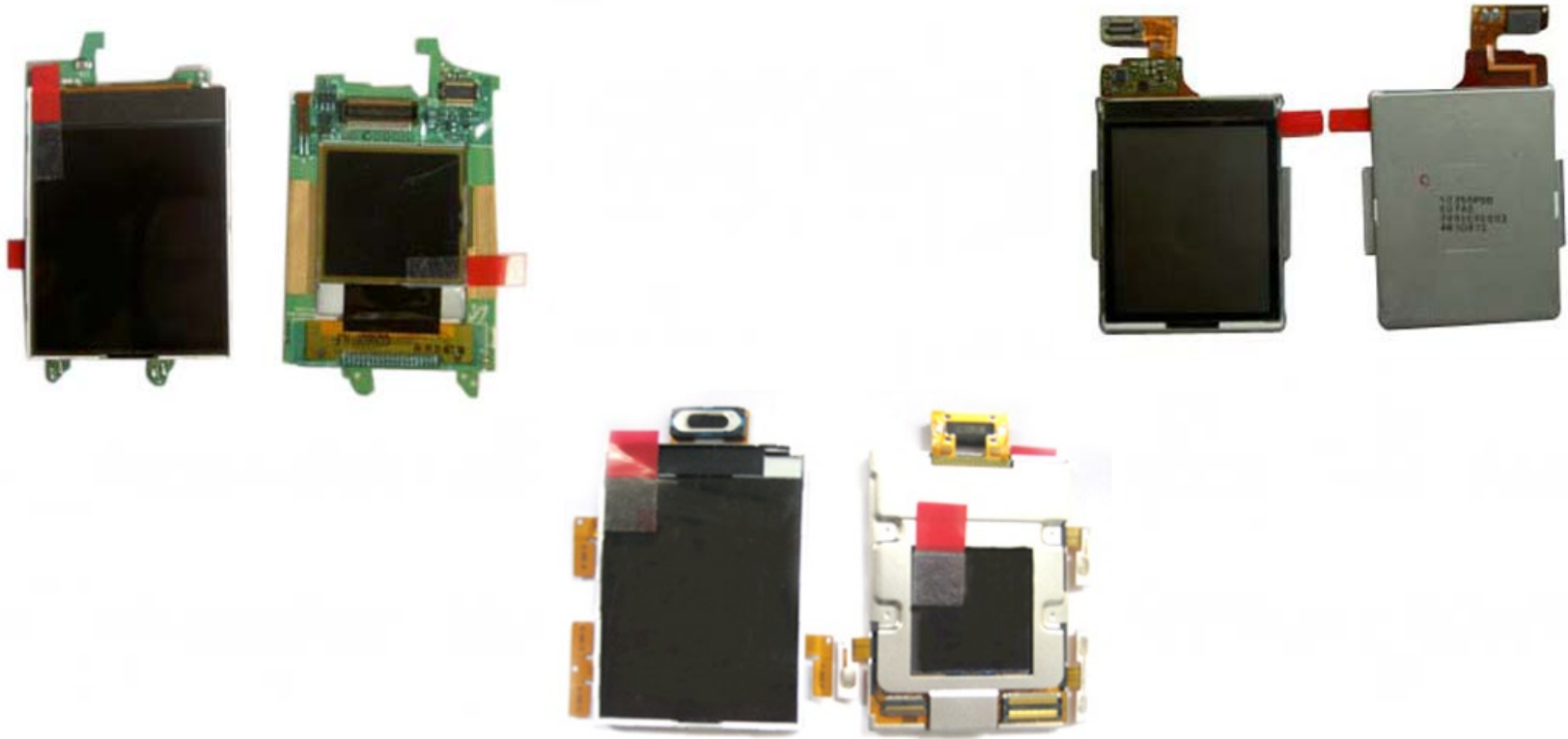


854 x 480

960 x 640



Inside a Mobile LCD



Many faces of a Mobile LCD

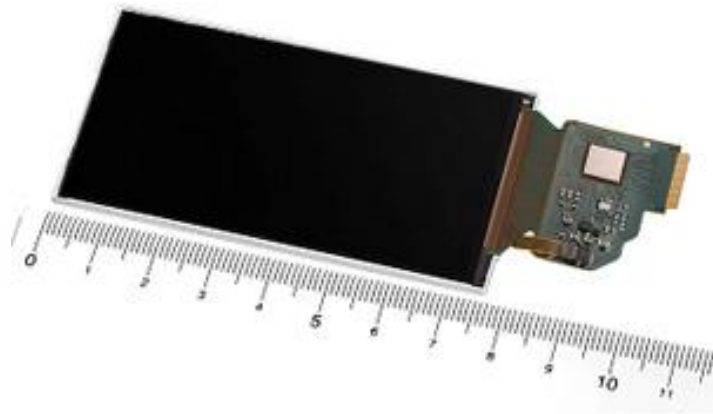
- There are many types of connectors to connect the LCD to the phone's CPU



Mobile Screen Displays

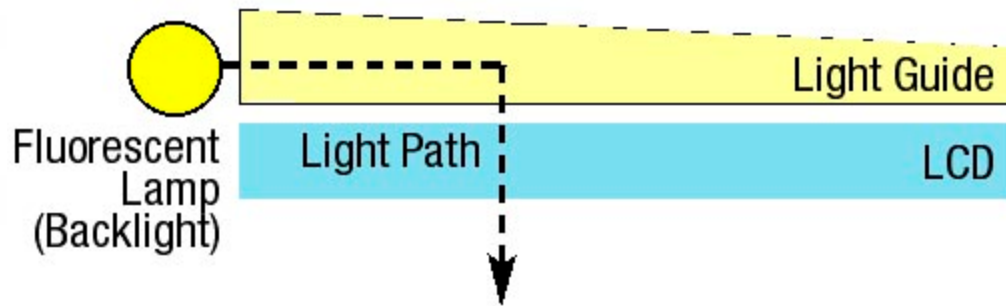
- Previously, we looked at image/video display on TVs and PC monitors. Now let's take a look at the screen display of mobile phones.
- Types of common screen display
 - Transmissive
 - Reflective
 - Transflective
 - CSTN (Passive Matrix)
 - TFT (Active Matrix)
- We'll look at just the ones in red

slashphone.com



Transmissive

- Most of the older notebook screens are transmissive
- What do we mean by transmissive?
 - Pixels are illuminated from behind the screen
 - Offer high contrast, deep colours

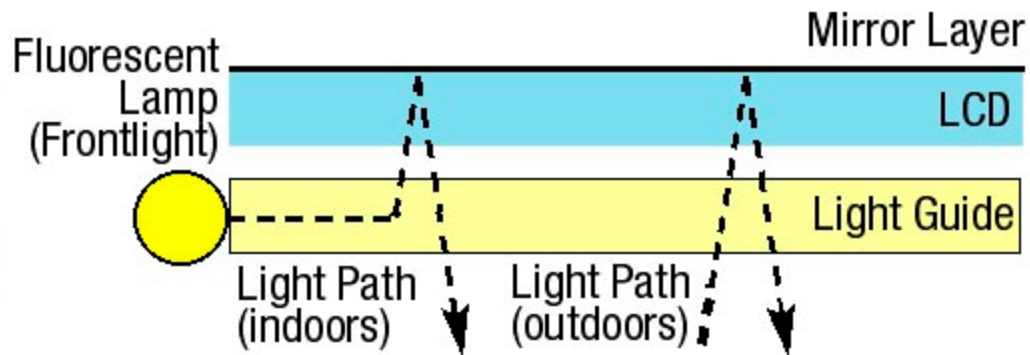


- Disadvantage: faint image under sunlight



Reflective

- Pixels are illuminated from the front of the screen
- Most PDA LCDs use this method
 - Uses less power
 - Well suited for bright and medium light conditions

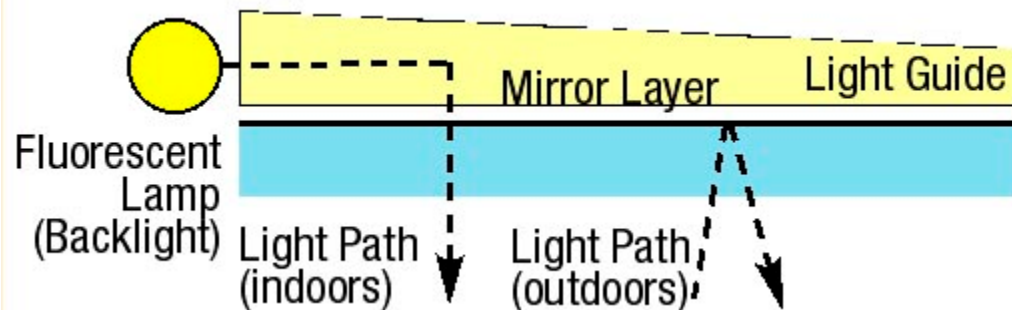


- Disadvantage : Lower contrast ratio



Transflective

- This is a combination of illumination characteristics of 2 technologies
 - Transmissive
 - Reflective
- Pixels are illuminated from both front and behind the screen



For more reading

- For more elaborate understanding on LCD
 - <http://electronics.howstuffworks.com/lcd.htm>



LED-TVs

- Technically, these are LED-backlight **LCD** TVs
- Same technology as LCD except backlighting by LED vs CCFL (Cold Cathode Fluorescent lamps)
- Advantage
 - Deeper contrast
 - Lower power consumption
 - Environmentally friendlier
 - Less pollution when disposing ☺
- But currently more expensive



OLED Display

- True LED-based display technology
- Examples
 - Samsung Super AMOLED
 - Sony XEL series
- Does not require a backlight
 - Can be thinner than LCD
 - Capable of high contrast
- Has issues
 - Short lifespan (about half of LCD's)
 - Susceptible to water damage
 - Burn-ins



Touchscreen Displays

- User can interact with the system by touching on the display screen
 - More intuitive – directly interact with display
 - Simple or multi-touch gestures



Touchscreen Displays

- Common Technologies

- Resistive

- 2 flexible sheets coated **with resistive material separated by a gap**. Pressing the top sheet causes it to contact the bottom sheet, allowing **resistance** to be measured.
 - **Lower cost** than capacitive screens
 - Can use with **non-conductive gloves or stylus**

- Capacitive

- Human body is an electrical conductor – touching (or going near) the screen surface distorts the screens **electrostatic field**, which can be detected as a **change in capacitance**
 - **More sensitive** than resistive screens
 - **Higher contrast** than resistive screens
 - **Multi-touch** support

