AMOLED Display

Semiconductor and Lighting Technology 2018

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School of Electronic and Information Engineering,
Xi'an Jiaotong University

Passive Matrix → Active Matrix

LED -> Light Emitting Diode → Organic Light Emitting Diode

AM **OLED**

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Passive Matrix → Active Matrix

LED -> Light Emitting Diode → Organic Light Emitting Diode

AM ↑

OLED ↑

AM | OLED Display

Controls the **displaying mechanism**

Reproduce the **colour** and **brightness**

*Evolve from **LED***

(showing images; refreshing the screen)

TFT (Thin Film Transistor) Technology

Outline

- Introduction
- AMOLED Display Evolution
- Working Principle
- Key Matrices
- Applications and Outlook

Introduction

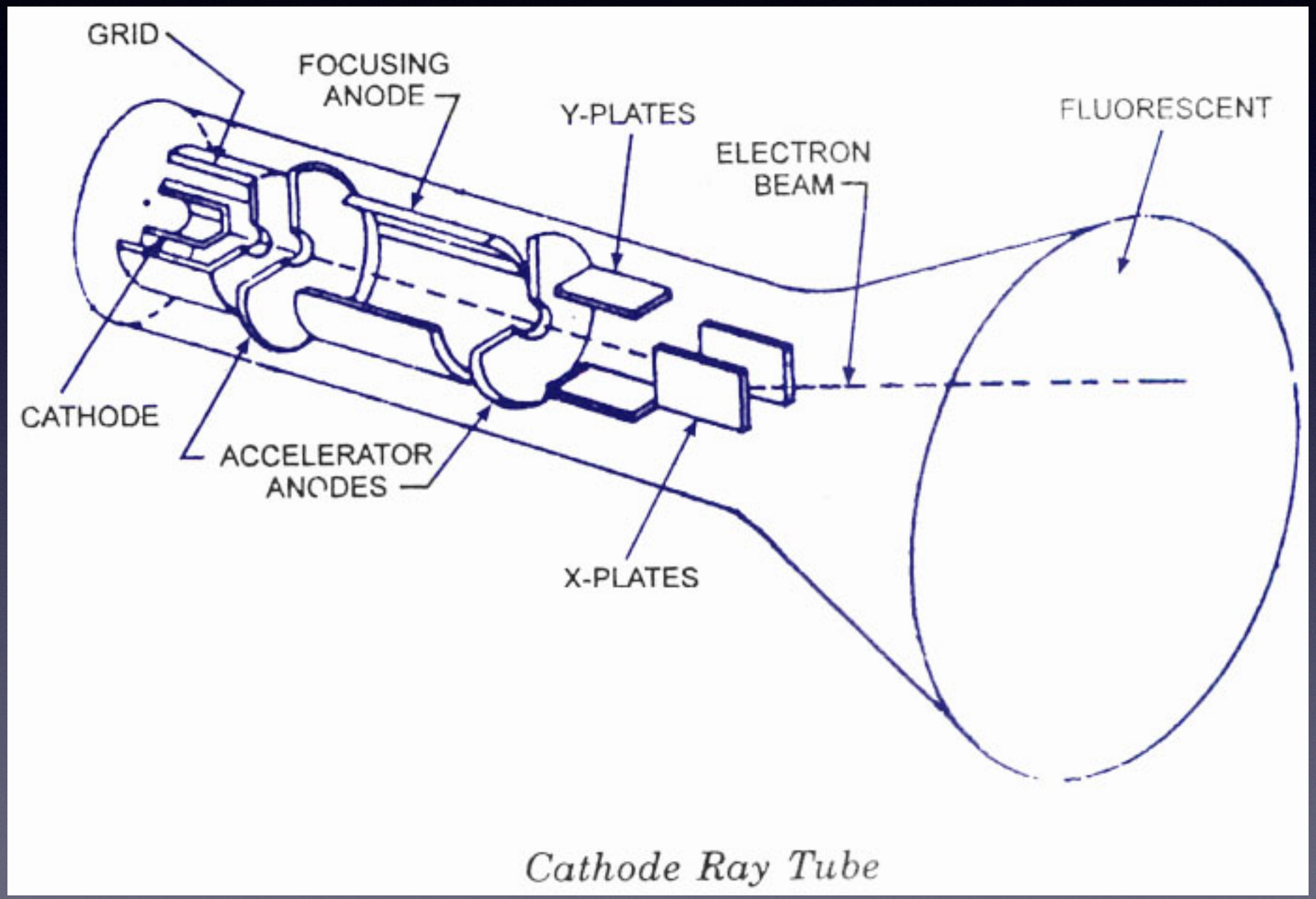
Question

AMOLED Display is more suitable for large or small display?

AMOLED Display Evolution

Light source	***Emitting array***	***Controlling matrix***
Electron gun	Phosphor screen	EM field

CRT



Cathode Ray Tube

http://www.circuitstoday.com/crt-cathode-ray-tube

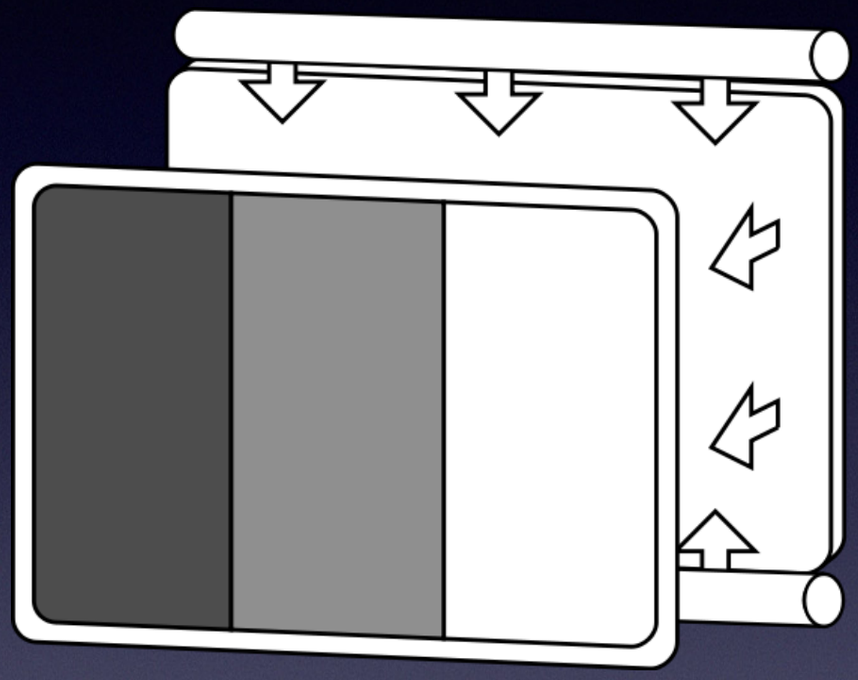
AMOLED Display Evolution

Light source	***Emitting array***	***Controlling matrix***
Electron gun	Phosphor screen	EM field
CCFLs LED	Liquid Crystal + colour filter	Passive Matrix Active Matrix (TFT)

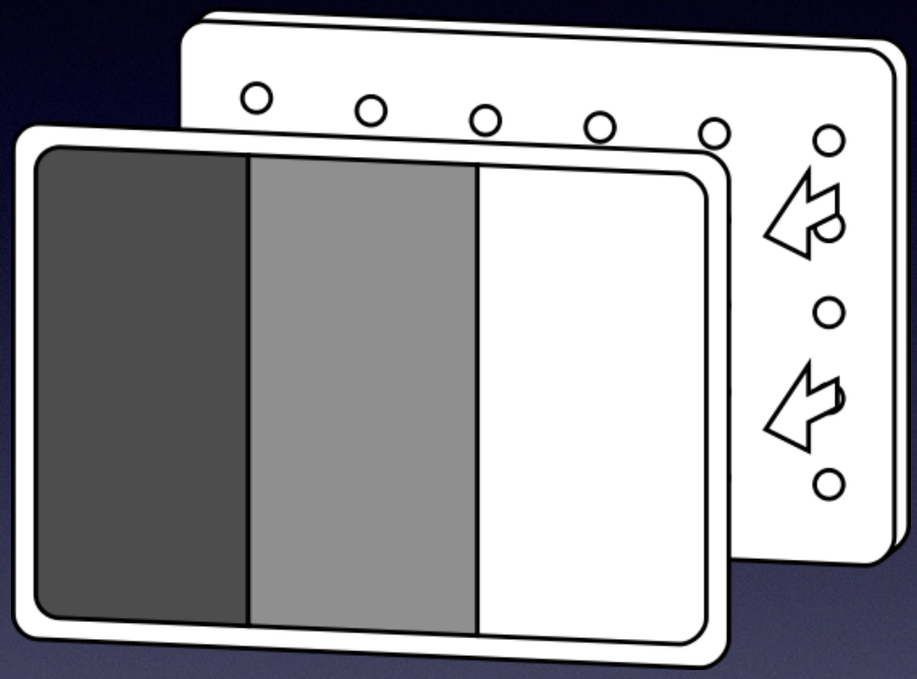
CRT

LCD

Light source in LCD era



Structure of cold cathode fluorescent lamps; CCFLs



Structure of LED backlight

Example of CCFLs application

AMOLED Display Evolution

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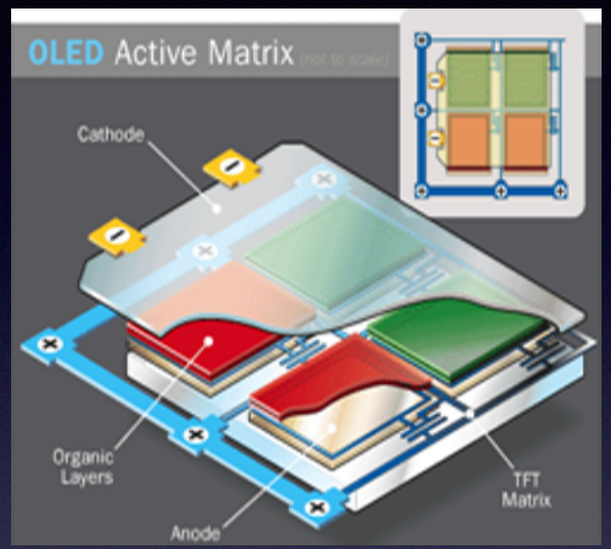
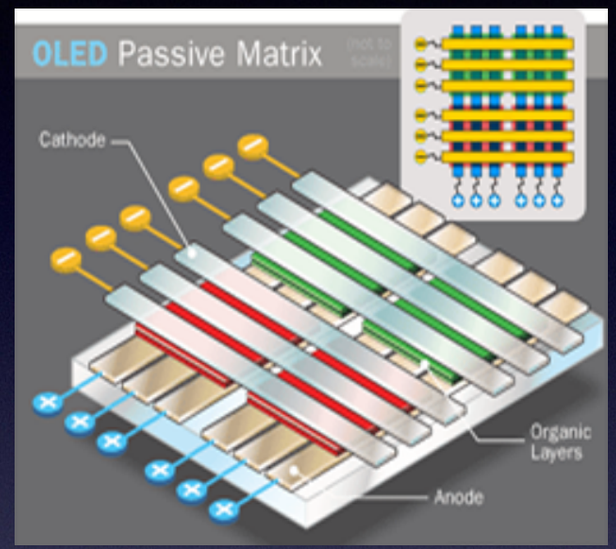
CRT

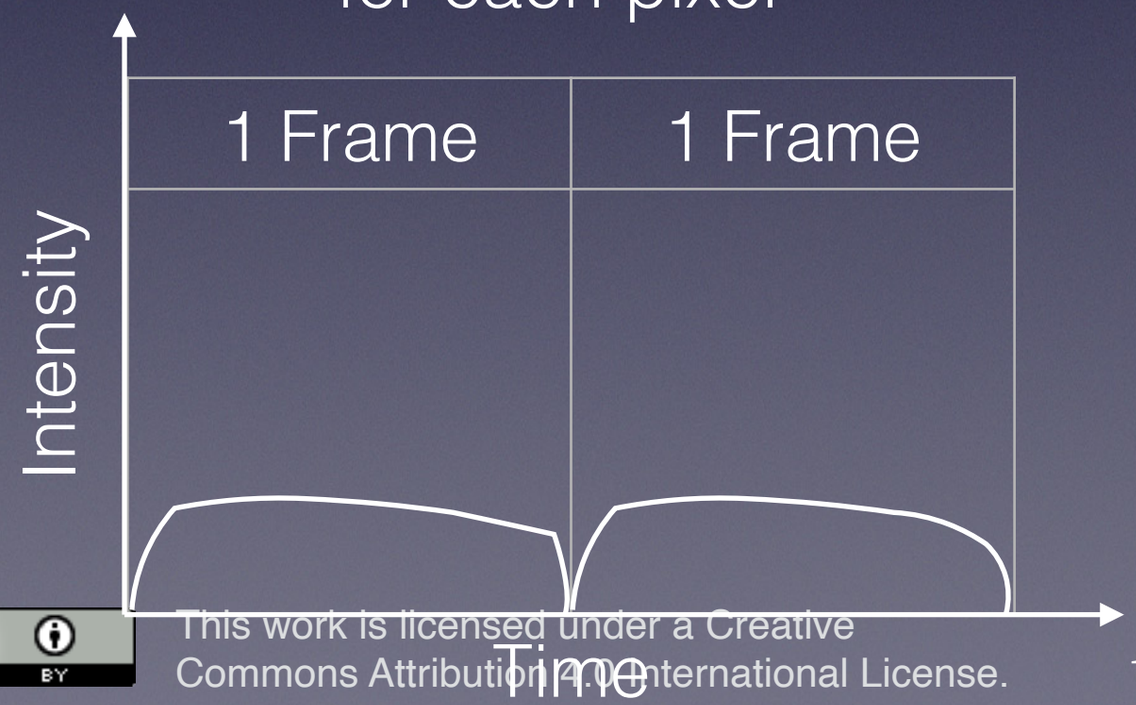
LCD

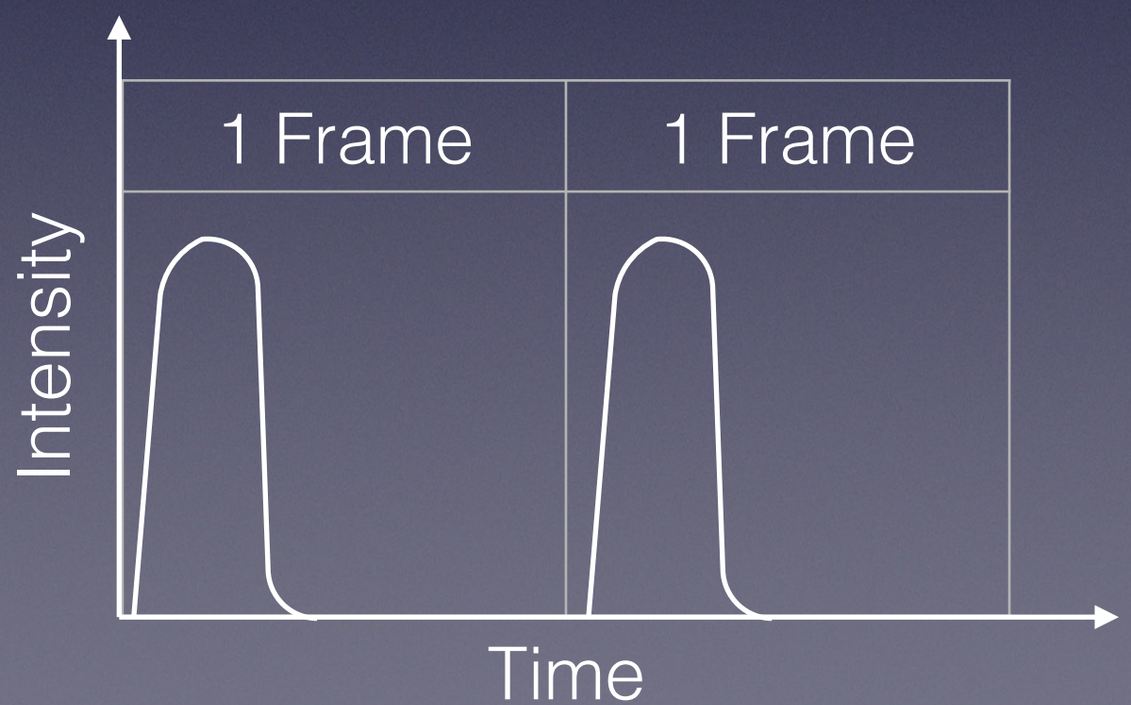
Active & Passive Matrix





Contains dedicated transistor for each pixel





AMOLED Display Evolution

Light source	***Emitting array***	***Controlling matrix***
Electron gun	Phosphor screen	EM field
CCFLs LED	Liquid Crystal + colour filter	Passive Matrix Active Matrix (TFT)
x	OLED	Active Matrix (TFT)

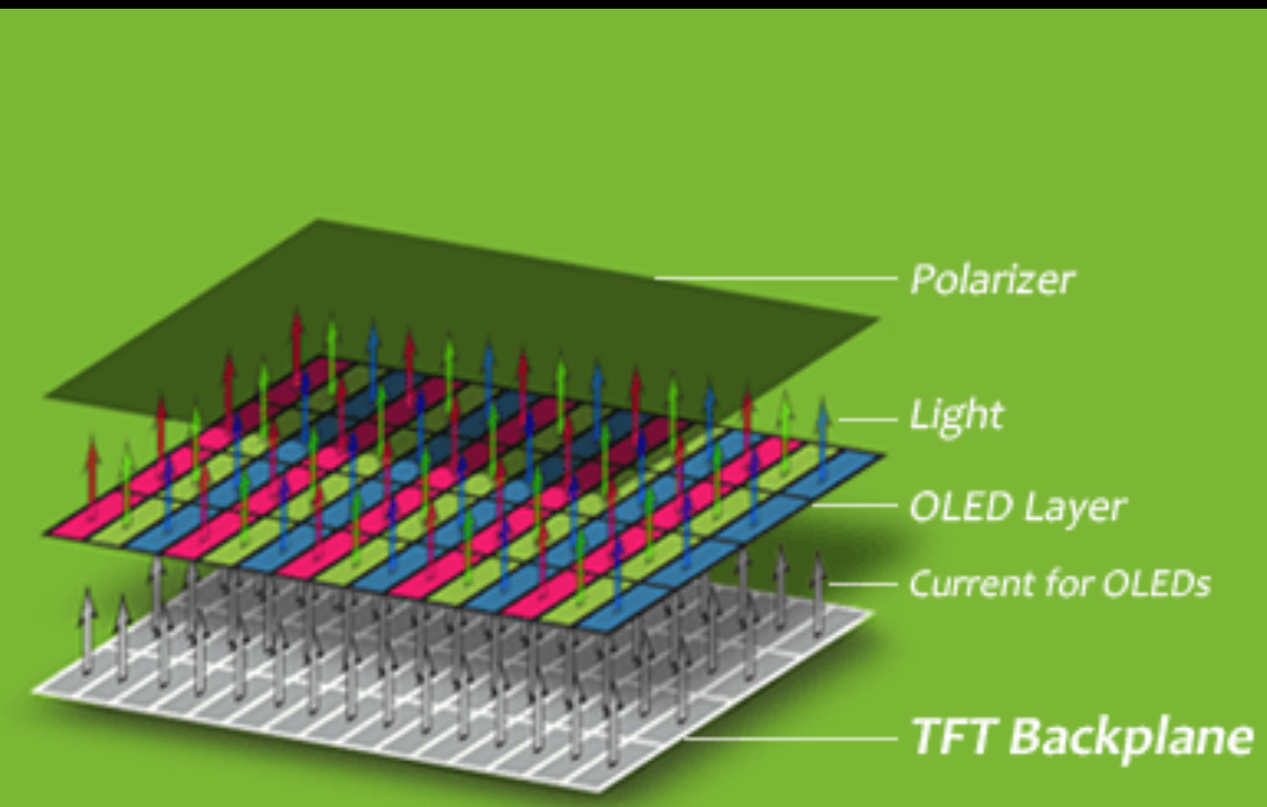
CRT

LCD

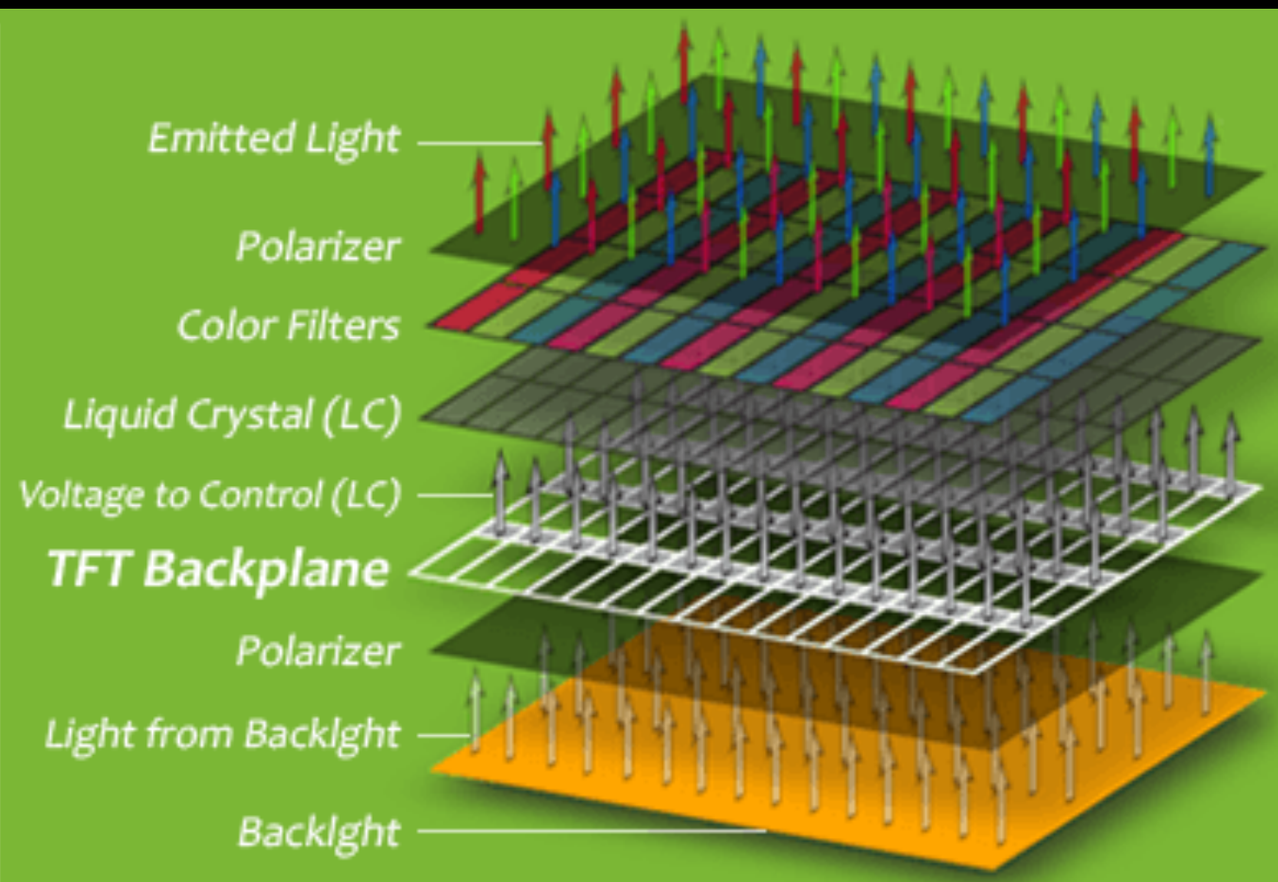
OLED

Working Principle

AMOLED

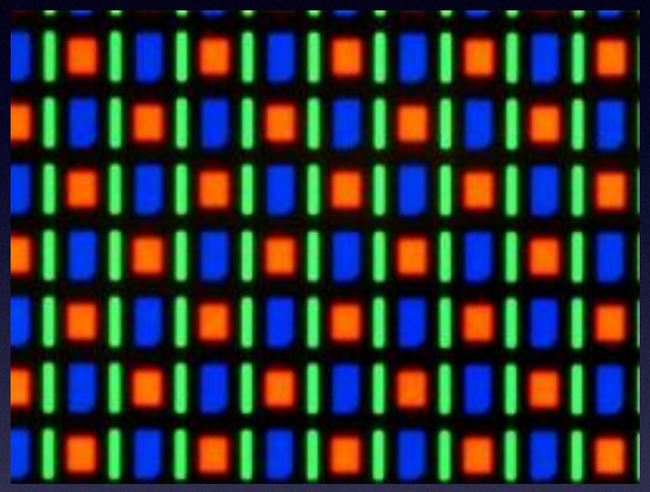


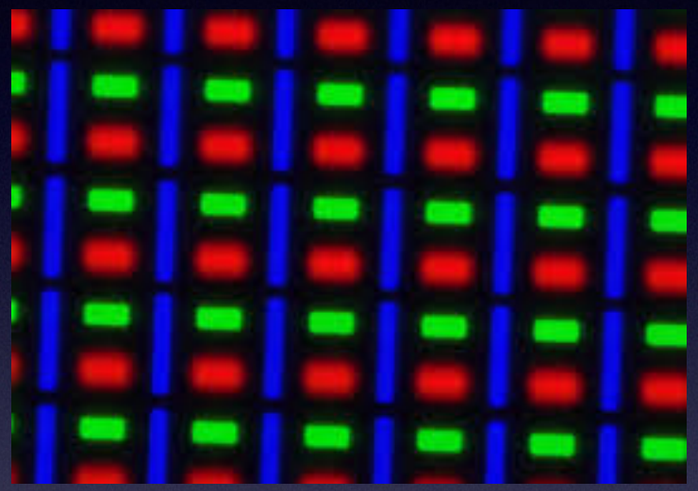
AM-LCD



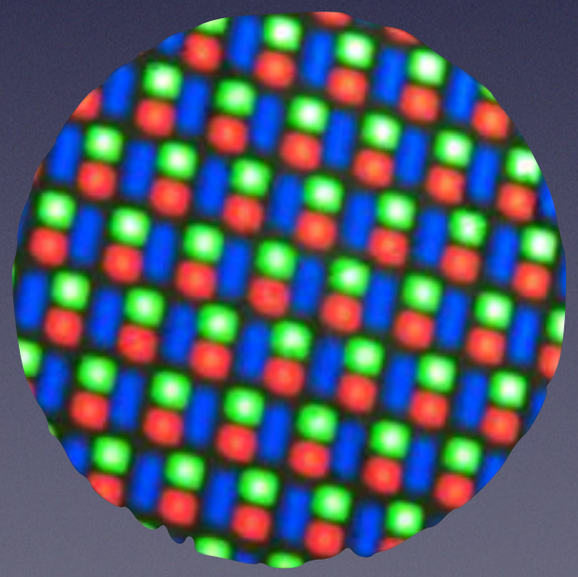
http://www.geosumtech.com/product.html?url=product_AMOLED-what.html

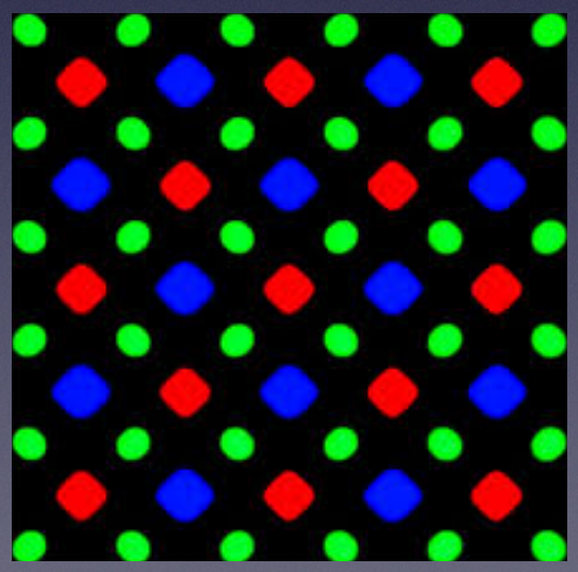
Working Principle





Pixel arrangement





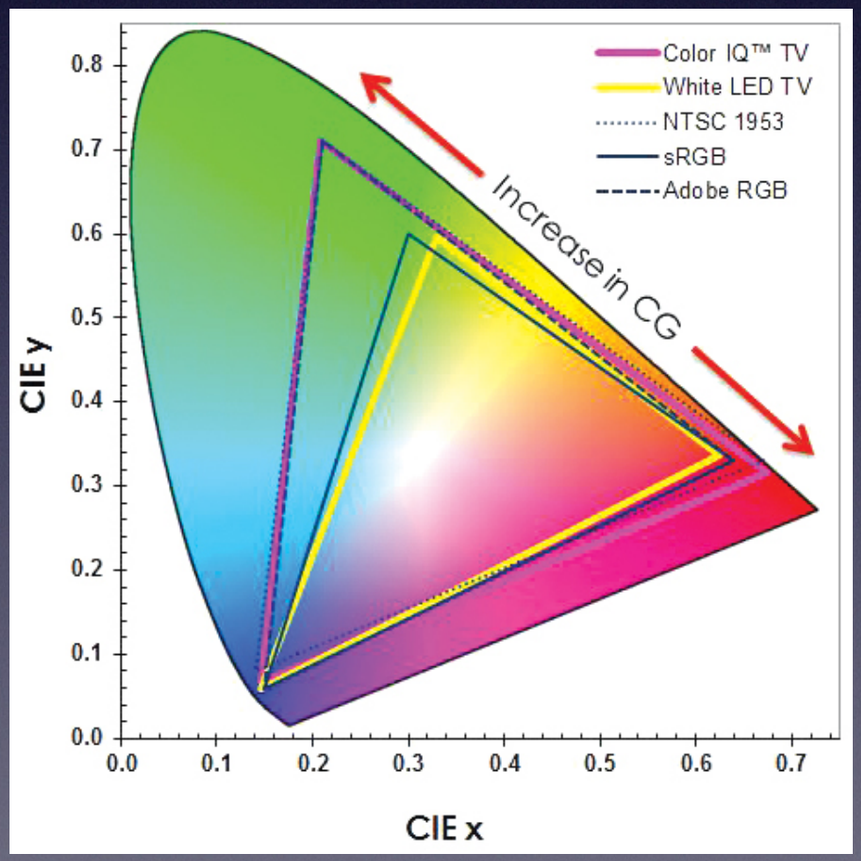
Key Matrices

Brightness
Typical max brightness:
[cd/m²]

Resolution
Number of pixels in the display: **m x n** pixels

Pixel density
Pixel per inch (or cm)

Colour support:
… Millions color



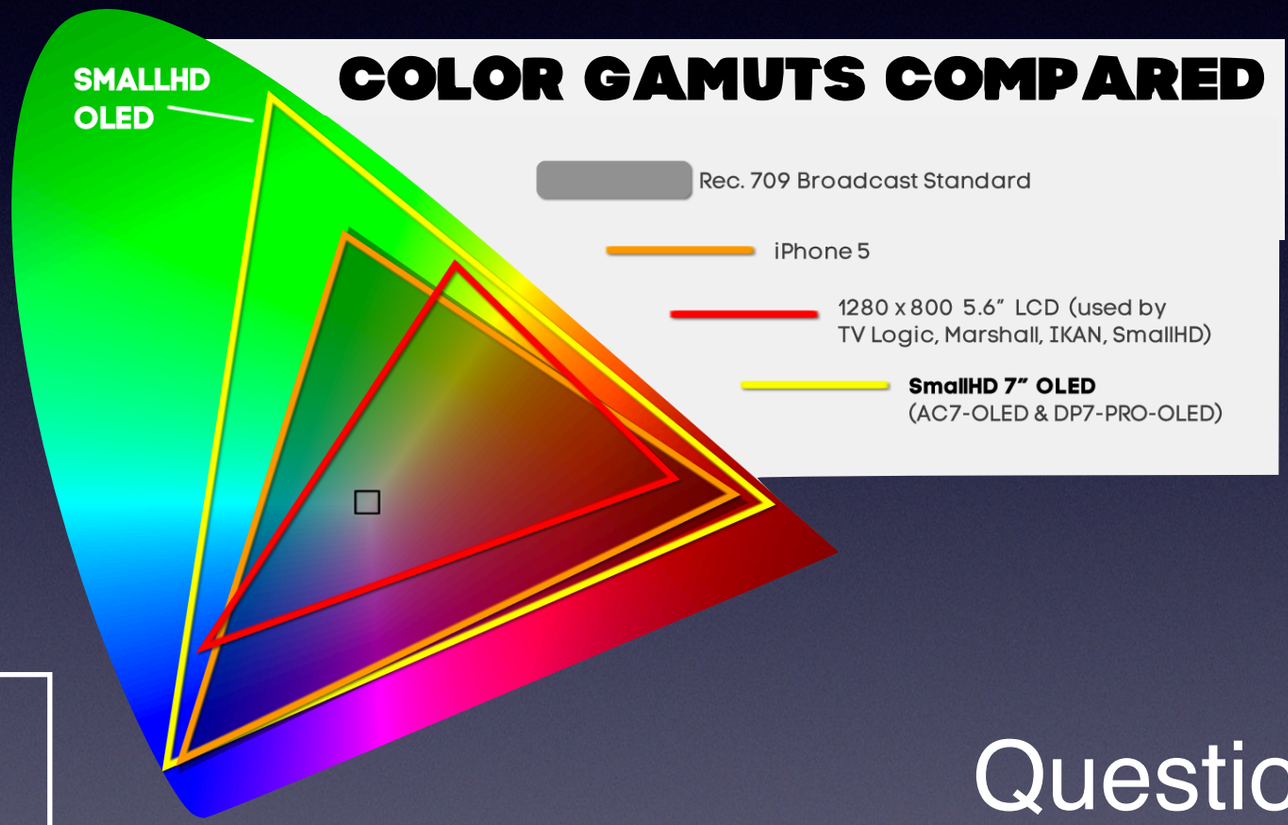
Key Matrices

Response Time

Typically <8 ms

Refresh rate

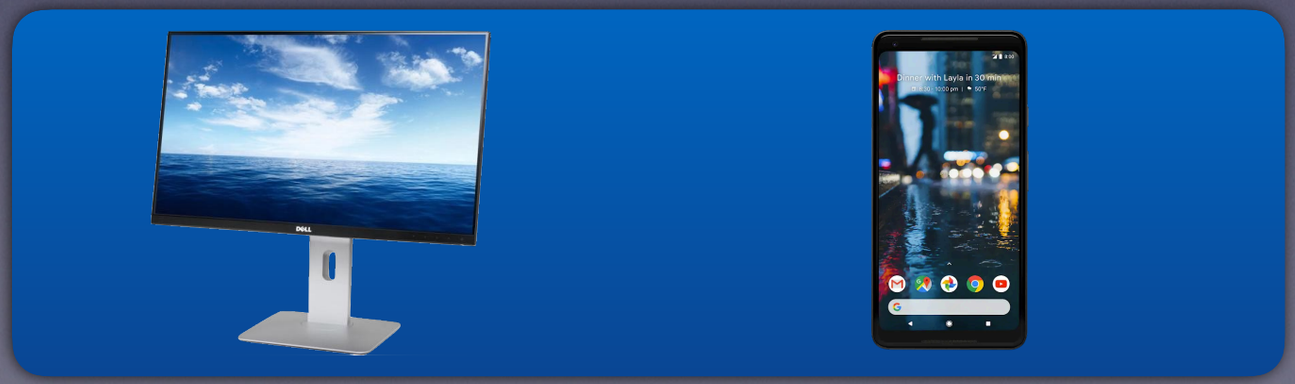
24 - 240 Hz



Others

- Power Consumption
- Contrast Ratio
- Coatings

Question



Application

- Replace displays in smaller devices such as smart watches and smart phones
- Flexible display

- Transparent display

Application & Outlook
Always-on display

Why is it possible with AMOLED?

Ability to turn only some pixel on
Consumes less energy than LCD

Challenge:

Screen burn-in

Supplementary 1

Colour Rendering Index

$$R_a = \frac{1}{8}\sum_{i=1}^{8} R_i$$