Brainstorm: Optoelectronics

In 10 years, which display technology will dominate the TV marketplace?

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The short answer is: TFT (Thin Film Transistor) LCD with LED backlighting. Active Matrix TFT LCD will continue to assert its dominance in screen sizes less than 50” diagonal. With all the investment and infrastructure already in place, it will be difficult for any other technology to catch up. White LED edge-lighting will have displaced CCFL as the low cost entry for LCD TV. White LED direct backlighting will be the next step up – local dimming for higher contrast and dynamic range will come at a higher cost due to use of more LEDs.

For the higher end market, use of direct RGB LED backlights with local dimming will offer unmatched color purity and contrast ratio. Local dimming processing replaces global backlight control with local control, enabling the modulation of each individual LED, or clusters of LEDs, in the backlight and improving both static and dynamic contrast and power consumption, but at a higher system cost. Fast LC (liquid crystals) will be available for color sequential operation, eliminating color filters (and 1/3 of the materials cost) and putting the cost of RGB LED backlighting within reach of high-end professional applications. The advantage in performance, compared to direct white LED backlighting, is mostly expanded color gamut and color accuracy, which is critical for professional applications such as movie-editing but perhaps not important enough for the casual consumer.

As far as plasma technology goes, some feel it is on the way out, despite its high picture quality, because of declining volume, slower price reduction and higher power consumption. However, in large screen sizes (50” +), it currently beats LCD on image quality for price. Once a major OEM’s Gen 10 manufacturing operation gets up to speed, LCD will very likely have raised the bar to 60” or higher.

Tom Kapucija, Microsemi, www.microsemi.com [2]

 Active matrix liquid crystal display (AM-LCD), surface conduction electron emitter display (SED), and organic light emitting diode (OLED) display technologies are legitimate candidates for market dominance over the next 10 years. Among these promising display technologies, AM-LCD appears to have the most staying power and could be the dominant TV display technology a decade from now.

AM-LCD technology has sufficient headroom to migrate from the soon-to-be-mainstream 2K (1920x1080P) format to higher resolutions such as 4K. With the potential transition to LED backlights, LCD TVs can be the dominant technology for the next 5 to 10 years. If the LCD industry remains committed to continued technical advances including improving LCD response time, we could see field sequential displays that approach the promised image performance of OLED or SED technology while utilizing the majority of today’s existing manufacturing base.

SED displays offer the performance advantages of emissive CRTs (i.e., high contrast, wide viewing, fast MPRT), along with the packaging benefits of LCD, plus lower power utilization than either LCD or plasma technology. However, none of these benefits have yet appeared in a commercialized product in the general market place.

As for OLED technology, it also promises the superior image quality of an emissive display, while utilizing significantly less power than plasma or LCD technology. For the consumer to enjoy the benefits of OLED TV displays, manufacturers must overcome the hurdles of short product life and high manufacturing costs. Attempts to utilize existing glass fabrication techniques with modified flows will help to contain costs for OLED TVs, but will also present the challenge of sub-optimal performance and shortened lifespan as compared to current and expected future implementations of OLED displays on LTPS substrates.

Alan Lowne, Saelig, www.saelig.com [3]

 With increased emphasis on "green" energy-efficient components, including solid state lighting, there is a growing trend for individual, personal video displays, rather than bulky, wall-mounted devices. For these applications, which include TV, Internet-content and personal communication media, the dominant technologies will be low-cost, flexible, emissive active-matrix organic light-emitting diode (AMOLED) technology and -to a lesser extent- electrophoretic, or electronic paper, display technology. AMOLEDs are ultra thin, ultra bright emissive displays (no backlight needed). For personal devices, electrophoretic displays made on flexible plastic sheets, similar to black-and-white e-readers like Kindle, will offer fast-response and full-color displays consuming very little power, rugged by virtue of their flexible construction.

For larger devices, as well as small personal video projectors and wearable devices, AMOLEDs will find increasing application. AMOLED displays fabricated on flexible plastic substrates are very thin and lightweight, offer lower cost compared to today's LCD displays, and have potential to be made into roll-up displays for convenience, transportation and storage, offering exciting new design concept options.

Alan Bennett, OPTEK Technology, www.optekinc.com [4]

 If you pause and look at what has happened in TV technology in the last 10 years, you would probably conclude that the TV marketplace has changed dramatically. Rear projection and picture tubes are passé, replaced by either plasma or LCD. It is not just early adopters who have elected to buy into HD.

Whether its 720 or the truly impressive 1080p, both are widely available at your local store. The next ten years should bring an even faster pace of product development, with the advent of OLED.

OLEDs can be printed onto a flexible substrate and provide a greater range of colors and contrast while offering a wider viewing angle than LCDs. Hence we'll see thinner, lighter and more energy efficient TV sets that can be hung on the wall in every room of the house (perhaps even over the bath tub!).

Since OLED technology does not require a backlight, it consumes far less energy. This will allow its use in handheld devices as well as outdoors. This could result in the proliferation of handheld TV's (you will get to see that replay regardless of where you sit in the stadium). Before we see widespread use of OLED technology in mobile devices, the cost needs to come down, but a lot can happen in the next 10 years.

Tom Lahutsky, TAOS, www.taosinc.com [5]

Before speculating about which display technology will dominate the TV marketplace in 10 years, one needs to understand how TV content – and the way it is accessed – is evolving. Today, TV is becoming more mobile and access includes not only stand-alone TV units (LCD, Plasma, DLP, etc.) but also portable devices such as cell phones and laptops. Thanks to mobile TV formats such as DVB-H (Digital Video Broadcasting-Handheld), MediaFLO and MBMS (Multimedia Broadcast Mobile Service), mobile TV viewing will continue to expand well into the next decade. While it remains difficult to predict the exact display technology that will dominate, there is one common theme that is assured.

TV display manufacturers will be driven to develop smarter and more efficient displays with an emphasis on reduced power consumption, increased resolution, enhanced color balance and ease-of-use features such as proximity/presence detection to enable automated features. These smart displays will be enabled by supporting technologies – such as proximity detectors, ambient light and color sensors. Leading TV display manufacturers will need to forge close relationships with component providers of these critical technologies to differentiate their products in a highly competitive global market. Together, they will determine which

display technology is best-suited for the 2019 TV offerings.

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Looking back 10 years to 1999, CRT displays were the dominant TV technology. Back then, LCD TV was still in its infancy, with even less of a market share than rear projection TV. Fast-forward to 2009, when LCD TV has surpassed all the other display technologies and has become the dominant display technology for TVs. Looking ahead another 10 years, by 2019, will history repeat itself and another display technology surpass LCD for TV?

The strong candidate is the active matrix organic light emitting diode (AMOLED) display. Compared to TFT LCD, AMOLED has advantages of better color gamut, higher contrast ratio, 180 degree viewing angle, faster response time (eliminating motion blur), thinner and lighter weight form factor, and lower power consumption. DisplaySearch forecasts that AMOLED TV will have strong growth in the next 10 years. While the dominant display technology for TV will still be LCD, AMOLED TV will be the second largest TV technology by 2019 for a number of reasons:

1. The biggest hurdle AMOLED TV currently needs to overcome is cost. It is too expensive and there is only an 11” size commercial available from Sony. A 15” size will be in mass production by this coming holiday season by LG Display and LG Electronics. The largest AMOLED demonstrated is 40”. The technology challenge for large AMOLED is from the TFT backplane. Since AMOLED is current-driven, almost all the AMOLED in the market are using low-temperature polysilicon (LTPS) TFT backplanes. LTPS is manufactured using expensive processes (laser annealling or metal-induced crystallization) and currently, it has very low manufacturing yields when above 20 inches in diagonal. In the next several years, DisplaySearch expects more suitable TFT backplanes will be commercialized for AMOLED.

2. When LCD and CRT TV competed for market share, the fundamental advantage of LCD TV was its thin form factor, as it was a significant change for consumers to go from a bulky ~30-inch thick CRT to a ~2-inch LCD TV. AMOLED TV is thinner than LCD TV, but the difference is not so dramatic. When flexible/bendable AMOLED TVs become commercial available, they will have a fundamental advantage. But that won’t happen until after 2014.

3. LCD TV technology is improving every year. LED backlights and new liquid crystal modes will bring it better color gamut and lower power consumption. Wide viewing angle technologies have improved its viewing angle. Motion blur is also being addressed through 120 and 240 Hz frame rates.

In the future, 2D/3D switchable displays for TV will also become available. 3D (stereoscopic) is very attractive for TV applications and entertainment. Both LCD and AMOLED displays are capable of showing stereoscopic.

Links:
[1] http://www.osram-os.com/
[2] http://www.microsemi.com/
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