# Smartphone & Tablet Display Strategies

By Keith Mallinson Thursday, May 3, 2012



*Differentiation is critical for device manufacturers and display technology is one area where the potential to shine is particularly bright.*

Display technology innovations have been most significant in the development of wireless communications over the last decade with introduction of color, widening gamuts (i.e., more colors), increasing screen resolution with much higher pixel densities, faster response times required for full motion video and graphics and multi-touchscreen capabilities. These advances are no less significant than improvements in networks, operating systems, processors and communications platforms and the expanding ecosystem with applications developers. Display sourcing is a crucial strategic issue for device manufacturers seeking to differentiate their products in a very competitive marketplace.

Leading performance is available in the latest smartphone displays employing the prevailing TFT-LCD and AMOLED technologies. However, this comes with the penalty of relatively high power consumption unless one is willing to sacrifice color or motion performance by selecting an alternative technology, as one typically does in eReaders such as Amazon's Kindle. Overcoming these compromises is the next frontier in display technology development.

**Picture This**

Enormous advances in cellular and its extensive adoption have resulted from a virtuous circle of complementary factors. Smartphones and tablets only thrive as they do today because of technological and commercial advancements on several fronts. Improvements in display technologies employed in phones have been no less significant, though often rather less well-known, than the introduction of 3G and 4G radio technologies, high-level operating systems including Android and Apple's iOS, multimedia applications processors and app stores stocked by thousands of developers.

Japanese mobile operators pioneered the mobile web from around the millennium including the 1999 launch of NTT DoCoMo's very popular i-mode service with tens of thousands of sites accessible via a micro-browser. However, the corresponding, monochrome-only WAP browser experience curried little favor from European or U.S. users. Mobile web did not take off in Europe or the U.S. until long after the introduction of color screens from around year-end 2001, with Ericsson's T68 including a 1.7-inch CSTN-LCD screen providing 256 colors and 101 x 80 pixel resolution, and Nokia's 7210 with 1.5-inch CSTN-LCD screen providing 4,096 colors and 128 x 128 pixels.

Despite initially lagging behind Japan in mobile Internet adoption, by 2004 European and U.S. consumers were demanding, for example, phones capable of taking, displaying and transmitting photos, displaying graphic images and playing games. However, CSTN screen technology suffered from poor dynamic performance with motion blur and "ghosting" effects on video. Within a few years, CSTN-LCD technology was largely superseded by the TFT-LCD technology, widely used in TVs, to support moving video and graphics. Dynamic performance has continuously improved to support increasing video frame rates.

Display sizes gradually increased to exceed a couple of inches with, for example, the 2.2-inch screen Motorola RAZR V3 and with BlackBerry screens around 2.6 inches being introduced over the following few years. But multimedia activity remained a significantly offline activity in Europe and the U.S. with occasionally downloaded games, pictures and video clips. Non-voice network usage continued to be dominated by SMS on most phones and email on BlackBerries until smartphones really took off with massive data network growth following the introduction of Apple's iPhone in 2007.

Significantly, the first iPhone model owed much of its success to its, rather large, 3.5-inch TFT-LCD capacitive multi-touchscreen with 16,000,000 colors and 320 x 480 pixels. This iconic smartphone also included Wi-Fi, a slick operating system and unique, screen-based, user interface software. Until introduction of the iPhone, screens were almost invariably coupled with mechanical keyboards. Apple made a success of on-screen qwerty with touch. Multi-touch, with scrolling and zooming, enabled access to regular web pages and eliminated the previous need to adjust web content for the particular mobile phone screen. The iPhone's application processor was unremarkable, and the baseband modem was only 2G.

With 690 x 960 pixels, the latest iPhone 4S model has four times more pixels than the 2007 iPhone, 40 times more than the Nokia 7210 and 80 times more than the Ericsson T68 launched one decade earlier. As screens have grown in size diagonally, the devices in which they are incorporated have become fashionably thinner and thinner, significantly due to reductions in display module thickness.

TFT-LCD screen technology has predominated in mobile phones for the last decade, but there are significant rivals. Samsung currently favors Super AMOLED technology in its devices including the Galaxy Note – on the fringe between a smartphone and a tablet – including a 5.3-inch screen with 1280 x 800 pixels.

**Supplier Screening**

Achieving and maintaining market leadership in smartphones and tablets requires the very best in display technologies and their supply. These are highly specialized products that are difficult to manufacture with high quality in large volumes. They are not commodities like D-RAM memory chips. *Consumer Reports* reckons the new iPad 3's high-resolution screen provides the best detail and color accuracy of all tablets and its high-resolution "retina" display ranked the best feature by new owners. The specification for this includes a 9.7-inch LED-backlit IPS LCD touchscreen with 2048 x 1536 pixels and a scratch-resistant, oleophobic coating.

Despite significant hostilities between Apple and Samsung with extensive intellectual property litigation pending in several jurisdictions worldwide, Samsung is the supplier for these highly-regarded displays. According to iSuppli analyst Vinita Jakhanwal, as reported in *Bloomberg Business Week*, Apple turned to Samsung after LG Display and Sharp could not meet its stringent requirements. This selection is despite Apple's announced commitment one year ago to spend $3.9 billion on long-term supply agreements with three vendors believed, by the *Financial Times*, to be LG Display, Sharp and Toshiba Mobile Display for iPhone and iPad displays.

**Viewing technologies in a new light**

With crystal-clear definition and excellent dynamic performance, power consumption remains a bugbear because battery capacity is always in short supply on small devices. Power is also significantly demanded by on-board communications, applications and graphics processors. Back-lighting and side-lighting work just fine with modest ambient light indoors, but screens for use outdoors in bright sunlight need alternative designs to conventional back-lit displays.

E-ink has been popular with eReaders such as Kindle. Qualcomm's Mirasol technology consumes a small fraction of the power taken by a TFT-LCD display and has a color gamut and dynamic performance that, while falling short of TFT-LCD performance at this early stage in its development, significantly exceeds that of other, low-power rivals.

Competition with innovation among display providers is as fierce as it is in baseband modems, application and graphics processors, operating systems and user interfaces. In a similarly dramatic way to various flat-screen technologies eliminating CR tubes from TVs and monitors within a decade, disruptive technologies and vendors

most likely can and will – within years, not decades – significantly substitute new for existing mobile phone screen technologies, while also making obsolete much of the plant used to manufacture the latter.

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