

DisplaySearch's 8th annual US FPD Conference

March 21-23, San Diego, California

Geoff Walker summarizes presentations from the US FPD Conference put on by DisplaySearch. This summary looks at the presentations from the perspective of high-information content displays



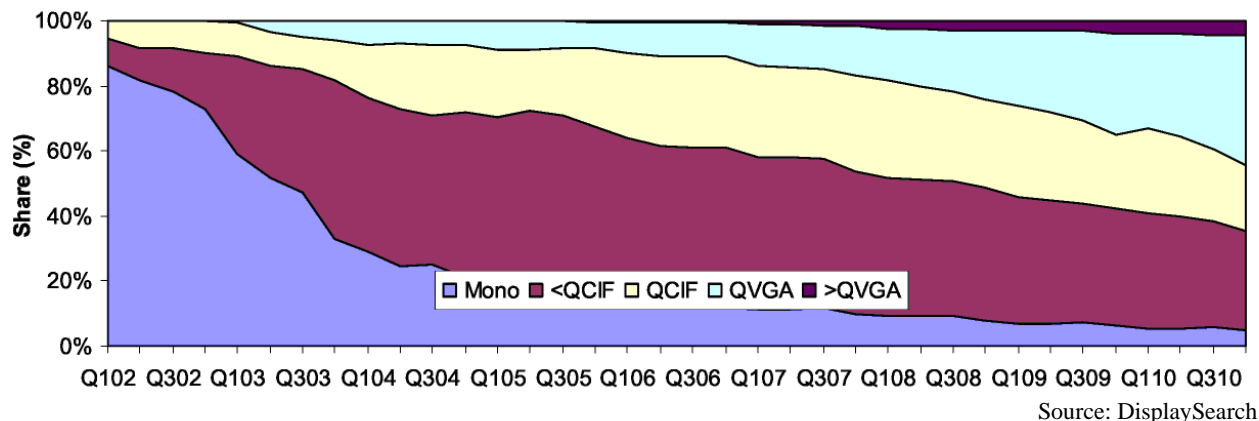
Based in Silicon Valley, Geoff Walker is a consultant with Walker Mobile, LLC. He has worked on the engineering and marketing of mobile computers since 1982 at GRiD Systems, Fujitsu Personal Systems (now Fujitsu Computer Systems) and Handspring. In addition to mobile computers, Geoff's areas of particular expertise include displays and digitizers.

DisplaySearch held their 8th annual FPD conference March 21-23 in San Diego, CA. There were a total of 61 sessions spread over two and a half days. Although that's a LOT of PowerPoint slides, the author believes they can be boiled down into the following key conclusions of relevance to *High Resolution* readers:

- Pixel density is rising in cellphone displays and should hit ~300 ppi by 2008-2010
- Notebook pixel densities are creeping up ever-so-slowly
- Monitor pixel densities are not expected to change significantly by 2010
- Wide-aspect monitors will increase but won't be in the majority by 2010
- Nobody had anything to say on the issue of 1080p resolution in 40"-49" plasma displays

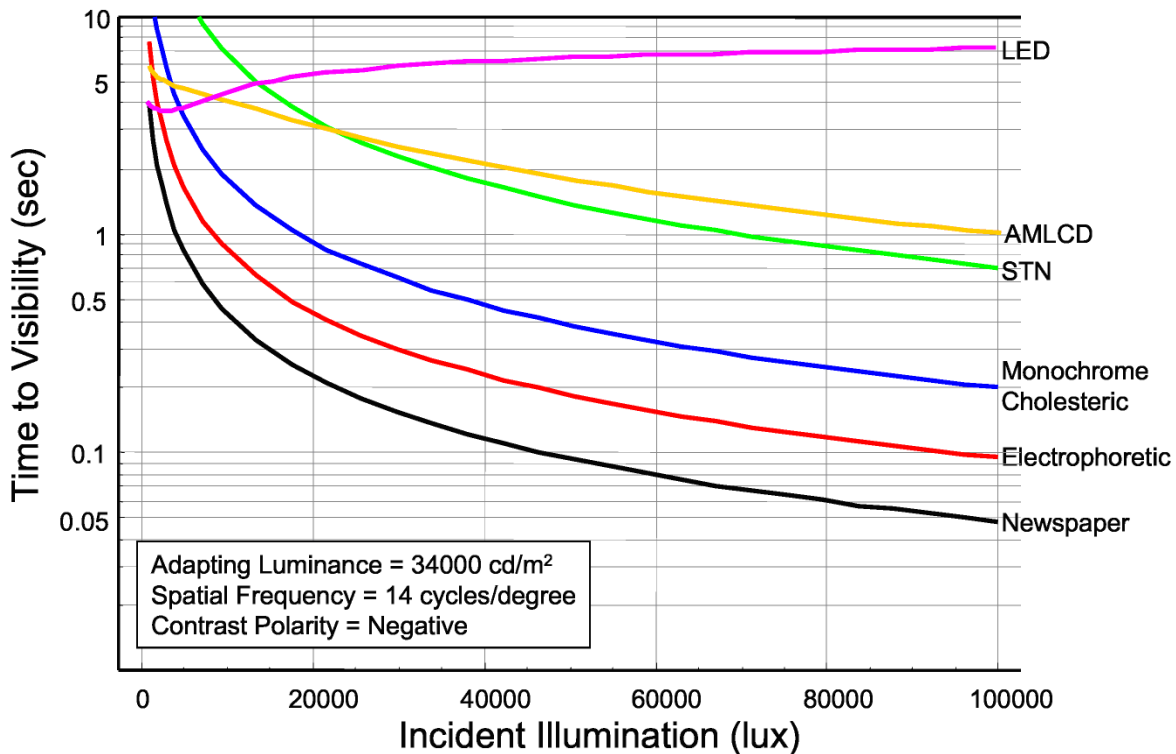
The following paragraphs provide more detail on 10 of the most relevant presentations.

DisplaySearch Small-Medium Display Market Overview: The following graph presents DisplaySearch's history and forecast for mobile phone resolution. Assuming a 2.2" screen and ignoring mono, the resolutions shown in the graph translate into <100 ppi, 100 ppi, 182 ppi and >182 ppi. Barry Young of DisplaySearch predicted that in the near future a so-called "convergence platform" will use 640x480 resolution, which in a 2.6" screen would be 308 ppi.



Qualcomm: In his talk on MEMs display technology, Miles Kirby of Qualcomm presented some interesting information on a model of display "time to visibility" (TTV) implemented in Mathematica. According to Qualcomm, the model has been used by several display manufacturers to evaluate design tradeoffs and estimate display parameters. The particular output of the model shown below is a graph illustrating how long it takes a user

to recognize an image in varying levels of illumination for multiple display technologies, with newspaper providing a baseline. The author hasn't been exposed to this metric before and finds it especially fascinating.



Source: Qualcomm, courtesy of Lou Silverstein

Philips Mobile Display Systems: Giovanni Montesanti from Philips presented information on future resolution requirements in mobile displays that were very consistent with DisplaySearch's view. Philips predicted that mobile phone display pixel density will increase from an average of 148ppi in 2005 to an average of 185ppi in 2008, and that 2.4" and 2.6" 640x480 displays will have a small but measurable market share in 2008.

Philips also made a pitch on how "out-of-the-box" thinking about mobile phone displays as a key component within a larger system might be able to significantly improve display performance in the face of ever-increasing requirements. Without going into any significant detail, Giovanni talked broadly about smart color mapping, dynamic backlight control, spatial and temporal image scaling, RGBW pixel layouts and high-performance LTPS.

DisplaySearch Notebook Market Overview: John Jacobs of DisplaySearch started his presentation with an interesting comparison of his notebooks in 1992 and 2005, as follows.

John presented a graph of 2004-2005 notebook shipments by pixel density. The average density increased from 96.7 ppi to 98.8 ppi over the period, driven mainly by the shift to wide-aspect screens (14.x" at 107-108 ppi and 15.4" at 98 ppi). From the perspective of *High Resolution* readers, that's

Spec	1992	2005
CPU	25 MHz	1.5 GHz (60X)
DRAM	4 MB	2 GB (500X)
Display	9.8" 640x400 mono-STN	17" 1440x900 TFT (5X pixels)
HDD	120 MB	80 GB (667X)
Drive	2.5" floppy	DVD-RW/CD-RW
Weight	6.8 pounds	6.3 pounds
Price	~\$2,500	~\$2,500

Source: DisplaySearch

miserable progress! John also presented DisplaySearch's forecast of notebook shipments by size and resolution, which is a bit more optimistic. His forecast for 2009 is summarized in the table below. Note that 83% of the forecast is over 100 ppi. The weighted average of that 83% share is 113.2 ppi, which represents an increase of

14.5% over four years – slow but steady growth. Vista came in for a bit of indirect criticism in John’s presentation. He pointed out that while Vista is optimized for higher resolutions (up to 200 ppi, as compared with XP’s limit of ~150 ppi), in his opinion the cons of higher resolution outweigh the pros, as follows:

PROS

- Crisper images
- Increased information content
- Enhanced productivity?

CONS

- Higher display power consumption
- Increased system cost (~\$100) due to more memory and a high-resolution price premium
- Lower panel brightness
- Lower panel yield
- Higher panel cost due to more and higher-power driver ICs
- Cosmetic defects in panel

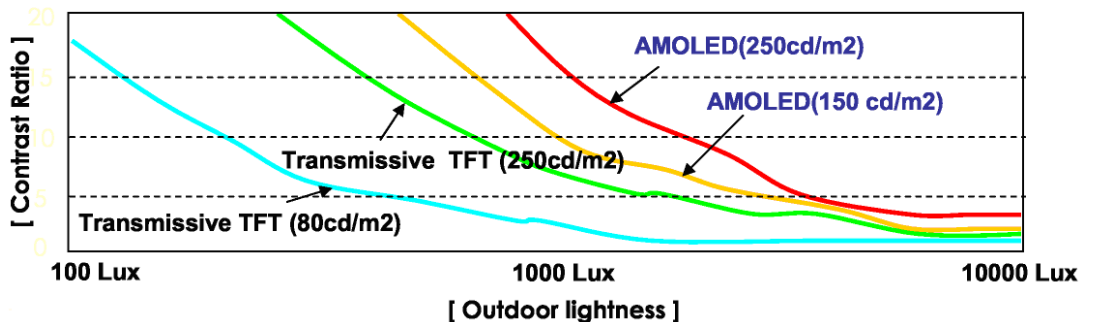
Size	Resolution	PPI	2009 Share
12.1”	1024x768	106	2%
12.1”	1280x800	125	1%
13.3”	1024x768	96	0%
13.3”	1280x800	114	5%
14.1”	1024x768	91	5%
14.1”	1400x1050	125	0%
14.x”	1280x800	107	19%
14.1”	1440x900	121	2.3%
15.0”	1024x768	86	12%
15.0”	1400x1050	117	1%
15.4”	1280x800	110	37%
15.4”	1680x1050	129	4%
15.4”	1920x1200	147	4%
17.0”	1440x900	100	4%
17.0”	1680x1050	117	1%
17.0”	1920x1200	133	2%
19.0”	1680x1050	105	0.1%

Source: DisplaySearch (PPI column added by author)
 Note: DisplaySearch published resolution acronyms; changed here to represent actual pixel formats

The author tried to convince John that some of the cons may be overstated, but wasn’t able to make any progress.

Acer America: Sumit Agnihotry from Acer also expressed optimism about higher resolution notebook panels. He suggested that the rapid acceptance of multimedia applications and Vista’s “120 ppi recommendation” will generate new opportunities for higher resolution panels. Acer plans to focus their performance notebook segment on 15.4” 1440x900 (110 ppi) and 15.4” 1920x1200 (147 ppi), and their value segment on 15.4” 1280x800 (98 ppi). In a side note, Sumit also mentioned that Acer’s retail buyers are currently buying only glare screens because consumers tend to return anti-glare screens to the store as defective once they see someone else’s glare screen.

Samsung SDI: Hye-Dong Kim from Samsung SDI’s Display R&D Center made an interesting presentation on the current R&D status of AMOLED for mobile applications. Hye-Dong supported DisplaySearch’s and Philips’ projection of demand for 640x480 in mobile phones. He said that Samsung’s basic strategy for achieving the higher resolution is (1) applying narrow design rules in LTPS, (2) increasing the aperture ratio, and (3) using LITI for high-resolution color patterning. When discussing the requirements for future mobile displays, Hye-Dong presented an interesting graph (shown below) that positions AMOLED as the best solution for outdoor readability. His argument is that it’s not brightness that really counts in outdoor readability, it’s black level, which makes OLED better. Unfortunately there were no numeric values on the left axis of the graph. (Note also that while the graph stops at 10K lux, full sunlight can be in the range of 30K to 100K lux.)



Source: Samsung SDI

Clairvoyante: Thomas Credelle from Clairvoyante made a fairly compelling presentation positioning their PenTile RGBW technology as a complementary power-saving solution for mobile phone displays. Thomas began by defining the market trends that are leading to increased power consumption (and cost) in small mobile displays. Then, digging a little deeper, he explored the factors affecting display power and system power, and the impact of video content on power consumption. One key impact is the need for higher brightness so that details in normal video images can be seen easily. Cellphones today are ~200 nits, while they need to be ~400 nits or higher to accomplish this, which increases the backlight power consumption by at least 2X.

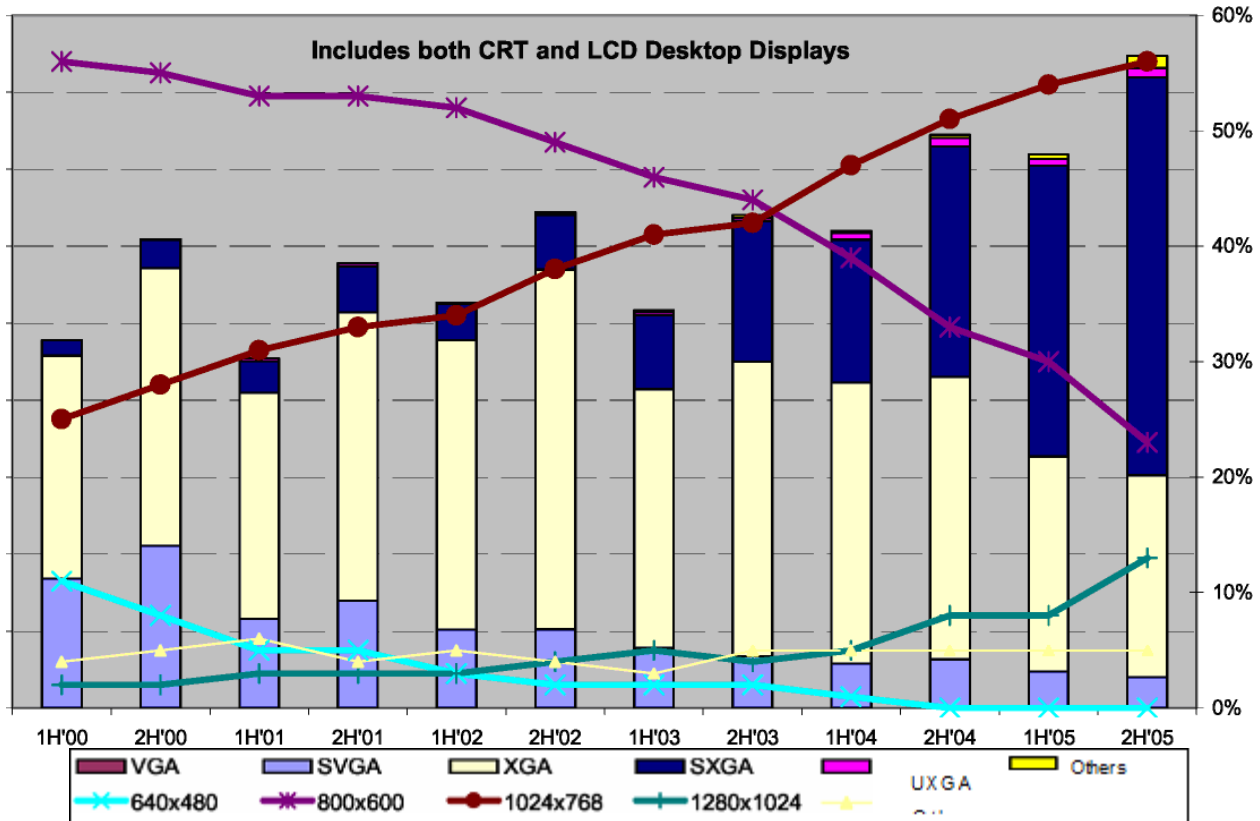
The typical potential solutions to this power challenge include improved power management, brightness enhancement films in the LCD or backlight, OLEDs (especially for video), improved battery technology, transfective LCDs and combinations of all of these. Clairvoyante's position is that in addition to all of these, a more efficient pixel design that takes advantage of what the human eye can and can't see (but without adding cost) is highly desirable. Clairvoyante's PenTile technology is basically sub-pixel rendering with only two subpixels per pixel. Using only two subpixels per pixel can increase the aperture ratio by 30%-40%, and adding a white subpixel can increase the brightness by more than 50%. Neither of these require any change in manufacturing process (no new tooling), so they're easy for manufacturers to implement.

None of this is actually new, other than perhaps the revised positioning. Clairvoyante has been marketing PenTile for at least five years (the author really admires their persistence). What has changed to make the display manufacturers more willing to consider it are two basic things: (1) the PenTile pixels are rectangular, and (2) the market demand for increased display performance has continued to mount. The rectangular pixels may not seem like a big thing, but Clairvoyante's previous non-rectangular-pixel design was almost totally rejected by display manufacturers because it required too much change.

Newnham Research: Michael Ledzion from Newnham Research presented their NIVO (network in, video out) technology that supports external monitors via USB. Using USB makes it very easy to add second and further monitors to a desktop or (especially) a notebook. The NIVO solution consists of a virtual (software) graphics card and a hardware (ASIC) rendering engine. The software supports all Windows XP extended display modes and allows management via the standard Windows Display Properties control panel. In the exhibition portion of the conference, Michael demonstrated a Wacom Cintiq pen-enabled LCD monitor connected via USB; the performance of the pen and monitor seemed indistinguishable from that of a VGA-connected monitor. The first commercial implementation of Newnham's technology is in a universal laptop docking station that will be available from Kensington in June.

DisplaySearch Monitor Market Overview: Chris Connery from DisplaySearch raised an interesting question in his session on the monitor market: Does native resolution matter any more? Chris presented some statistics that show the majority of monitors have not historically been operated at their native resolution. DisplaySearch plotted actual resolution data from 34 million visitors to web pages using <http://www.thecounter.com>'s service against their own monitor shipment data by resolution. The result (shown in the graph below) is quite surprising. The dark blue is SXGA resolution monitor shipments. Although the volume scale on the left axis of the graph is missing, you can still see that SXGA (1280x1024) accounted for the majority of shipments in 2H'05, which is as expected. The red, purple and blue-green lines are actual XGA (1024x768), SVGA (800x600) and SXGA (1280x1024) resolutions in use by the 34 million website visitors. More than half of the users are at XGA (1024x768), while only ~13% are at the native SXGA (1280x1024) resolution).

While the results seem amazing to the author, they may not be that far off the mark. The author recently sent a close working associate a spreadsheet that was set for 100% on an SXGA monitor. The associate complained that he couldn't see all of it without reducing the percentage. The author asked what resolution he had his monitor set to, and it was XGA. When the author asked him why he was using a non-native resolution, he said that "things are too small at SXGA".



Chris also addressed another favorite topic, that of the forecast for wide-aspect monitor shipments. Chris' latest forecast is more bullish than in the past – it projects that 23% of all LCD monitor shipments will be wide-aspect by the end of 2010. The author has heard estimates of over 50% by as soon as 2008, so DisplaySearch may still be too conservative in this area. For example, Chris is forecasting ~5% share for 19" W and ~45% share for 17" 4:3 in 2007, while Acer's "admittedly aggressive" forecast is that 19" W and 17" 4:3 will have equal shares in 2007.

In terms of pixel density, Chris isn't forecasting any significant change before 2010, which (unfortunately) is probably realistic.

Microsoft: Sriram Subramanian from Microsoft gave the last presentation of the conference. With a grand total of eight content slides on "Windows Vista and Display Hardware Opportunities", the presentation was a serious disappointment. It seemed to be aimed at someone who knew nothing about Vista. It included only one forward-looking slide that suggested the following new opportunities:

- Short Term: (1) Higher resolution for laptops as well as desktops, and (2) Continue transition to wide screen and wide view
- Medium to Longer Term: Higher gamut/dynamic range.

That was it for the Microsoft presentation. Those attendees who left before the end of the conference (more than half) certainly didn't miss much.