Standard Panels Working Group
Quarterly Newsletter

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First SPWG Newsletter

This is the first quarterly newsletter related to the activities of the Standard Panels Working Group (SPWG). The newsletter is being released to help assure industry-wide awareness about the continuing efforts to standardize the displays used in notebook PCs. Mark Fihn and Paul Salisbury, two of the original people most directly involved in the creation of the SPWG, are writing this newsletter in an effort to help assure an open communication about future standardization efforts and to sustain the successes the SPWG has enjoyed to date. *Any opinions expressed in this newsletter are entirely those of the authors, and any errors or omissions are unintentional.* Our goal is to provide a clear and open communication about the benefits and problems associated with the SPWG and to identify and help implement additions and improvements to the SPWG effort. Guest articles, opinions, or rebuttals are welcome from any source. There are no subscription fees associated with this newsletter; likewise no advertisements will be accepted.

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What is the SPWG? 1999 Until Today…

This is actually not an easy question to answer, because the SPWG has historically been just an ad hoc group of people with no specific charter, no regular meetings, no organized membership, no legal entity, and no structured processes. Without any organizational structure, many in the industry were initially openly skeptical about whether any standards could be effectively established.

The SPWG was born out of a Symposium about the Economics of the Display Industry, sponsored by DisplaySearch. The conference was held in mid-March 1999 in Austin, Texas. The timing is important, since the LCD industry was entering its worst-ever shortage stage of the Crystal Cycle, and PC companies were facing serious supply constraints. At the conference, Dell's VP of procurement, Glenn Neland was a keynote speaker, and during his presentation he pointed out that the notebook PC industry was without simple mechanical and interface standards and he called for the adoption of standards for notebook PC displays. In the session following Mr. Neland's keynote speech, Ted Callaghan from Compaq and Mark Fihn from Dell repeated the need for establishing standards during following presentations in the notebook PC session. In a panel session about notebook PCs, Mr. Callaghan and Mr. Fihn agreed to work together to help create industry standards. Mr. Carl Steudle from Samsung and Mr. Alan Jones from IBM also participated in the panel session (representing the panel makers' perspective), and pledged their support for the creation of industry standards. And by the conclusion of the panel session, Ross Young, President of DisplaySearch, agreed to serve as a third party intermediary to help establish appropriate standards. And so the SPWG began…

Within a few weeks after the March conference, representatives from IBM and HP's PC groups contacted DisplaySearch expressing an interest in participating in a standardization effort. And so, representatives from these four companies (Dell, Compaq, HP, and IBM) met for the first time in mid-May 1999 at the Society for Information Display (SID) conference in San Jose to discuss what might be done to establish standards. Acer also indicated they would support a standardization effort, but would not be actively involved in the creation of the standard. Inquiries were also made to Toshiba, Sony, NEC, and Apple, but these companies declined to participate in the standardization effort.

By the end of August 1999, a total of nine formal meetings were held by the SPWG. In addition to the San Jose meeting, face-to-face meetings were held at Compaq in Houston, at Dell in Austin, at IBM in Raleigh, and at an industry convention in San Francisco. The other meetings were telephone conferences. Compaq, Dell, and IBM participated in all the meetings, and HP participated in several of them. By mid-July, the group agreed that it was important to "recruit" Toshiba to support the standardization effort, since Toshiba was the market leader for notebook PCs at the time. So the group contacted Toshiba who agreed to review the standard once completed and then decide whether or not to publicly endorse it. Toshiba eventually did endorse the standard, although they were not actively involved in its creation.

The creation of the original SPWG standards can be primarily linked to five people: Larry Mabe from Compaq, Mark Fihn and Paul Salisbury from Dell, Toshiyuki Ikeda from IBM, and Ross Young from DisplaySearch. Many other people were peripherally involved from numerous companies, but these five people were the driving forces in bringing about the standardization results.

By early September 1999, the four primary companies agreed upon the SPWG (Version 1.0) document. It took another 6 weeks to get the legal and public relations departments of the authoring companies to agree on final wording and to finally recruit Toshiba to support the effort. On October 27, 1999, the standard was officially released. In other words, from the first formal meeting to spec release, the SPWG was launched in only 5 months. DisplaySearch hosted an SPWG website at which the standards could be freely downloaded and at which interested parties could find out about the SPWG's efforts.

When this first specification was released, no LCD makers actually had begun the development work necessary to bring out a new SPWG panel. Dell was particularly strong in requiring its suppliers (and potential suppliers) to bring out SPWG-compliant panels, to the point that Dell even modified some

existing system designs. By early 2000, several companies introduced SPWG-compliant panels, and by the end of 2000 Dell was incorporating a significant number of SPWG panels in its systems. No other companies are believed to have introduced notebook PCs with SPWG panels in 2000, as they were unwilling to disrupt their ongoing development efforts. But by 2001, many companies began introducing new systems that used SPWG-compliant panels.

In early 2000, the original SPWG authors determined that the initial specification inadequately dealt with higher resolutions and thin panels. Through a series of phone calls and e-mails over the next several months, the group released SPWG Version 2.0, which was formally released on September 19. 2001. Version 2.0 is an enhanced version of the specification and was intended to eventually fully replace Version 1.0.

In July 2000, IBM's Ikeda-san shifted to a different engineering group at IBM. With his departure from IBM's Raleigh group, IBM has had essentially zero involvement in the ongoing efforts of the SPWG. At the same time, Mark Fihn left Dell and joined DisplaySearch, where he stayed actively involved in helping to support the standard. Compaq's Larry Mabe remained involved, but the acquisition of Compaq by HP in early 2002 resulted in changes that were clearly not as focused on LCD standardization and Larry Mabe's involvement was diminished. As such, by late 2001, Dell's Paul Salisbury and DisplaySearch's Mark Fihn were the only two of the original authors of the SPWG effort that were still actively involved in the ongoing support and maintenance of the SPWG effort. At this point, HP, IBM, and Toshiba were essentially inactive.

In March 2002, DisplaySearch sponsored an "open" SPWG meeting at its annual conference in San Diego. Any interested party was welcome to attend the meeting. Although more than 30 companies sent representatives to the meeting, Compaq, IBM, and Toshiba did not attend. At the March 2002, meeting, discussions were about how to expand the SPWG effort to support smaller panels, larger and wide-aspect ratio panels, display timing, power, integrated inverters, and a variety of other possibilities. Unfortunately, since that discussion, virtually nothing has been done by the SPWG.

The ongoing support related to the SPWG was not insignificant. DisplaySearch typically received 1-2 inquires about the SPWG standard on a weekly basis. While many of these inquires required little effort, and could be easily answered by Mark Fihn, many times the questions were technical in nature and required some amount of effort by Dell's Paul Salisbury.

In the last quarter of 2002, Paul Salisbury resigned from Dell and no one from Dell was specifically assigned to take over Paul's efforts related to the SPWG. In early 2003, absent any funding for the website and without adequate support for the ongoing maintenance of the standard, DisplaySearch made the decision to take down the website.

As a final effort, in February 2003, DisplaySearch offered to sponsor an SPWG meeting at its conference in April 2003, but of the primary companies involved with the effort, only Dell was willing to send a representative. As such, the SPWG effort was essentially stalled…

Finding Evangelists… In many ways, the most important factor in the successful creation and implementation of the SPWG specifications was due to the evangelistic efforts of a very small group of people who persisted both internally and externally to popularize the standardization effort. Without "true believers" helping to influence change in the industry, the constraints of intra-company politics and inter-company competition are likely to bog down any efforts to develop consensus.

Although the focus for furthering the SPWG standards has clearly changed, a tremendous interest remains throughout the industry for expanding the scope of the SPWG effort. But there is a need for new evangelists at key companies in the notebook PC industry to step up and newly help to implement change in the industry. Inspired by inputs from many in the industry, Mark and Paul have agreed to continue supporting the SPWG efforts as a non-affiliated operation.

SPWG Endorsing Companies

Although the SPWG specification was created primarily from key individuals at Compaq, Dell, and IBM, (with HP and Toshiba involved from the sidelines), it should be emphasized that a large number of companies throughout the notebook PC display food chain were actively involved in the creation of the SPWG specifications. Virtually all TFT LCD manufacturers have contributed to the creation and review of the specifications, connector makers have made valuable inputs, and numerous other companies have provided countless inputs and clarifications.

When the original SPWG specifications were announced in October 1999, 19 companies formally endorsed the new standard, (through merger or acquisition 3 of those companies no longer exist). Over time, more and more companies formally endorsed the standard, until the current time when more than 40 companies have indicated their support. As of August 1, 2003, as depicted in Figure 2, the top players in the notebook PC market, (brands, LCD manufacturers, notebook PC manufacturers, and notebook PC display connector makers, all endorsed the SPWG effort. Even those notebook PC brands that did not formally endorse the SPWG specifications are believed to all be using SPWG-compliant displays in their notebook PCs.

In addition to the above companies, several related companies have endorsed the SPWG specifications, including: ATI, Corning, DisplaySearch, Extended Battery Life Working Group, Intel, Nitto Denko, nVidia, Texas Instruments, and Toppan. Several additional companies have newly endorsed the SPWG efforts and others are currently considering the possibility of becoming new endorsees.

Figure 1 Historical SPWG Endorsees: Focused on the Notebook PC Industry

Notebook PC Brands		
1	■	Dell*
2	■	HP*
3	■	Toshiba
4	■	IBM*
5		Sony
6		Fujitsu
7		NEC
8	■	Acer
9		Apple
10		Gateway
11	■	Sharp
12		Hitachi

NBPC LCD Makers		
1	■	Samsung
2	■	LG.Philips LCD
3	■	AU Optronics
4	■	Sharp
5	■	Hitachi
6	■	Quanta
7	■	TMDisplay
8	■	IDTech
9	■	HannStar
10	■	Chi Mei
11	■	BOE-Hydis
12	■	Tottori Sanyo
13	■	CPT
14		NEC
15	■	Mitsubishi
16	■	InnoLux

Notebook PC Makers		
1	■	Quanta
2	■	Compal
3	■	Wistron
4	■	Arima
5	■	Inventec
6	■	FIC
7	■	ECS
8	■	ASUSteK
9		MiTAC
10		LG Electronics
11		Samsung
12	■	Uniwill
13		Clevo
14	■	Twinhead

NBPC Connector Makers		
1	■	JAE
2	■	JST
3	■	Hirose
4	■	KEL
5	■	LG Cable
6		Molex
7	■	Uju
8	■	Sunridge

Rankings based on DisplaySearch data for 2002. Connector company rankings may not be accurate.

*Note that in late August, 2003, Bob Myers (who sits on VESA's board of directors from HP), Susan Leurich (who sits on VESA's board of directors from IBM), and Stefan Peana, an LCD engineering manager from Dell, requested that their endorsements of the SPWG effort be removed from the SPWG website.

When the SPWG was established in 1999, the five authoring companies (Compaq, Dell, HP, IBM, and Toshiba) claimed more than 57% of the total notebook PC market. At the time most analysts predicted that industry would continue to consolidate – that the big companies would continue to get bigger and bigger and that most of the smaller companies would either be acquired or go out of business. Consolidation in the notebook PC industry, however, has simply not occurred. The five SPWG originators

(now 4 considering the HP/Compaq acquisition) have actually lost combined market share each year since 1999 and now expected to represent less than 50% of the notebook PC market in 2003.

At the same time that the influence of the leading brands has diminished, the relative position of the notebook PC OEM producers has increased. In 1996, 3rd party OEM manufacturers did less than 40% of all notebook PC production. In 2003, it appears that fully 80% of all notebook PCs will be manufactured by third party companies, led by Taiwan's Quanta and Compal. Although brand companies certainly still have considerable influence in decisions relating to component selection, even the design function is rapidly transferring away from the brands and to the Taiwanese and Korean OEM makers, (who are ever-increasingly being referred to as ODMs, rather than as OEMs).

While it is absurd to think that a meaningful standard can be created without the support of Dell, HP, or IBM, it is also unreasonable in today's environment to think that today a meaningful standard can be established without the broad-based participation of many other industry participants through a broad-based process of consensus-building involving all levels of the food-chain.

www.spwg.org Website Introduced

In mid-August, 2003, Mark Fihn and Paul Salisbury launched a new website at **www.spwg.org**. The goal is to maintain an updated site related to the SPWG, a single non-affiliated website where people can find out most anything they might want to know about notebook PC display standards. The SPWG website was previously hosted by DisplaySearch, and the DisplaySearch folks have graciously agreed to mirror the new spwg.org site on their website.

The new website is expected to be a constant work in motion, with updates made frequently. This and future newsletters will be posted to the site and will be available as a free download.

SPWG Revitalization Effort Launched

Paul Salisbury retired from Dell in October 2002. Mark Fihn retired from DisplaySearch in March 2003. Both, however, have remained active in the displays industry in many ways. In late May 2003, Mark and Paul were approached by The Extended Battery Life Working Group, (EBL-WG) to help revitalize the SPWG. Paul and Mark contacted numerous companies in the industry to assure that such an effort would be supported and were they strongly encouraged to move forward. In early July, the two began making plans and identifying the needs and processes needed to move the SPWG forward. The result of this planning process was a kick-off meeting, held in Tokyo, on August 28, to be held in conjunction with meetings held by the EBL-WG.

No less than 40 companies joined the meeting in Tokyo on August 28, including: ASUSteK, AU Optronics, Compal, Corning, CPT, Dell, DisplaySearch, FIC, Fujitsu, HannStar, Hirose, Hitachi, IBM, IDTech, Intel, Inventec, JAE, JST, KEL, LG Electronics, LG.Philips LCD, Microsoft, National Semiconductor, NEC, Nitto Denko, O2 Micro, Panasonic, Portrait Display, Quanta Computer, Quanta Display, Samsung Electronics, Sharp, Stanford Resources, Texas Instruments, TMDisplay, Toppan, Toppoly, Toshiba, Uju Electronics, and Wistron

The event started with presentations from Intel's Eunice Chang about Intel's work related to display sub-system power measurement recommendations, which was summarized in a paper published on July 3, 2003 by the EBL-WG. (Note a recent version of this interesting paper is available for review at the EBL-WG's website, http://www.eblwg.org/documents.asp). Intel's Tom Rossi then presented results of testing performed by Intel relating to various notebook displays. The process established by the EBL-WG and the results of their testing are quite interesting. Considering that 30-40% of total system power is consumed by the display, the EBL-WG is focused on helping define ways to reduce/manage display power.

The second portion of the event was related to how best to go about revitalizing the SPWG. A copy of Mark's presentation from the Tokyo event is available for download at the spwg.org website. After Mark's presentation, Gary Verdun from Dell led a discussion on next steps for the SPWG. The attendees created a list of the following focus areas, using Mark's presentation as a basis for discussion:

1) Integrated Backlight Inverter
2) Mechanical: Connectors (pin count, size, lamp wire length); Size / Resolution
3) Video Timings; Setup & Controls
4) Electrical; AC Timings; Power Source Distribution & Power Management
5) Validation; Instrumentation/ Measurement - definition of terms and measuring methodology
6) System Integration Support; Test / Maintenance
7) Optical Performance [include definitions and possibly measurement methods for best uniform and consistent comparison]; Color Definition / Consistency (with respect to filters); Efficiency
8) Output Uniformity; Viewing Angle
9) Brightness Control; Response Times; Control Range

Mark and Paul

Follow-on actions were for companies to identify any committee activities they would be interested in supporting. Mark and Paul to coordinate communications with these various committees.

VESA Adopts the SPWG Specifications

On August 27, 2003, the Video Electronics Standards Association (VESA) announced "it will accept the existing Standard Panels Working Group (SPWG) panel specifications for publication by VESA as 'industry standards', per a request from former SPWG organizers Hewlett-Packard/Compaq and Dell". According to VESA's press release:

> According to VESA executive director, Bill Lempesis, the SPWG was never formally organized as a standards organization; these documents have recently been in need of a "home" to ensure their continued support and availability. Dell and Hewlett-Packard asked VESA to provide this service.
>
> "Hewlett-Packard expects the work of the SPWG to continue within VESA and we are already beginning the process for further development of these specifications," said Bob Myers, manager of the Display Technology Center, Hewlett-Packard.
>
> "Dell welcomes the recent VESA decision to accept the existing SPWG specifications for publication as industry standards, and Dell will provide all necessary support to ensure success and further expansion of the specifications within VESA," said Joe Goodart, senior display engineer, Dell.
>
> VESA has in the past provided such support for existing de-facto industry standards, especially in the area of display timings. The VESA Board of Directors felt that it was appropriate to publish these standards as "VESA Industry Standard" documents although they had not gone through the formal VESA approval process. However, any future development of these specifications - and this has also been proposed, to add the new 15.4" and 17.0" widescreen notebook panels to these standards - will be performed under the standard VESA process.

Paul and Mark's Opinion: VESA's Adoption of SPWG

Paul and Mark are very pleased that VESA's board of directors made the decision to adopt the existing SPWG standards, as it helps to verify the legitimacy of the standard. Immediately upon hearing of VESA's intentions related to the SPWG, Paul and Mark volunteered to shift their efforts so that they fell "under the VESA umbrella" and invited VESA to participate at the SPWG revitalization meeting in Tokyo. (Note: VESA did not send a representative to attend the meeting in Tokyo and has not yet responded to our suggestion to utilize our expertise to help enable the revitalization of the SPWG). Paul and I are committed to helping to improve the usability of LCDs in notebook PCs and have no particular allegiances as to how this accomplished. In fact, we believe that the implementation of SPWG standards through a body like VESA is preferable to the ad hoc process previously used by the SPWG.

We believe that what is truly needed in the notebook PC industry is much more than a simple rubber-stamping of the existing industry standard, but is the active evolution of a vibrant industry-wide specification. While we believe that VESA is entirely capable of expanding and maintaining such a standard, we believe there are some areas of concern that VESA must address if they are to be successful in the revitalization of the SPWG.

Concern 1: VESA must overcome some legacy issues. Historically, VESA has been focused on establishing standards for the desktop computer industry, (primarily related to timing). Until only very recently, VESA's standards have been focused on CRT technologies, and even today it would be difficult to identify any VESA standards that have been specifically created to support the fastest growing segment of the computer market – notebook PCs. Adopting an existing standard is an easy way to show support for the notebook PC industry, but we worry that VESA's leadership is still monitor-centric.

Concern 2: VESA must attract an additional membership that better reflects the interests of the notebook PC industry. Of the 40 companies that have historically endorsed the SPWG, only 25% are VESA members. VESA membership is lacking most TFT LCD manufacturers, virtually all notebook PC makers, and virtually all LCD connector manufacturers. And although VESA does have good representation from notebook PC brands, it's interesting to note that of the top 10 PC brands, VESA members include Sony, NEC, Fujitsu, Apple and Gateway, all of which are not SPWG endorsees. In other words, VESA's current membership is heavily comprised of companies that have NOT previously supported the SPWG effort.

Concern 3: VESA's fee structure inhibits open participation. Several SPWG endorsees have pointed out that they are unwilling to join VESA due to its fees. By contrast, endorsement of the SPWG and access to the SPWG specifications has always been free of any charges. (By the way, we are pleased that VESA has so far posted the SPWG specification on the VESA website at no charge).

Concern 4: It appears that the SPWG specification has undergone a "VESA-fication". While the acronym "SPWG" is not particularly important, it is certainly familiar within the notebook PC industry. VESA's posting of the SPWG specification is without the "SPWG" logo or any reference to the SPWG.

On September 4, 2003, VESA announced the formation of a new Special Interest Group, the "Panel Standardization SIG". VESA published:

> Statement of Purpose: Due to the tremendous growth in the availability and uses for LCD's, an extremely large number of variables has arisen preventing the standardization of LCD panels. The display industry has endured unique/custom designs by most of the industry's LCD suppliers, forcing OEM's and other end-product users to change packaging, interface design, and tooling for each new panel supplied. These changes frequently cause schedule slippage, missed market opportunities, and product obsolescence. Some LCD manufacturers have found they cannot be considered as potential suppliers because of the changes their design would force on the monitor end product. As the number of panel suppliers increases, the potential problems of such independent designs will grow for both monitor OEMs and LCD suppliers.

> The goals of this standard effort will be to establish a set of displays with standard mechanical dimensions and selected electrical interface requirements for industry standard LCD panels, to enable both LCD monitor makers and panel suppliers to better manage volatile LCD supply and demand. This effort will allow panels from various LCD suppliers to be used in most applications, including, but not limited to desktop monitors, notebook PCs, all-in-one PCs, point of sale, kiosk and industrial products. When products are designed around the standard panels, display panels from various display module suppliers could be interchanged without requiring alterations in either the product tooling or the display module, thus facilitating multiple sources of supply and greater availability for the LCD consumers.
>
> VESA has formed a Special Interest Group (SIG) for the purpose of determining which companies would be interested in this new standard, and to determine if an existing or new committee would be suitable to finalize the standard.
>
> The VESA Board requires this SIG to hold meetings as required and to produce by December 5, 2003 a recommendation to the VESA Board of Directors about formal organizations and charter for continued developed of standards. The Board of Directors will consider this recommendation and decided whether to assign this work to either an existing VESA technical committee or to establish a new committee to deal with it. The SIG will in any event be disbanded following the December 2003 meeting of the VESA Board of Directors.

Paul and Mark note three things about this announcement:

1. The statement of purpose and goals of the SIG are primarily focused on LCD monitors, with only one mention of notebook PCs in the announcement.
2. A formal organization/charter will not be established until December 5. This means that 4 months will have elapsed from the time VESA determined to "take over" the SPWG effort and the time that a charter will have been established.
3. Paul and Mark believe that it is very unlikely that a set of mechanical and interface standards can be created to serve the requirements of multiple and diverse applications as suggested by the SIG announcement. Displays for notebook PCs have fundamentally different mechanical requirements than those used in LCD monitors, which differ again from harsh POS and kiosk environments.

Although Paul and Mark think that VESA's recent announcement to support the existing SPWG standard is quite positive, we also believe that we can help VESA transcend some of the gaps in the organization's current structure, focus, and membership, and we encourage the VESA membership to seek ways to more broadly reflect the needs of the entire notebook PC industry.

SPWG and Intellectual Property

Most industry standards attempt to assure that no one benefits by virtue of reliance upon any one company's patent position. Perhaps one of the biggest weaknesses of the SPWG specifications is that it does address any known patent conditions. The original SPWG specification simply states:

> The contributors to this document acknowledge that each contributor may have patent rights. Except for the rights expressly provided by this Agreement, no Promoter grants or receives, by implication, estoppel or otherwise, any rights under any patents or other intellectual property.

Numerous inquiries came to DisplaySearch about SPWG-related intellectual property rights, to which the response was that the implementation of the SPWG standards implied no rights to any company's intellectual property and that any patent rights should be managed through appropriate licensing arrangements with any patent holder.

In fact, the SPWG document specifies at least two things that appear to be protected by patents. First is LG.Philips LCD's side-mount patent portfolio, (the SPWG specification describes the location and depth of the screw-holes for side-mount solutions). Second is JAE's connector patent position, (the SPWG specification identifies a JAE connector "or equivalent"). There is no known litigation related to the JAE connector patent, but the side mount patents have seen a substantial amount of litigation, which is known to be ongoing at this time.

In February or March 2003, Mark made an inquiry to VESA about their policies related to intellectual property. He was clearly advised that VESA's bylaws prohibited the adoption of any standard with intellectual property issues. Mark reported this information to the original SPWG companies, and after getting no guidance, and then after getting no interest in holding an SPWG meeting at the DisplaySearch conference in April, DisplaySearch made the decision to take down the former SPWG website.

With VESA's recent announcement to adopt the existing SPWG specifications, Mark and Paul have been deluged with inquiries about what this means in relation to the SPWG position on intellectual property. According to numerous postings on the Internet, VESA's by-laws support "open standards", which suggests that usage of the standard does not create any intellectual property issues. (Note: VESA's bylaws are not available on-line to non-members, so Mark and Paul cannot verify VESA's actual written policy). Bill Lempesis, VESA's executive director, however, clarified:

> "…while VESA (and virtually all standards organizations) would prefer "Open" standards free of all IP, the reality is that most standards include IP. VESA, like many other organizations, accepts IP within its standards as long as the holders are willing to license the IP on a non-discriminatory basis and at a reasonable fee".

As of this writing, it's not clear that VESA members LG.Philips and JAE have agreed to any such provisions with regard to SPWG. In any case, Paul and Mark certainly encourage any SPWG-related companies to help assure non-discriminatory licensing of their intellectual property.

We note that the SPWG specification newly published on VESA's website has been revised from the original version to newly read:

> The following specification has NOT BEEN DEVELOPED BY VESA, NOR DOES VESA ASSERT OWNERSHIP RIGHTS IN THIS SPECIFICATION. It is being made available at the VESA site because it has (i) been developed by third parties operating in an informal collaborative process, which is no longer operative, and (ii) has become a widely implemented "de facto" standard.
>
> This specification is being published at the VESA site AS IS, WITH NO WARRANTY, EXPRESS OR IMPLIED, OF ANY KIND WHATSOEVER, INCLUDING WITH RESPECT TO THE OWNERSHIP OR NON-INFRINGEMENT OF THE SPECIFICATION, OR AS TO ITS ACCURACY, COMPLETENESS, SUITABILITY OR USEFULNESS. Any copying or implementation of this specification shall be solely at the risk of the party taking such action, and VESA shall have no liability whatsoever with respect to the consequences of such conduct, including with respect to any intellectual property owner alleging infringement of its copyright(s), patent(s) or other rights. VESA assumes no obligation to notify any implementer of any subsequent allegations of infringement or other violations.

Metrology Standards Related to Notebook PCs?

In Mark Fihn's Tokyo presentation on August 28, he claimed, "The notebook PC industry is essentially without global standards for how to measure display performance". Mr. Bill Lempesis, executive director at VESA took exception to this claim, writing, "you mention that there are no measurement standards for flat panels. The VESA FPDM2 is widely used for this purpose and has been in existence for a number of years. See http://www.pcworld.com/news/article/0,aid,110483,00.asp**".**

During Mark's Tokyo event, he pointed out that indeed there are numerous "standards" relating to the measurement of flat panel displays, including VESA's excellent FPDM2 document, but there remains a rather wild range of how different companies specify their notebook PC LCDs such that specification confusion has proliferated throughout the industry.

By the way, the very interesting article in PC World that Mr. Lempesis referenced is only related to LCD Monitors – and makes no mention of notebook PCs. The PC World article identifies that even if LCD monitor companies use VESA's FPD metrology, there is still a wide range of confusion about the specifications, and that many companies have simply chosen not to use VESA's measurement processes at all.

Mark's Tokyo presentation went on to cite Dr. Norman Bardsley, Director of Roadmaps & Standards at the USDC who recently stated that:

"Greater attention to performance measures is needed to:

- Provide guidance to customers
- Provide data for product differentiation
- Provide common ground for analysts and planners
- Relate display performance to user needs
- Give guidance to researchers
- Prevent lawsuits
- Avoid unnecessary expenditures
- Attract attention to factors other than cost"

Dr. Bardsley's points are similar to those made in the PC World article. In any case, Mark and Paul recognize that a great deal of very good work has already been done by VESA and other standards organizations related to display metrology. Such work, however, needs to be defined appropriately for each application and not serve as a broad and general reference. Accordingly, Mark stands behind his statement that "The notebook PC industry is essentially without global standards for how to measure display performance", although perhaps it would be more accurate to say, "The notebook PC industry is essentially without meaningful guidelines about how to apply standards related to the measurement of display performance".

PSWG (LCD Monitor Standardization Effort)

While the SPWG is focused on standardizing panels used in notebook PCs, a separate working group has been working since early 2002 to similarly create standards for the LCD Monitor market. On March 10, 2003, the Panel Standardization Working Group (PSWG – renamed from the prior SPWGm) released its first specification for 15.0" XGA (1024x768) panels. The PSWG effort was moderated by Don Chambers from Cables To Go, and is available for download at the Display Labs website: http://www.displaylabs.com/. According to the PSWG specification, the creation of the document involved four LCD monitor companies, (Dell, HP, IBM, and Viewsonic, although sources indicate that Samsung and NEC-Mitsubishi were also involved). The PSWG specification was also supported by six LCD manufacturers, (AU Optronics, Chi Mei, CPT, HannStar, LG.Philips, and Optrex). Hirose and National Semiconductor are also listed as supporters of the PSWG effort. PSWG sources have indicated that the group is now very close to releasing the specifications for 17.0" panels for LCD monitors.

Engineering vs. Procurement?

Mark and Paul have observed that most companies seem to view the development of industry standardization as a function that is exclusively under the responsibility of the engineering department. With the single exception of Mark's involvement in the original SPWG effort, (at which time he was in Dell's procurement organization), the development of the SPWG specification was entirely under the purview of LCD engineers.

While certainly spec documents should be developed by qualified engineers, standardization efforts are likely to be much more effective if they are developed in concert with company procurement representatives.

1. Although standardization simplifies the engineering qualification process, the primary benefits of industry standardization are seen by the procurement side:

    a. Second-sourcing flexibility
    b. Lower pricing and improved negotiation leverage
    c. Inventory minimization
    d. Simplified end-of-life supply management
    e. The ability to upgrade
    f. Cross-platform interchangeability
    g. Ease of Serviceability
    h. Remote Test/Diagnostics
    i. Ability to focus on price/performance

2. The creation of standards is much more than just the release of a specification. It requires a coordinated process to evangelize about the advantages of standardization – internally and to external suppliers and industry participants. In many situations, buyers are in the best position to manage this evangelism process since they are primarily responsible for managing supplier relationships. Without involvement of procurement organizations in the standardization effort, there is a risk that the standards will be relaxed – either at the internal engineering level or at the supplier level.

3. Procurement managers are trained to negotiate for compromises that allow win-win situations. Engineers, on the other hand, are trained to find the best solution and to continuously experiment and invent to find the best possible solution. In other words, in a standards setting situation, if engineers are the primary people involved in establishing the standard, there is always a risk that the scientific method will break down the consensus-building process.

4. As more and more notebook PC brand production moves to third party manufacturers, the major brands are shifting engineering resources to the third party manufacturers as well. This means the role of the buyer is becoming more and more important in determining supplier selection and commodity features, (which is another reason favoring standardization).

In other words, brand procurement managers are encouraged to take a more active role in the standardization process, helping to assure timely implementation of such specifications. This suggestion clearly does not mean that engineers should not be involved in the standardization process, just that it's important for both engineering and procurement to work closely together in the development of consensus-building strategies related to industry standardization.

Focus of the SPWG Specifications

As depicted in Figure 1, the SPWG specifications are focused on mechanical and simple interface requirements and do not address display performance parameters. The focus is to standardize those factors that do not enable product differentiation. In other words, customers do not care about those factors addressed by the SPWG specifications.

Figure 2 Are/Are Not Summary of the SPWG Specifications

Industry Standard LCD Panels "Are / Are Not":

Are	Are Not
Std. Mechanical outline X & Y	Std. Thickness
Std. Mounting hole location	Std. Luminance
Std. I/O Connector and pin out	Std. Weight
Std. Active area centers	Std. Contrast ratio
EEDID LCD panel ID (PC2000)	Std. Viewing angle
Std. CCFL connector	Std. Color
	Std. Response time
	Std. Resolution

Benefits of LCD Standardization

Identifying a disadvantage resulting from the SPWG effort is actually not easy to do. Perhaps companies with very strong sales teams are disadvantaged because they previously were able to get their custom panels designed into system more effectively than companies with weaker sales teams. Once designed in, due to the difficulty of switching to a new display, perhaps these companies have seen a disadvantage because they are now more easily replaced with a competitive panel. But this possible disadvantage goes both ways, since it's now easier for all companies to be second-sourced…

Moreover, the "design-in argument" suffers from the reality that design wins are often less successful than the buyer originally forecasts – translating to inventory build-ups of customized solutions that are usually difficult (or impossible) to switch to a different platform. In other words, customized design wins sometimes results in customized inventory surpluses and is not really such a benefit after-all. The SPWG specifications help to minimize such inventory issues, (at multiple points in the supply chain).

Second-sourcing flexibility. Perhaps the primary inspiration for the creation of the SPWG was related to the difficulty of designing multiple sources into a notebook PC design. So long as platform volumes were relatively small (as was generally the case until the late 1990s), second-sourcing was not essential, but as platform volumes increased, particularly in shortage environments, the custom-LCD situation that

was the industry practice at the time, simply became so unwieldy that the SPWG effort was required. The entire design-in process is now greatly simplified, with no need to create multiple enclosures, bezels, and connectivity solutions.

Lower pricing and improved negotiation leverage. By increasing volumes for any panel (and the associated components) at each LCD supplier, not only are costs reduced due to the economies of scale of larger production runs, but also product interchangeability reduces the risks of obsolescence as well as stimulating a more competitive pricing environment. Although supply/demand factors impact pricing, in general, there is ample evidence that SPWG-compliant panels sell on average for $3-8 less than comparable non-SPWG panels.

Inventory minimization. From the component level to the LCD manufacturer, to the notebook PC maker, and to the notebook PC brand, standardization enables inventories to be reduced – eliminating tremendous waste in the industry. Not only does reduced inventory translate to lower pricing, but also it directly impacts a company's profitability.

Simplified end-of-life supply management. With single-sourced customized LCD solutions, managing end-of-life situations was frequently very difficult. Stop production too soon and customers may not get a product they want; stopping production too late may result in obsolete inventory. The SPWG means that TFT LCDs can be used interchangeably from various LCD makers, greatly simplifying end-of-life management.

The ability to upgrade. If product performance is customized, then upgrading a system is almost impossible. Although it's not possible yet, someday the SPWG efforts may actually enable notebook PC end-users to upgrade their systems, in much the same way they can currently improve their HDD or system memory. Even if the SPWG never gets to the end-user, the ability for the OEM or the brand to configure systems with different LCD performance characteristics at the last moment is a huge advantage.

Cross-platform interchangeability. Planning for customer preferences 3-4 months in advance (typical lead-times for customized TFT LCDs) is very difficult, particularly when such planning must consider multiple platforms and multiple performance parameters within each platform. The ability to plan at a higher level allows all in the TFT LCD supply chain to shift more quickly and responsively to changes in demand from platform to platform and/or from customer to customer.

Ease of Serviceability. Field service technicians previously had to manage notebook LCDs at a very high level. With each customized panel, the service group also had to manage customized enclosures, bezels, connectivity solutions (FPC or wire harness), and sometimes also separate EMI solutions. The range of combinations made field service very unwieldy. With SPWG, field service is greatly simplified.

Remote Test/Diagnostics. The SPWG's requirements for pin-outs that enable panel identification allow some level of testing and diagnostics troubleshooting. Panel ID also simplifies BIOS development so that company-by-company differences can be adjusted by way of software protocol rather than in firmware.

Ability to focus on price/performance. Overall, perhaps the biggest advantage enabled by the SPWG is that the industry has little need to focus on electro-mechanical customization that serves little/no value in winning sales. Instead, the entire supply chain can better focus on improving display performance and/or cost in ways that truly benefit the end user.

Does Standardization Lead to Commodization?

Perhaps the most common criticism about the SPWG standardization effort is that it will lead to "commoditization". Although it's not certain that "commoditization" is a bad thing in the first place, the fact of the matter is that standardization actually helps to stimulate technological development. The

SPWG specifications have in fact enabled companies to become increasingly innovative in terms of differentiating the LCDs used in notebook PCs.

Consider the example of resolution. Prior to the SPWG, 1400x1050 and 1600x1200 were unusual pixel formats for notebook PCs. A few companies had experimented with the desktop SXGA standard (1280x1024) in notebook PCs, but the 5:4 aspect ratio really required an entirely new notebook PC format and the SXGA "standard" simply did not work for the notebook PC industry. Accordingly, Dell developed the SXGA+ pixel format (1400x1050), in a 4:3 aspect ratio identical to the commonly used XGA (1024x768) panels. **The SPWG specifications actually enabled notebook PCs to transition to these higher resolutions.**

Some may question whether the transition to higher resolutions is truly the result of the efforts of the SPWG. It's true that a few companies, (most prominently Sony), introduced notebook PCs with high resolution displays independently from any standardization efforts, but such products were niche products in relatively low volumes. SXGA+ and UXGA, on the other hand, have been transformed into common, industry-wide standards. Perhaps the real "proof" of how SPWG has enabled higher resolutions to "take off" is to look at examples where such standards are not available.

> **LCD Monitors**. The most obvious example is in the LCD monitor market, which despite the efforts of the PSWG, is still mired with a multiplicity of non-standard mechanical and interface solutions. And today, at any given panel size, buyers have only one choice of resolution. Despite the fact the notebook PC market has already demonstrated there is considerable demand for 15.0" panels at 1400x1050 and 1600x1200, the LCD monitor market only offers 15.0" panels at 1024x768, (which is currently the worst pixel density that is commonly available for displays used in the PC market). Note: The current 15.0" PSWG spec is described as only for XGA panels.
>
> **12.1" Notebook Panels**. The SPWG did not address 12.1" panels in its specifications. Even though these smaller size panels have historically led the industry to higher pixel densities, and even though applications like the Tablet PC scream out for higher pixel densities than the 106-ppi found on 12.1" XGA panels, there have not been any products developed in the 12.1" size at higher resolutions. At least one explanation is that there are no SPWG-like electro-mechanical standards at the 12.1" size that would help mitigate the risks associated with developing such a product.

Consider the historical details:

- When the SPWG effort originated in Q1'99, DisplaySearch reported the notebook PC market used displays at 6 different TFT LCD panel sizes, in two different pixel formats, (a total of 9 display options). 91% of the panels used in Q1'99 were 12.1" SVGA, 13.3" XGA, or 14.1" XGA. (STN LCDs in two sizes were also used at the time).
- In Q2'03, DisplaySearch reported there were 14 different panel sizes for notebook PCs, in 13 different pixel formats, (a total of 23 different display options). (a-Si and p-Si options are used).
- The current SPWG specifications address 7 of these 23 options in Q2'03. These 7 options currently represent about 83% of the market – of which about 57% of the total market uses SPWG-compliant panels.

In addition to enabling differentiation in terms of pixel density, the SPWG similarly has helped to minimize the risks, to both LCD manufacturers and notebook PC manufacturers, associated with the introduction of other display performance enhancements, including wider viewing angles, higher brightness, faster response times, etc.

Wire Length Issues

Perhaps the biggest failure of the entire SPWG effort has been the inability of the industry as a whole to accept the SPWG-defined wire length from the backlight. In actuality, a large number of the panels currently being sold as "SPWG-compliant" panels are not pursuant to the specification.

The SPWG specification does not currently identify the location(s) of the inverter. For various reasons, the inverter is located in different places from platform to platform, (usually on the back of the panel, the side of the panel, or at the bottom of the panel). The positioning of the inverter can therefore determine the length of the wire coming from the backlight. The current SPWG specification states that the wire-length is to be 60 +/-5 mm.

Engineers at HP were the first to ignore the SPWG wire-length specification, requiring their suppliers to provide a different wire length. Since the wire is part of the backlight assembly procured from backlight manufacturers, this exception to the specification essentially destroyed many of the industry-wide advantages of SPWG. Backlight manufacturers had to make multiple assemblies for each of their customers, forcing LCD manufacturers to plan, assemble, and test multiple LCD modules. These multiple modules are no longer interchangeable from platform to platform, so the planning, inventory management, and production flexibility at notebook PC manufacturers is also complicated. Although the Compaq-side of the current HP was highly influential and instrumental in the creation of the SPWG standards, the company was quite slow to actually implement SPWG panels in any of their notebook PCs, and when they finally did so, this wire length issue was in fact not SPWG-compliant. One LCD manufacturer advised that HP has never actually used an SPWG-compliant display in their notebook PCs.

Engineers at Dell faced similar issues, since they wanted to position inverters in different places depending on the platform design. Rather than ignoring the SPWG wire-length specification, however, Dell engineers managed the problem by designing a pigtail from the inverter to the backlight wire to accommodate such position issues. In other words, the Dell engineers modified the low-cost inverter rather than the high-cost LCD panel, thereby allowing Dell to continuously utilize SPWG-compliant panels. Unfortunately, recent reports suggest that Dell's engineers may have also chosen solutions that violate the SPWG wire-length specification, a decision that will certainly create issues for Dell's planning, procurement, manufacturing, and service organizations.

Unfortunately, it seems that other companies followed HP's lead such that there are now a multiplicity of panels with varying wire lengths. Unfortunately, the result is that there is a hodge-podge of "SPWG" panels, to the point that the specification has not allowed industry-wide improvements to the magnitude that could have otherwise been achieved. Both LCD manufacturers and notebook PC manufacturers have advised that this is by far the biggest issue that must be resolved as the SPWG specifications move into their next incarnations.

Screw-hole Depth Issue

A minor issue associated with the current SPWG specification has to do with the specified screw-hole depth for mounting the display to the back frame of the notebook PC. The current specification identifies a minimum screw-hole depth of 2.5mm. At the time the specification was created, all LCD manufacturers confirmed that they could support 2.5mm, but after moving into production, at least two LCD manufacturers (Sharp and Hitachi) identified that they could only support a depth of 2.3mm. As such, if the notebook manufacturer uses screws that fill the entire 2.5mm length specified by the current specification, there may be issues associated with which panels can be used. The simple solution is to use slightly shorter screws. Manufacturers that currently support the 2.5mm specification would not have to make any changes. It may be advisable to change the SPWG specification to call out a 2.3mm minimum screw-hole depth to avoid any possible confusion.

Can the SPWG Interface Connector be Changed?

At the time that the SPWG Version 2 specification was created, in order to support 1400x1050 and 1600x1200 panels, a 2-channel LVDS solution was necessary, requiring a 30-pin connector. With the recent introduction of high-speed LVDS, it may be possible to support resolutions up to 2048 x 1536 using single-channel LVDS, which only requires a 20-pin connector.

Shifting to a 20-pin connector would save a few pennies of cost without creating any noticeable communications or pin-out issues. There needs to be a discussion within the SPWG about the pros and cons of sustaining backwards compatibility vs. reduced component costs. **Paul and Mark recommend that the SPWG specification NOT be changed from the current 30-pin connector solution, based on the following considerations about interface speed, EMI, and backwards compatibility:**

LVDS is designed for low EMI, which is very important in a notebook PC. SPWG Style A calls out at a 20-pin connector and Style B a 30-pin connector. The number of pins required for a notebook PC connector is a function of multiple factors. The first issue is LVDS transmission speed.

The LVDS chip single channel transmission rate has gone from 65MHz to 85MHz to 112MHz today. LVDS signals are sent in parallel over paired lines for each color. The signals are sent at a clock rate up to the maximum for the chip. The necessary interface speed is a product of the number of pixels being addressed and the frame rate. As an example, a XGA panel (1024 x 768) running at a 60Hz frame rate requires a transmission rate of 47.2MHZ (1024 x 768 x 60). See Table 1 below.

Table 1 Single-Channel LVDS at 60Hz

Resolution	Pixels	Frame Hz	Required LVDS MHz (1-channel)
XGA	1024 x 768	60	47.2
SXGA+	1400 x 1050	60	88.2
UXGA	1600 x1200	60	115.2
WXGA	1440 x 900	60	77.8
WSXGA+	1680 x 1050	60	105.8
WUXGA	1920 x 1200	60	138.2
QXGA	2048 x 1536	60	188.7
QXGA+	2248 x 1680	60	226.6
WQXGA+	2608 x 1632	60	255.4

If the frame rate is reduced to 50Hz, which may be possible, the single channel LVDS transmission rate can be reduced as shown in Table 2:

Table 2 Single-Channel LVDS at 50Hz

Resolution	Pixels	Frame Hz	Required LVDS MHz (1-channel)
XGA	1024 x 768	50	39.3
SXGA+	1400 x 1050	50	73.5
UXGA	1600 x1200	50	96.0
WXGA	1440 x 900	50	64.8
WSXGA+	1680 x 1050	50	88.2
WUXGA	1920 x 1200	50	115.2
QXGA	2048 x 1536	50	157.3
QXGA+	2248 x 1680	50	188.8
WQXGA+	2608 x 1632	50	212.8

In either case, higher resolutions push the single channel LVDS chip speed requirements beyond their current limits. In the future higher transmission rates may be available and this could push the single channel resolution capability. Single channel transmission requires only 8 lines (4 pairs) of inputs plus power, typically 2 lines, ground, and 3 lines for EDID information. This could be done with a minimum 14-pin connector. SPWG Style A, however, used a 20-pin connector, which was OK for XGA resolutions.

20 pins were used instead of 14 because another major transmission rate factor is EMI. By adding a ground line between pins, there is far less cross-talk and in turn, lower EMI. Higher resolutions require faster LVDS clock transmission rates which impact EMI, so just having a super fast chip is not necessarily the answer.

A simple approach is to address multiple channels simultaneously. As an example, 2 channel transmission halves the necessary transmission rate but does require 8 (4 pairs) more lines for LVDS transmission. This approach was used in SPWG Style B with the introduction of the 30-pin connector, as shown in Table 3. Again to keep EMI low ground lines between pairs were maintained. This approach allows a single cabling system to be used for all resolutions available on a single notebook platform. With this approach a PC maker can offer multiple resolutions in a single notebook and only the panel must be changed.

Table 3 Interface Cable Pin Assignments, SPWG Style B

Pin #	SYMBOL	FUNCTION
1	VSS	Ground
2	VDD	Power Supply, 3.3 V (typical)
3	VDD	Power Supply, 3.3 V (typical)
4	V EEDID	DDC 3.3V power
5	*NC*	*Reserved for supplier test point*
6	Clk EEDID	DDC Clock
7	DATA EEDID	DDC Data
8	Odd_Rin0-	- LVDS differential data input (R0-R5, G0) (odd pixels)
9	Odd_Rin0+	+ LVDS differential data input (R0-R5, G0) (odd pixels)
10	VSS	Ground
11	Odd_Rin1-	- LVDS differential data input (G1-G5, B0-B1) (odd pixels)
12	Odd_Rin1+	+ LVDS differential data input (G1-G5, B0-B1) (odd pixels)
13	VSS	Ground
14	Odd_Rin2-	- LVDS differential data input (B2-B5, HS, VS, DE) (odd pixels)
15	Odd_Rin2+	+ LVDS differential data input (B2-B5, HS, VS, DE) (odd pixels)
16	VSS	Ground
17	Odd_ClkIN-	- LVDS differential clock input (odd pixels)
18	Odd_ClkIN+	+ LVDS differential clock input (odd pixels)
19	VSS	Ground
20	Even_Rin0-	- LVDS differential data input (R0-R5, G0) (even pixels)
21	Even_Rin0+	+ LVDS differential data input (R0-R5, G0) (even pixels)
22	VSS	Ground
23	Even_Rin1-	- LVDS differential data input (G1-G5, B0-B1) (even pixels)
24	Even_Rin1+	+ LVDS differential data input (G1-G5, B0-B1) (even pixels)
25	VSS	Ground
26	Even_Rin2-	- LVDS differential data input (B2-B5, HS, VS, DE) (even pixels)
27	Even_Rin2+	+ LVDS differential data input (B2-B5, HS, VS, DE) (even pixels)
28	VSS	Ground
29	Even_ClkIN-	- LVDS differential clock input (even pixels)
30	Even_ClkIN+	+ LVDS differential clock input (even pixels)

With 2 LVDS channels currently integrated in graphic and TCON chips, the transmission rate requirement is decreased. Along with updated cabling systems (twin coax) and internal panel transmission improvements, this has made low EMI possible on even for high resolution panels, as shown in Table 4.

Table 4 Dual-channel LVDS at 60Hz

Resolution	Pixels	Frame Hz	2 Channel. LVDS MHz
XGA	1024 x 768	60	23.6
SXGA+	1400 x 1050	60	44.1
UXGA	1600 x1200	60	57.6
WXGA	1440 x 900	60	38.9
WSXGA+	1680 x 1050	60	52.9
WUXGA	1920 x 1200	60	69.1
QXGA	2048 x 1536	60	94.4
QXGA+	2248 x 1680	60	113.3
WQXGA+	2608 x 1632	60	127.7

In other words, although shifting to a 20-pin connector would save a few pennies, it also creates both forward and backward-looking issues. Looking forward, the 30-pin connector anticipates the inevitable trends to higher and higher resolutions. Looking backward, the 30-pin connector assures compatibility in older systems – a huge service and logistics benefit – which is one of the key reasons for having standard panels in the first place. Incidentally, regarding connectors, a recent innovation is a locking I/O connector. This connector is backwards compatible so that cabling without locking capability will mate with the LCD panel locking connector. If the system cable has a locking connector it will mate and lock on the LCD panel. The locking connector does not violate the standard since the 30-pin connection is still in tact.

EBL Working Group Releases Display Power Measurement Recommendations

On September 17, 2003, The EBL-WG released recommendations that simplify power measurement and reporting and that enable all companies in the food chain for notebook PC LCDs to better compare display power parameters. It is exactly this sort of recommendation that Paul and Mark believe should be incorporated into industry-wide standards programs. The EBL-WG press release follows:

> SAN JOSE, Calif.--(BUSINESS WIRE)--Sept. 17, 2003--The Mobile PC Extended Battery Life Working Group (EBL WG) has released recommendations to enable uniform and consistent power measurement of display subsystems across the mobile PC LCD industry. The Display Subsystem Power Measurement Recommendations address the measurement of panel electronics power, backlight power and screen luminance, as well as the use of appropriate color patterns, ambient room conditions and a suggested list of equipment.
>
> Displays typically make up a significant portion of power consumed by a mobile PC. As the industry works to reduce mobile PC power consumption, the display subsystem should keep pace with this trend. The Display Subsystem Power Measurement Recommendations are designed to assist mobile PC LCD vendors and mobile PC makers by providing common procedures for the measurements of this critical subsystem's power consumption.
>
> "These recommendations emphasize the importance the industry places on the display power consumption in mobile PCs and accurate reporting of it," said Kamal Shah of Intel Corporation and chairman of the Mobile PC EBL WG. "This is the first time the major mobile PC manufacturers and designers have come together to provide power measurement recommendations to display subsystem suppliers. These recommendations will help to promote

consistency among display vendors and will contribute to the drive toward display subsystems of three watts or lower power consumption."

"The group working on the recommendations had the interests of both the display vendors and the mobile PC makers in mind," said Simon Shih of Quanta Computer and the EBL Working Group's Suppliers Recommendations subgroup chairman. "We have created a document that will promote the adoption of common power measurements and reporting. It is much simpler than anything that was available before, and should drive the vendors of other subsystems to follow the suit."

The Display Subsystem Power Measurement Recommendations document is available on the EBL WG Web site. A list of mobile PC display panels at three watts or less measured using these recommendations will be available on the EBL WG website.

The Mobile PC Extended Battery Life Working Group (EBL WG) is a worldwide, industry-wide group of companies working together to extend the battery life of mobile PCs. Current members of the EBL Work Group include Acer, ASUSTeK Computer, Compal Electronics, Dell, First International Computer, Fujitsu, Hewlett Packard, Intel, Inventec, Legend, LG Electronics, Matsushita Electric Industrial (Panasonic), Microsoft, NEC, Quanta Computer, Samsung Electronics, Toshiba and Wistron. For more information about the EBL WG, visit the EBL WG web site at http://www.eblwg.org/.

Opportunities to Reduce Display Power Requirements

Particularly as wireless applications gain popularity in both home and business computing environments, the demand for reduced power consumption will accelerate. Since the display demand such a significant portion of the total notebook PC power budget, one of the expected focus areas to reduce system power will certainly be on the display subsystem, (which includes both the LCD module and the related inverter).

While Mark and Paul believe that the SPWG should NOT attempt to define any performance parameters such as display power, there are a number of things that the SPWG can do to help improve display power. Simply by working with the EBL-WG to create measurement definitions related to display/inverter power, industry participants have a much better way to make appropriate comparisons from one display to the next. Other areas for potential improvement include: standardized timing; reduced frame rate options, and inverter control standards.

Integrated Inverters

One of the best ways to significantly improve the overall display subsystem for notebook PCs is to bundle the LCD module with the inverter. Historically, inverters have been designed and developed independently from the LCD. In fact, somewhat surprisingly, LCD makers and inverter makers rarely, if ever, communicated with one another. The result was a situation where a relatively inexpensive device (the inverter) controlled the performance of a very expensive LCD device, with little interaction between the two groups. The situation has been made worse by the fact that the notebook PC makers have desired to simplify their production processes by installing a single inverter, regardless of the LCD used. This results in a situation where the performance of the LCD is not matched to the inverter being used, such that power efficiency is not optimal for any particular system.

A big opportunity exists to improve display power by assuring that each inverter is designed specifically to enable optimal efficiency for each display. This is best managed by the LCD maker, who is positioned to act as the intermediary between the lamp maker and the inverter maker. As such, inverters should be bundled (and perhaps eventually integrated) with the LCD module. The notebook PC maker will buy a fully tested “video sub-system” from the LCD maker that is optimized for power efficiency and that can be installed easily as an SPWG-defined form-factor.

In addition to improving performance, integrated inverters will inevitably lead to improved quality and serviceability, since the LCD maker is responsible for any warranties on the entire video sub-system. Eventually, the other advantages of the SPWG (enumerated above) will also come into play with regard to the inverter so as to further improve supply-chain logistics, pricing, and inventory management.

Defect Definitions

Pixel defects and polarizer defects (and perhaps some other cosmetic defects) are another area where the SPWG can help create a common vocabulary. One of the most common complaints from notebook PC customers, at least in relation to the display, is related to pixel defects. But there really are no industry-wide standards about how to define what such defects. While the SPWG should not attempt to define limit requirements, the standard should work to define a way by which all in the notebook PC industry agree upon how to identify and specify such things as pixel defects.

New SPWG Endorsee: InnoLux

InnoLux Display Corp is part of Taiwan's Hon Hai Precision group (commonly known as Foxconn) and is the most recent company to break ground for a TFT LCD fab. The new company will reportedly focus their production efforts on large-area displays for the TV market, the LCD monitor, and the notebook PC markets. Output from the InnoLux fab, which is located in the Chunan Science-based Industrial Park in southern Taiwan, is expected in mid-2004. InnoLux President, H.C. Tuan advised, "InnoLux is happy to endorse SPWG. A good panel standard will help everybody in the TFT-LCD industry without restricting anybody's ability to create and innovate".

New SPWG Endorsee: ASUSTeK

ASUSTeK Computer Inc. is part of the ASUS Group, one of the world's largest manufacturers of motherboards. ASUSteK designs and manufactures notebook PCs under is own brand in addition to its production as an OEM for major notebook PC brands. ASUSteK's notebook PC Product Manager, Vincent Liu advised: "We at ASUSTeK think the SPWG is a good idea. Ensuring LCD vendors & PC makers are communicating together can let all of us work on the same path".

New SPWG Endorsee: ECS

Elitegroup Computer Systems (ECS) claims to be the world's leading producer of motherboards, with production reaching 24 million units in 2002. Dedicating to Drive the New PC Era, ECS has concentrated on broadening its product range. With their acquisition of AlphaTop in 2002, the company is growing as a designer and manufacturer of innovative notebook PC system. ECS sells products both under its own brand and as an OEM manufacturer to leading computer brands.

New SPWG Endorsee: LG Cable

LG Cable is one of the LG group companies, specializing in optical and electronic cable as well as optical communications components. The company has four main business fields: telecommunications, electric power, industrial machinery and electronic components and materials. Among many other things, LG Cable manufacturers electrical connectors for LCDs. They count among their current customers LG.Philips LCD, AU Optronics, and Chi Mei.

New SPWG Endorsee: Uju Electronics

UJU Electronics Co., Ltd. is a Korean company, founded in 1993, that manufacturers interconnect components, particularly for the TFT LCD, PCS, and cellular phone industries. Uju's ISO-9002 certified factory utilizes full-feedback-control molding machines, high precision presses, and fully automatic assembly and packing lines.

With respect to the SPWG, company President Y.B. Ro stated, " Uju Electronics, as a major LCD connector manufacturers in Korea, would like to fully support the Standardization initiative. We strongly believe the SPWG efforts will favor not only the PC manufacturers but also end users and part makers. Our company will remain committed to developing more advanced products that are SPWG-compliant and to helping our customers reduce costs and improve their product performance." The company has promoted SPWG-compliant connectors for the past years. Currently their SPWG-related sales activities include the both "Conventional User Connectors" and "New Uju User Connectors". Uju's "Conventional User Connectors" are "almost identical" with their JAE equivalents in terms of mechanical and electrical performances, except they look slightly different in appearance. Uju claims their "New Uju User Connectors" surpass the performance of the conventional connectors in many ways, while they still remaining compatible with SPWG specification. Uju suggests that these new connectors offer higher reliabilities at a relatively cheaper cost.

Conventional User Connectors		New User Connectors
Uju Part No.	Equiv. JAE Connector	Uju Part No.
1524A-2041R	FI-SEB20P-HF13	IN-30-BB100
1524B-2041R	FI-SEB20P-HF10	IN-30-OA100
1524C-2041R	FI-SEB20P-HF13R	
IN-30-BA10	FI-X30S-HF	
IN-30-OA10	FI-XB30S-HF	

Uju advises that they count Samsung and Liteon among their current customers for display-related connectivity solutions.

New SPWG Endorsee: Ambit

Ambit Microsystems Corporation, a Taiwan company, is one of the leading manufacturers of TFT LCD backlight inverters for notebook PCs. According to Ambit's Director of Power R&D, David Wen, "Ambit is pleased to help the SPWG define inverter-related standards for notebook PCs. We will not only identify inverter-critical specifications, but will provide performance evaluations for TFT LCDs in combination with the backlight and inverter".

In addition to inverters, Ambit specializes in the production of other power supplies (DC-DC converters, power boards, etc) for LCD Monitors, LCD TVs, and various Telecom, Data Storage, and Networking products. The company also manufacturers modems and wireless modules for notebook PCs, broadband modems, radio frequency power amplifiers for mobile phones, and Bluetooth modules. With factories in Taiwan and China, Ambit now boasts production capacity for up to 2.9 million inverters per month.

New SPWG Endorsee: Raylar

Raylar Design, Inc. is an electronic design company that specializes in remote computing and analog-to-digital solutions for flat panel displays. Since being founded in 1997, Raylar has been developing products that are widely used in industrial applications. Vice President, Ray Page, stated, "The SPWG's efforts

to standardize the form, fit and function of flat panel displays will have a very positive impact on development-cycles and procurement issues. Raylar Design, Inc. applauds the SPWG!

Raylar recently released a powerful EDID editing tool named Phoenix and is making it available to the public for free. The Phoenix 1.1 Beta incorporates an intuitive user interface, which presents the EDID 1.3 structure in a logical format. According to Raylar, this makes the creation of new EDID structures straightforward. Editing existing EDID structures is also simplified. One can either load a previously saved Phoenix EDID file or retrieve any EDID structure located in the Windows registry. The latest version of Phoenix can be found at http://www.raylar.com/phoenix.htm. In the near future, Raylar expects to make a companion product, which is a handheld EDID extractor/programmer, enabling users to retrieve EDID structures from displays or write them.

New SPWG Endorsee: Westar

Westar Display Technologies, Inc. offers the industry's widest range of image quality measurement and display performance improvement products including flat panel display test systems for R&D, high-throughput QA/QC, and bench-top instruments for panel evaluation, integration, and repair.

Note: Endorsement of the SPWG efforts is a simple show of support for the standardization efforts related to the displays used in notebook PCs. There are no fees or membership requirements associated with such endorsement. There are also no obligations associated with endorsing the SPWG, although it is expected that endorsing companies will be sincere in their efforts to help further the industry-wide efforts to improve LCD supply chain efficiencies and the price/performance benefits that result from standardization.

Endorsing companies get the opportunity to participate in the standardization process. Providing timely inputs and reviewing draft documents, when requested, is critical to the successful implementation of the SPWG standards efforts. Companies that choose not to endorse the SPWG standards are free to utilize the standards, but by not participating in the standards creation process, non-endorsing companies may find themselves in a reactionary mode, rather than proactively helping to improve industry-wide operations. Any company that newly wishes to endorse the SPWG is encouraged to do so by contacting Mark Fihn or Paul Salisbury.