Insight Media
Display Intelligence™

3D@Home Consortium
Monthly News Service

Market Intelligence

3DTV by the Numbers

Two Taiwanese market research firms have weighed in on the prospects for 3DTVs. Both see healthy growth for the category.

Topology Research Institute said that it expects there to be 48.2M 3DTV shipments in 2012. Growth for 3DTVs is expected to be 78.2% for 2012 to 2013, then 32.2% for 2013 to 2014.

Meanwhile, Market Intelligence and Consulting Institute (MIC) said 3D applications are gaining the most growth in large-size flat-panel TVs, with 3DTVs expected to account for 11% of global TV shipments in 2011 (21M units). With the growth of 3D content and peripheral products, 3DTV sales may reach 30% of the overall TV market in 2014.

MIC thinks that less than 2% of the notebooks and monitors will be fitted with 3D panels in 2011, however.

MIC has forecast global LCD TV shipments to reach 194M units in 2011, with a mild increase of 9% on-year compared with 2010. MIC added that global LCD TV shipments may reach 285M units in 2016, with a compound annual growth rate (CAGR) of 8% from 2011–2016.

MIC does not break out sales of SmartTVs vs. 3DTVs, but Topology Research Institute does. According to its analysis, 3DTV unit shipments will not exceed those of SmartTVs.

It sees SmartTV worldwide sales reaching 52.9M units in 2012, up from 7M units in 2010 and 25.2M in 2011. By 2012, 20% of all TVs will be SmartTVs, increasing to 41.2% in 2013 and 66.2% in 2014.

There is much overlap between the two TV categories, with many SmartTVs also including 3D capabilities. While penetration of SmartTVs and 3DTVs can be viewed independently, in reality they are closely tied, which is helping to build the installed base of 3DTVs.

Here in the U.S., CEA expects 3DTV shipments will top 3.6M in 2011 and nearly double that in 2012, reaching 6.9M.

Meanwhile, the German consumer electronics association, the GFU, has upgraded its expectation for 3DTV sales this year by 30%. The GFU now expects 1.3M 3D-enabled TVs to be sold by the end of the year.

Some 79% of sales of screens with a size over 50 inches are now of 3D-enabled devices, with 90% being Internet enabled. In the 43-49 inch range, 3D units account for 57% of sales of sales while internet-enabled TVs account for 74% of screens.–*Chris Chinnock*

3D Surveys Clouding the Picture

Nearly every week I see a new survey on some aspect of the 3D market. The results are all over the map. Sometimes we try to dig a bit deeper into the data to better understand the methodology and validity of the results. At times, it seems the surveys come to conclusions that exactly match what their sponsors hoped they would reveal, casting suspicion on the survey. While political surveys can be surprisingly accurate, that does not seem to be the case when measuring consumer behavior or attitudes toward CE products.

Two surveys I saw recently highlight the perils. The first was from Spain's Consumers and Users Organization (OCU), a not-for-profit group created in 1975 and dedicated to protecting the rights of consumers. In their survey, the OCU polled over 400 3DTV users with questions ranging from the technical performance of their screens to the personal viewing experience, as well as detected problems and preferred brands.

According to the published results, users spent 13% of their viewing time on average watching 3D content. Most of that content originated from Blu-ray/DVD players, followed by TV channels showing — in decreasing order of preference — film, documentary and sports programming. This result seems reasonable, if not a little high to me.

For the majority of performance-related issues, like image resolution, quality of 3D effects, subtitle legibility and price/quality relationship, Panasonic PDP 3DTVs were the top brand. On the question of the interoperability of the TV set with gaming consoles, Sony was the top choice. Again, this seems reasonable given Sony's PlayStation dominance.

The results also showed that 70% of owners preferred LED LCD 3DTVs, followed by PDP 3DTVs (15%) and LCD 3DTVs with CCFL backlights (14%). This data suggests some confusing results. If only 15% preferred PDP 3DTVs, yet the majority thought PDP performance was best, why was the preference number so low?

Another issue identified by the report was conveniences with the 3D glasses. This is not surprising, but no information was released on the nature of these issues or on the percentage of users who voiced concerns. More than likely that means these numbers were big, so they were not revealed.

So while some of these numbers seem reasonable, it is the lack of full disclosure that can make you wonder about the validity of the results.

A second survey from UK-based research firm YouGov focused on what cinemagoers thought of their 3D theatrical experience. Full results of the survey can be found here. Note that this data includes the gender, age, social grade and UK region of the survey participant, but it also includes their political affiliation (Conservative, Labor, Liberal Democrat). The YouGov poll of 2,796 adults was weighted to be representative of the British adult population as a whole.

Results show that 48% of cinemagoers polled (2,259 of the 2,796 polled were cinemagoers) had been to a 3D film in the past five years. The remaining questions were apparently asked of this same group, even though 51% said they had not seen a 3D film in the last five years. Amazingly, only 31% of respondents said they didn't know if the 3D experience was better than 2D. That means 20% expressed an opinion on this and other questions without having seen a 3D movie in the past five years! Therefore, one must question the outcome of this survey.

So what did the survey show? It found that only 22% said the 3D experience was better than 2D, 19% thought it was worse and 28% about the same.

When asked to choose between the 2D and 3D version of the film if there was no premium for the 3D, 47% said they would be more likely to see it in 3D.

The price premium was then explored to determine the top amount consumers would pay. Forty-eight percent said they would pay no premium, with 18% willing to pay £1 with 11% able to pay £2. The "no premium" response is not surprising, but Hollywood can take some solace that consumers do see some value in 3D and will pay something for it. On the other hand, 41% "think 3D is a gimmick."

In five years, only 26% think all films will be in 3D, while 16% think no films will be shown in 3D.

The other dangerous part about surveys is that certain responses are often cited by various constituencies, painting an incomplete picture of the results. What number do you need to support your business plan? I am sure there is survey out with the number you need (plus others that totally refute the finding). Let the reader beware. *–Chris Chinnock*

Standards

CEA to Look Into Energy Use With 3DTVs

Almost all of the energy rating agencies like EnergyStar base their assessments on operation of the device with 2D content. However, 3D content can create a different energy use profile — something that until now has not been considered. If energy use in 3D mode is much higher — and the user watches a lot of 3D content, then the expected energy use will be higher than expected. As a result, the Consumer Electronics Association (CEA) has announced the formation of the 3DTV Technology and Energy Consumption Discovery Group to look into the matter.

"The discovery group will allow timely progress on the revision of CEA's energy measurement standards, while at the same time opening technical discussions on the energy consumption of 3D display technologies," said Brian Markwalter, senior vice president of research and standards for CEA.

Participation in CEA standards and activities is open to any company, organization or individual with direct and material interest. To join the 3DTV Technology and Energy Consumption Discovery Group, visit http://standards.ce.org/kwspub/join/. *–Chris Chinnock*

CEA, Bill Belt, 703-907-5249, bbelt@CE.org

ATSC Publishes Reports on Next-Generation Broadcast TV, 3DTV Broadcast

The Advanced Television Systems Committee (ATSC) (Washington, D.C.) has published final reports of two critical industry planning committees that have been investigating likely methods of enhancing broadcast TV with next-generation video compression, transmission and Internet Protocol technologies, and developing scenarios for the transmission of three-dimensional (3D) programs via local broadcast TV stations.

The final reports of the ATSC Planning Teams on 3DTV (PT-1) and on ATSC 3.0 Next-Generation Broadcast Television (NGBT, PT-2) are available now for download from the ATSC Website (http://bit.ly/vKBLzo), along with presentations and papers from the ATSC symposiums on NGBT.

The documents summarize nearly a year of investigation by teams of broadcast industry experts, working through the ATSC, with a direct result being the formation of two new Technology Groups. "The conclusions of these planning committees set the stage for important ATSC standardization work," said ATSC President Mark Richer. "We are exploring backwards-compatible approaches to 3D transmissions, among other things, in our TG1 Technology Group while the new TG3 Technology Group is embarking on the longer-term project to define and standardize ATSC 3.0."

The PT-2 group looked at candidate technologies, potential services and likely timeframes. A key element of the study was that the group not limit its focus to backwards-compatibility with existing digital broadcasts. Several potential technology components were identified by PT-2, including improved audio and video codecs and more-efficient modulation approaches. The Planning Team also looked into ways that TV broadcasts could seamlessly converge with a hybrid device that might get content from the Internet or other methods. Among the subjects probed by the team were content personalization and targeting, more immersive presentation forms, and advanced non-real-time content downloading services.

PT-1, the 3DTV planning team, reviewed the visual sciences, existing technology, and the development of content for three-dimensional presentation. While 3D television broadcasts provide the potential for significant enhancement to the viewer's experience, it was found that the methods of both content creation and presentation are important to a positive viewing experience.

Substantial sections of the report deal with human visual issues sometimes associated with 3D viewing, with the planning team noting that many of the contributing factors are described, explained and accommodated by insuring proper viewing distances from the screen. While recognizing limitations of depicting 3D objects on a 2D display, the PT-1 report also details various options for transmission of 3D material, including utilization of both high-definition and mobile DTV channels and non-real-time caching of 3D content for future viewing.

From a timetable standpoint, it is likely that ATSC-3D would be implemented sooner than ATSC 3.0. For 3D, there are already products on the market (albeit not working with ATSC-3D), and a new 3D spec will almost certainly be backwards-compatible with ATSC A/54, the current DTV standard. This means that there could be a strong motivation to get a 3D standard out quickly. While this normally takes several years, it's conceivable this could be accelerated to a 12-to-18-month timeframe, given the right driving participants. ATSC 3.0, on the other hand, could result in a non-backwards-compatible transmission and decoding system, and that would certainly subject its development to a lot of business-driven debate, which would not likely result in a standard in less than two years. *–Aldo Cugnini*

ATSC Inc., Dave Arland, Arland Communications, 317-701-0084, Dave@ArlandCom.com

DVB Approves 3DTV Delivery System

The DVB (Geneva, Switzerland) Steering Board has approved the Commercial Requirements for a second 3DTV delivery system. Termed “Service Compatible,” the second system is a solution required by content deliverers that enables the 2D and 3D versions of a program to be broadcast within the same video signal so that new 3D televisions and next-generation Set-Top Boxes (STBs) can receive 3D programs, while consumers with existing 2D HDTV receivers and STBs can watch the 2D version. This 2D picture will probably be either the left or right image of the “stereo pair.”

In February 2011, the DVB Steering Board approved the specification for a first phase 3DTV delivery system; this system was developed for broadcasters and content providers needing a system that works with existing HDTV receivers, provided they are used with a 3D display. This approach, termed “Frame Compatible,” is now a principal system in use for 3DTV delivery throughout the world.

“Since 2009, the DVB leads the world in working on 3DTV delivery formats,” said David Wood, chairman of the DVB Commercial Module for 3DTV. “The Frame Compatible system works very well and delivers good quality 3DTV, but there are DVB members who have other requirements for 3DTV delivery. The DVB exists to serve all its members, and it has therefore examined the options for meeting these extra needs.”

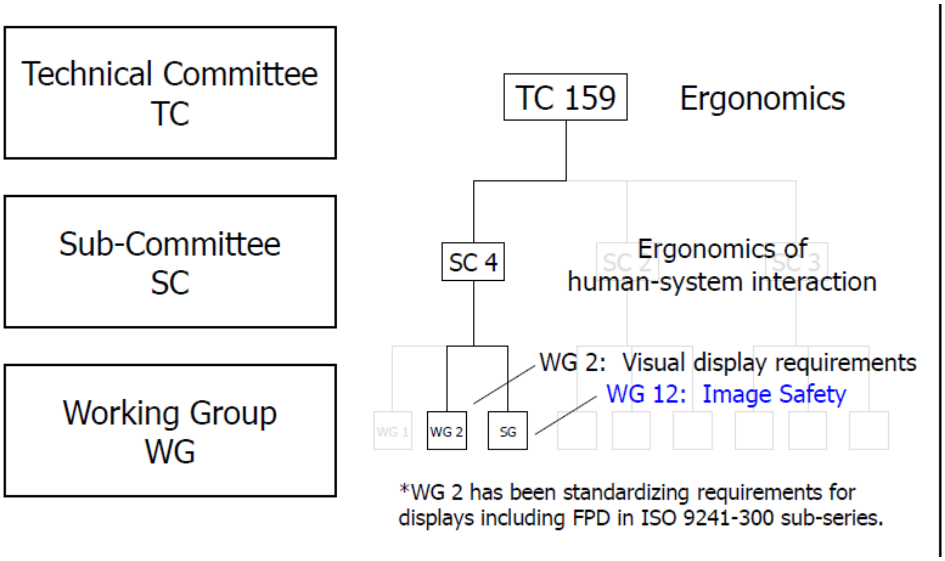
For convenience, this second approach is termed DVB-3DTV Phase 2a; the Commercial Requirements will shortly be available as a BlueBook on the DVB Website. The DVB Technical Module has been asked to complete the preparation of the specification for Phase 2a before the end of summer 2012. Phase 2a will provide additional opportunities for 3DTV services, complementing the first specification, which is referred to now for convenience as 3DTV Phase 1.

The DVB is also taking into account the requirements of content providers wanting to continue the use of a Phase 1 signal, but wish to provide additional information to improve the image quality for those with new receivers. This may result is a Phase 2b specification in due time. *–Aldo Cugnini*

ISO Vote on 3D Safety Guideline Closes Nov. 7

At the 3D @ Home User Experience Technical Conference (UETC) in September, we had a chance to hear more about standards development activities based on initiatives from Korea and Japan (see article: *Japan, Korea Offer 3D Guidelines*). In subsequent e-mail dialogs with the Japan group, we have now learned that ISO is closing a ballot on draft 3D safety guidelines on November 7. Information on these guideline can be downloaded here.

This is just the first phase of the process, however. Following the vote, a period of discussion of the voting results and comments will follow, leading to the development of a working draft document by April 2012. This will be circulated again, followed by a series of votes.


Technical Committee
TC
Sub-Committee
SC
Working Group
WG
TC 159
Ergonomics
SC 4
SC 2
SC 3
Ergonomics of human-system interaction
WG 2: Visual display requirements
WG 12: Image Safety
WG 1
WG 2
SG
*WG 2 has been standardizing requirements for displays including FPD in ISO 9241-300 sub-series.

Japan issued its first draft 3D safety guidelines document back in 2002 (published by JEITA) and began working with ISO in 2004 via an international workshop. During the discussions, they found out that guidelines are necessary and important for 3D viewing comfort and safety.

Current activity is under way in a new working group called WG 12 on Image Safety, which is under ISO/TC 159 (Ergonomics)/SC 4 (Ergonomics of human-system interaction). The purpose of these discussions is "to provide requirements and recommendation from a viewpoint of ergonomics for reducing the potential for visual discomfort, asthenopia and visual fatigue when viewing stereoscopic images."

Hiroyasu Ujike, a researcher at National Institute of Advanced Industrial Science and Technology (AIST), is leading the efforts with the ISO. In an e-mail exchange with him, he noted: "Based on discussions in the WG, I would like to find out and build a common framework for 3D Image Safety, and sharing it as 'international guidelines.'"

Potential areas of discussion include:

1) Interocular difference of images, as optical stimuli, in terms of geometrical distortions, luminance, etc.
2) Binocular parallax and disparity
3) Enhancement of 2D problems by the stereoscopic presentation
4) Temporal changes in the above items
5) Viewing environment and viewing conditions

–Chris Chinnock

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China’s SARFT Authorizes 3D Trial Run

China’s State Administration of Radio, Film and Television (SARFT) has approved a plan to begin trail distribution of 3D content. The program will include distribution over CCTV and 10 major satellite-TV networks.

The trial will use the existing digital TV broadcast system, using a single channel to deliver 3D content in a side-by-side format.

Broadcasting will begin January 1, 2012 and will run from 9am to midnight every day. There was little word on what content would be used other than to note that the 2012 London Olympics would be broadcast in 3D. The trial is expected to reach the largest potential audience of 1.3 billion people (only a limited amount will have 3DTVs, however).

SARFT may seek approval of ITU-T IPTV Standards later on. –*Chris Chinnock*

2D/3D TV

Loewe Developing 4K TV

3D Impact Media has collaborated with consumer electronics company Loewe to create a glasses-free 3D solution without any viewing zones/sweet spots.

Glasses-free 3D for consumers must be viewable by a multiple number of people at the same time, not only one person. Otherwise there is no use for commercial applications such as TVs and also probably laptops/desktops. You need to be able to walk from left to right without experiencing the ‘jumps’ in viewpoints inherent with current auto stereoscopic displays, says the company.

“The Loewe/3D Impact System uses parallax technology unlike the lenticular technology used by most other auto-stereoscopic screen manufacturers,” Kronenberg said. “But still, there is some light and resolution loss, which can be corrected with the upcoming 4k/2k displays. We are working with Loewe on 4K display to provide a very high-resolution image to go down to full HD image. There is currently no way around it.” –*Cheryl Knight*

Sharp Demos ICC 4K TV Prototype

At CEATEC Japan, Sharp Corp. and I-cubed Research Center (Kawasaki, Japan) teamed up to reveal a prototype next-generation LCD TV. The TV features a QFHD (3840 x 2160) panel from Sharp with the addition of Integrated Cognitive Creation (ICC) technology, developed by I-cubed.

Details of the ICC technology remain fuzzy, but the aim is to give viewers an experience like the “cognition” that occurs when people look at scenery and objects directly.

The company explained that when a camera is used to acquire images, parts of the image are in focus and parts are out of focus. This conveys the message that the out-of-focus parts are closer to or further from the focused part, but there is no sense of relative depth of the image that is obtainable.

In the real world, the company explained, our eyes and brain scan the scene we are looking at, figure out depth components, and we perceive the right resolution of objects based on their distance. The ICC technology is designed to “replace the incoming electrical signal with a picture formed using a real-world optical signal.”

For the demo, video content was shot in HD and then up-converted to 4K. The ICC process is more than simple noise reduction, scaling and up-conversion, said the company. “The idea is that it gives the viewer a sense of perspective, three-dimensionality and texture that’s much more similar to the natural world.”

共同開発 アイキューブド研究所とシャープの次世代 "4K" 液晶テレビ

A prototype of the technology was shown at CEATEC JAPAN 2011. Sharp and I-cubed will continue to co-develop this technology, with the aim of achieving a practical version next year. *–Chris Chinnock*

Samsung Plasma TVs Earn Top Scores for 3D

Consumers Union, the publishers of *Consumer Reports*, said their latest testing of 3DTV has revealed that PDPs offer the best performance and Samsung’s PN59D7000 active shutter glass 3D model earned the firm’s highest score.

According to the report author, James Wilcox, “We’ve been testing 3DTVs for well over a year now, and while many of the sets were capable of producing a satisfying three-dimensional viewing experience, none had achieved our highest 3D score. That’s all changed with several 2011 Samsung plasma models, the first TVs to earn excellent marks for overall 3D performance.”

Wilcox continued, “That achievement is even more impressive when you consider that our 3D tests have evolved since our first 3DTV ratings, when ghosting — or the presence of double images, even when you’re wearing 3D glasses — was the primary criteria for judgment. In addition to ghosting, we now consider 3D resolution, image brightness, and viewing angle when compiling a 3D performance score."

Samsung's 59-inch PN59D7000 1080p plasma set gained not only the top marks for 3D, but also the highest overall score in the ratings. It is among the best TVs CR has tested offering excellent overall picture quality, accurate colors, built-in Wi-Fi, and access to a lot of Internet content, including streaming movies and TV shows.

Three other Samsung plasma sets — including a 43-inch 720p model that costs only $550 — also earned excellent 3D scores, though overall 2D picture quality scores differed.

"We've also seen major improvements from many other brands, so that many sets can now deliver very good 3D performance," Wilcox said.

CR suggests that consumers first focus on finding a TV with excellent 2D picture quality and the features they want, and then checking its 3D performance. Sticklers for image detail may prefer models that use active-shutter 3D glasses, but others may opt for TVs that use passive 3D technology — which offer brighter images and use lightweight, comfortable polarized glasses like the ones you get at the movies.

Overall, CR has tested more than 100 TV models, but to view the results, you need to be a member. *–Chris Chinnock*

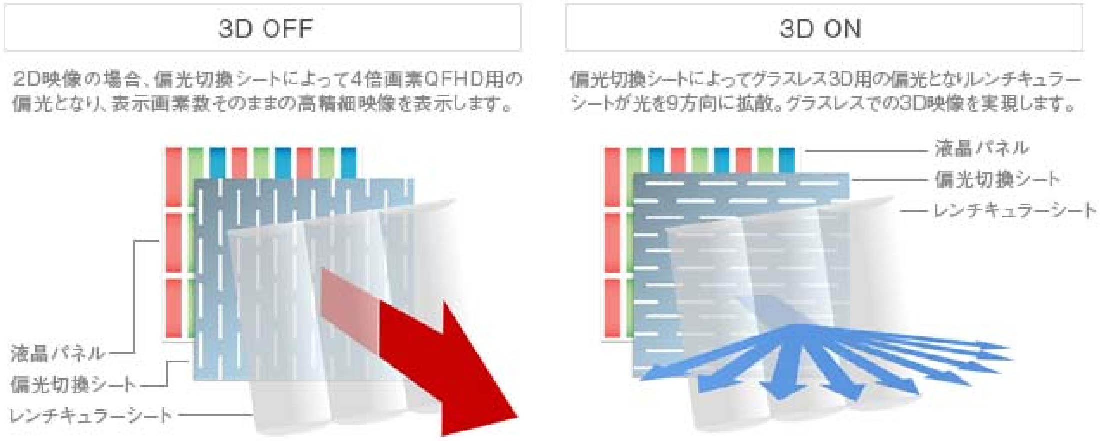
More Details on Toshiba's QFHD Glasses-Free TV

LDR readers may recall our coverage of Toshiba's new 55-inch QFHD (3840 x 2160) TV (model 55X3 in Japan) that also includes a lenticular array to create a nine-view 3DTV as well. It was debuted at IFA, but shown again at CEATEC in Japan with a few more details revealed.

As we speculated in our previous coverage, the resolution per view in 3D mode should be about 1280 x 720, which has now been confirmed by Toshiba. The TV also includes a built-in face detection camera. This determines a suitable viewing range from the positions of people's faces in front of the TV, and makes the required adjustments, moving the sweet spot left and right.

Toshiba appears to be using a large polarization switch to turn the lenticular array on or off. As shown in the graphic from Toshiba's Japan Website, in 2D mode, the switch passes linearly polarized light with a vertical orientation. The light then passes through the slanted lenticular array with no apparent change in direction or loss of resolution. In 3D mode, the polarization is switched to linear in the horizontal direction.

Now, the light passing through the lenticular array can be distributed into the nine viewing zones.



3D OFF

2D映像の場合、偏光切換シートによって4倍画素QFHD用の偏光となり、表示画素数そのままの高精細映像を表示します。

3D ON

偏光切換シートによってグラスレス3D用の偏光となりレンチキュラーシートが光を9方向に拡散。グラスレスでの3D映像を実現します。

But how Toshiba can adjust the image for each of the nine viewers remains a mystery. More than likely, what Toshiba is doing is measuring the distance that viewers are from the TV and optimizing the minimum and maximum sweet spot viewing range. This may work fine if all viewers are within a defined range, but will not work if viewers are very close and very far from the TV.

The sweet spot minimum and maximum distances are typically determined ahead of time so that the lens curvature and separation can be designed to meet these goals. To add some fine adjustment of these ranges requires a change in the curvature of the lenticular lenses. One way to do this is to actually squeeze the lenses and deform them a bit. This provides a change for all viewing zones but can’t be used to adjust for individual viewing zones. We will have to wait to see if this is indeed the approach that Toshiba is using.

The set can also convert 2D content to 3D and using a scanning backlight to improve motion response.

Toshiba also revealed a new optional input adapter (THD-MBA1) that allows native 4K or QFHD images to be input to the TV. It is connected to a PC and allows photos taken with 8.8megapixel cameras to be uploaded to the TV. It will be available in 2012.

Toshiba also reported that it is experimenting with a solution to stream 4K content to consumer too. Better have a very wide pipe for that.

But normal broadcast and Blu-ray content can also be input to the TV, as an internal scaling engine will up-convert that to QFHD.

There is still no word on if or when the set might be available in the U.S. Pricing for the Japanese model is 900,000 yen (US$11,845) with initial production set at 1K units per month. – *Chris Chinnock*

2D/3D Displays

AUO Shows Range at FPD International

AU Optronics Corp. (AUO) used FPD International 2011 in Japan to showcase its achievements in various display technologies based on the theme of "innovative applications." We will try to learn more later, but here is what we know so far.

- A 65-inch transparent display was shown that AUO said has three times higher transparency than conventional designs and offers vivid and clear images. AUO's 65-inch transparent display panels can be applied to buildings, car windows, function displays of consumers' home appliances, shop windows or vending machines.
- A 65-inch Extreme-PR 3D Gesture Display with its One-Glass Solution integrates AUO's glass-patterned retarder technology to make panels slimmer. AUO's glass-based solution has been trumped in the market by much thinner and lighter-weight film patterned retarder solutions. As a result, AOU has needed to add additional value to create a more compelling 3DTV (or digital signage) solution. This technology consists of a proprietary motion-detection technology with dual-camera system to detect a player's position and motion. This allows users to manipulate the 3DTV's control interface by means of gestures only.
- AUO also debuted a surprise product — a 46-inch 3DTV using a scanning retarder approach that allows the use of lightweight and inexpensive passive polarized glasses, but offers the full resolution per eye of a shutter glass solution. RealD and Samsung have announced plans to commercialize the technology in 2012 and LG Display has shown impressive prototypes in the past. Now AUO has publically joined the race to commercialize the approach.
- AUO presented a 138-inch LED display wall assembled using AUO's 46-inch Super Narrow Bezel LED display panels, with the distance between each bezel of the 46-inch panels only being 5mm.
- Regarding touchpanel technologies, AUO also exhibited its 27-inch FHD One-Glass-Solution Touch panel and 10.1-inch Advanced Hyper-Viewing Angle (AHVA) One-Glass Solution Tablet. AUO utilizes its One-Glass-Solution to make products slimmer and transparency higher through integrating touchsensors and cover glass. AUO's 27-inch FHD One-Glass-Solution touchpanel is the world's largest OGS touch panel, offering full HD images and support for 10 touch points, thus allowing users to move their fingers freely about the surface of the panels. AUO's 10.1-inch AHVA One-Glass-Solution tablet has been fitted with AHVA technology, which offers wide viewing angles for multimedia entertainment. Through the total solution, the weight of the product has dropped 33%, making it easy to carry while still offering WUXGA (1920 x 1200) high-resolution images.
- AUO surprised attendees by showing off it 32-inch full HD AMOLED TV for the first time. Only 3mm thick, the TV set uses a Metal Oxide TFT, instead of amorphous silicon,

as the backplane driver and is only 3mm thick. Metal oxide TFTs offer higher mobility, allowing for increased response time, high contrast ratio, and full HD high-resolution images (and higher).

- For flexible display technologies, AUO's six-inch Rollable Organic TFT E-paper is made pliable with high efficiency parts and plastic materials (PEN). Users can place the e-paper display in their briefcases or purses without worry of damage. In addition, with its optimized charging circuit design, AUO's six-inch Unplugged Flexible E-paper offers considerable power-savings, and its eco-friendly design allows it to be charged through solar power or indoor lighting with no plug in necessary.
- AUO also presented a four-inch flexible AMOLED with Low-Temperature Processed Metal Oxide TFT as backplane driver. It is only 0.3mm thick and is trendy, ultra slim and resistant. The panel can be applied to diverse personal portable display products in the future.

All in all, a very impressive array of new display technologies. Too bad we did not get a chance to see these. *–Chris Chinnock*

3D in Education

A Parallel Universe of 3D Educational Research

This last spring we saw the culmination of two large-scale research projects exploring the effectiveness of stereo 3D in K–12 education. The geographic diversity of the settings involved, combined with the timing of these two studies, offers us a very useful "parallel universe" environment for comparing insight and results.

The first project (BVS^{3}D) was fairly sizeable, involving four schools, eight classrooms, eight teachers and over 570 student participants. This project was conducted in the Boulder Valley School District, in picturesque Boulder, Colorado, under the supervision of two experienced educational researchers from Regis University and one project director.

Dr. Anne Bamford

At the same time, a large-scale research project was launched in Europe under the leadership of Dr. Anne Bamford (University of the Arts, London, Wimbledon). The Learning in Future Education (LiFE I) study was even larger in size and scope, involving schools in seven European countries. (This is the same study referenced in Chris Chinnock's article

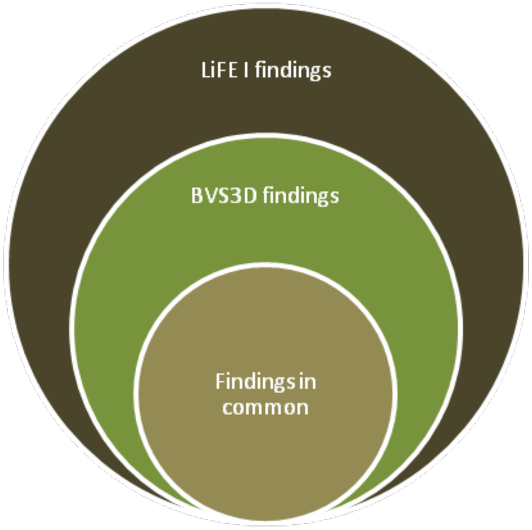


Figure 1: Finding the Overlap: BVS3D and LiFE I

last month, entitled *New European Education 3D Study Released*.) In the LiFE I case study, project sites were located in the UK, France, Germany, Italy, Turkey, The Netherlands and Sweden, and included rural, suburban and urban school settings. The larger LiFE I project encompassed 15 schools, 15 classes, 47 teachers and well over 740 students. Staffed at a much higher level, the LiFE I study was conducted by six IT coordinators and 12 researchers, including two doctoral students.

As Chris indicated in his article, the final report for the LiFE I study has just been released and is available by registering here. The U.S. study, however, is scheduled for release in late-October or early-November. At a recent international conference in Philadelphia, a small group of educators and researchers involved in the study met to exchange information and informally compare results. As the director in charge of the BVS^{3}D case study, I was an attentive participant in this informal exchange of ideas and gleanings.

In this month's article, I will highlight the findings that emerged in common from the preliminary data (see figure 1) — essentially, those results that were germane to both case studies. These overlapping areas of accord, featuring both U.S. and European perspectives, are both fascinating and informative.

Background

At this point, let us clarify both the *environment* and *methodologies* used in these studies. First, both the U.S. and European case studies involved a variety of school settings and grade levels. Both projects also centered on delivering science content.

In terms of methodologies, both case studies were similar. In each school, there was a 3D class and a "control" class. (The control classes were those in which 3D content was not used for the lesson instruction.) Both 2D and 3D classes were pre-tested and post-tested for content acquisition. In addition, both studies also incorporated qualitative feedback measures, such as student and teacher surveys, classroom observations and teacher/student interviews.

Results

The following results were found in common to both the BVS^{3}D and the LiFE I case studies:

- **Retention.** Students remember more and remember longer.
- **Thinking in 3D.** Whether students begin to "think" in 3D (LiFE I) or demonstrate a capacity for "mental reconstruction" (BVS3D), 3D learning is definitely affecting how the mind's eye approaches learning.
- **Improved Behavior.** Both studies reveal that in-class student behavior improves both during and after 3D learning experiences.
- **Increased Focus.** The ability of students to focus on the learning at hand increased during and immediately after the 3D experience. This was labeled *attentiveness* in the LiFE I study and both *focus* and *attention span* in the U.S. study.
- **Special Education Benefits.** Students (especially male students) with attention disorders in both studies showed the most positive change in attention and learning behaviors.

- **Learning Transfer to Modeling.** Students in both studies performed better at building 3D models of their learning than those students with just 2D instruction.
- **Positive Student Reaction.** Don't take my word for it — take a look at the similarities of what students say in these two representative universes:

"Teachers talk a lot and you just sort of tune out, but when you see things, it is there — and suddenly, it all makes sense." (European study)

"These 3D videos do help me learn it easier, especially because I'm a visual learner. Seeing what is going on is much more helpful than just talking about it. Especially because it's in 3D — it's literally in front of you." (U.S. Study)

"There is a big difference between 2D and 3D when you learn something. 2D is flat, but 3D has depth. It is real. We can see it and move it, and then we understand it." (European study)

"It's better than pictures, or movies, because you can travel through or within things and really 'see' them." (U.S. Study)

In this analysis, I describe merely those overlapping results shared by the two case studies. There are, of course, many unique findings in each of these study settings that will not be covered here. We will address those findings in subsequent articles, once we have both final reports in hand.

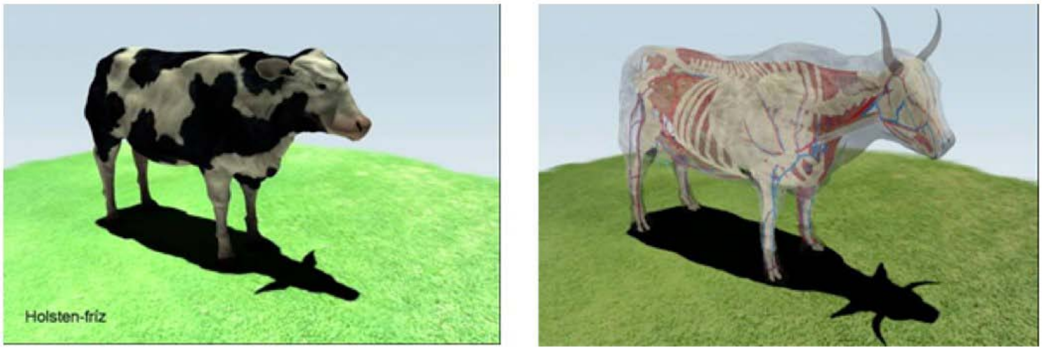
For now, however, what can we learn from these common-ground findings? It is clear that we are starting to see emerging evidence that the educational benefits associated with **teaching and learning in 3D** roundly echo across oceans and distinct cultures. Regardless of the geographic location or cultural settings, it appears we are growing cautiously closer to understanding how 3D affects the brain, how 3D impacts learning, and how it can be employed to support effective teaching.

Interestingly, here in the U.S., I hear of identical results coming from individuals employing 3D with the hardest of inner city youth. These findings go a long way to suggest that we are likely witnessing a universal educational effect — one common to all learners — perhaps not at all a 3D parallel universe. – *Len Scrogan*

Interactive 3D Learning Apps, Tools Announced

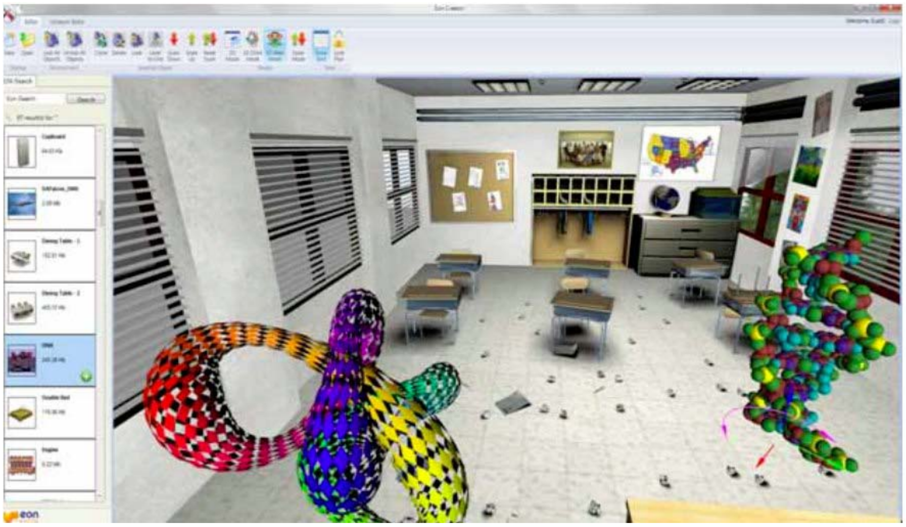
Most experts know 3D is giving education a boost. This is because 93% of communication is non-verbal, and humans can process visual information 60K times faster than text and use vision in 83% of learned content, according to Kognitiv, Hungary, an education JV with the City of Dabas, located just south of Budapest. Together with EON Reality, a long-time 3D software partner, the two say that new virtual learning applications are being installed in “most European schools.”

One recent example of the technology is a 3D cow used at culinary schools to teach students how and where the meat originates. The application included a 3D model of an adult bovine and included 3D pictures of the main varieties of Hungarian cows that students would use and see throughout the country. The model allowed for the dissection of the cow via 3D by key commands. The model highlighted the different edible parts of the cow and those that are necessary to harvest from the animal. The model also included in-depth models of each cut of meat and indicated where it originated on the cow. At the end, 3D images of prepared beef dishes were shown to stimulate the culinary creativity of the students.



Kognitiv uses this 3D Cow to help culinary schools teach about cuts of beef

Ideally, the executive chef and lead teacher will use this model with his culinary students, aged from 14–22 years old, the group said. “In terms of innovation, nothing like this model had ever been developed, to my knowledge, in any school in Hungary,” said Derick Arbaugh, marketing specialist for Kognitiv Hungary.



Screen shot from EON Reality Creator Software

The application, while simple in a sense that it only deals with one animal, the cow, is a relatively new concept in Hungary. 3D teaching is just taking ground throughout Hungary, and very few schools use the technology for other than viewing 3D films. The main benefit is the novelty of the application, and the most important aspect is captivating the students and engaging them in a new teaching method.

"We have also recently finished another model for a vocational high school involving a CNC milling machine in which students can utilize a 3D model to understand the internal function of the machine. These two projects are quite impressive as they give students a view of the internal function of a machine or an animal that would otherwise be impossible," Arbaugh said.

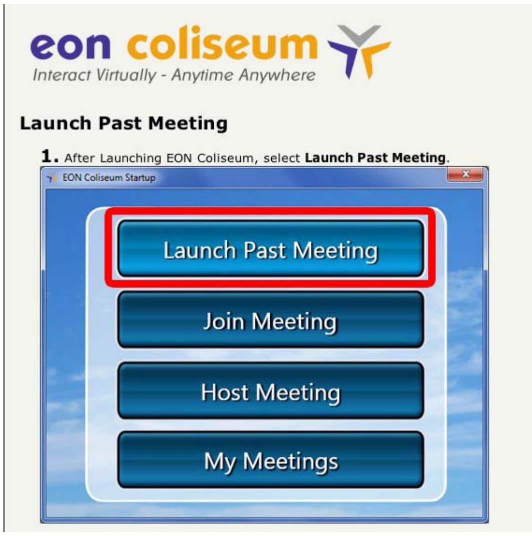
While having a 3D model of an animal or machine is a necessary first step, to be useful in the classroom requires a curriculum to be developed around this model. Eon Reality enables this self-generated curriculum by means of the tools it offers.

The idea is to start with a 3D content portal and use tools like EON Creator to develop new 3D scenes using high-resolution, interactive 3D content from the EON Experience Portal. The Portal contains thousands of models and scenes that a user can access directly from inside the EON Creator tool. Once the content is downloaded into EON Creator, users then add contextual knowledge to any of the 3D objects in the scene, the company said. Just about any media content can be linked from within a 3D scene, including:

- Sound
- Video
- PowerPoint presentation
- Hyperlinks
- Wikipedia entry

Once completed, the user can share the newly built 3D scene with "a click of a button," the company said. EON Creator PRO version offers a turn-key solution for Interactive 3D Stereo presentations in the classroom. Jamie Justice, director of Visualized Learning and Innovation, Kentucky Community and Technical College, said, "EON Creator represents the next generation of 3D interactive content creation tools that can enable, enhance and supplement learning activities," calling the technology an "immersive, interactive learning experience."

For 3D online meetings, the company offers EON Coliseum. This is a simulator-like technology that supports virtual meetings. The 3D multiuser platform leverages the benefits of 3D to present ideas, communicate complex concepts and collaborate in 3D environments. This includes sharing interactive 3D objects, avatars, slideshow presentations, videos, voice, and text chat running on a PC in real time from anywhere in the world. Participants can choose from a range of display options, including PCs, handheld augmented reality devices, or holographic and large immersive display environments.



Launch Past Meeting

1. After Launching EON Coliseum, select **Launch Past Meeting**.

Screen Shot from Eon Coliseum Online 3D Conferencing site

EON said its Coliseum product can overcome the delays and lagging effect that screen-sharing software has when viewing interactive 3D, presentations and video. The technology was developed so that instead of sending images over the Internet, it renders the 3D locally and only sends events and 3D positions over the Internet. This gives productivity and image quality a boost.

Key features of EON Creator include:

- Support for 3ds Max models through EON Raptor, a free software
- Supports some +100 different 3D/CAD data files through EON Professional (additional option)
- Direct support for search and import of thousands of interactive 3D objects from EON Experience Portal
- Easy scene editing, including position, rotation and scale of objects
- Trigger interactions of objects with intuitive pop-up menus in 3D window
- Quick authoring of environments and content for use in EON Coliseum
- Placement of presentation surfaces for video, PowerPoint and 3D objects for use in EON Coliseum
- Support for stereoscopic 3D presentations in EON Creator PRO through the EON Icatcher Mini system

Eon said its new Interactive 3D learning applications were presented during the HunDidac Exhibition and are available now for download. *–Steve Sechrist*

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3D Cameras & Rigs

Lytro Shows Light Field Camera

Lytro Inc. (Mountain View CA) discussed its light field camera earlier this year (see the July *MDR* or August *LDR*) without too many details, such as price or launch date. The camera was demonstrated at AsiaD (October 19–21 in Hong Kong), so more details are now available, including an online demonstration from C/NET.

The non-traditional camera shape, long and narrow, is dictated at least in part by the light-field image acquisition technology used by Lytro. The camera is 1.6 x 1.6 x 4.4” (41 x 41 x 112mm) and weight 7.55 Oz. (214g). The screen is a 1.46-inch touchscreen backlit LCD. The lens has an 8x optical zoom and maintains a constant f/2. While light field cameras are fundamentally capable of capturing 3D images, at least at distances comparable to the diameter of the lens, and that capability has been demonstrated on the Lytro Website, it is not supported in the current camera or software.

Two versions of the Lytro camera are expected to ship in early 2012: an 8GB model memory for 350 pictures for $399 or with 16GB good for 750 pictures for $499. Software to view the pictures on your computer is included in the price. Currently, only the Mac OS 10.6 or higher version of the software is available, with a Windows version is under development. – *Matthew Brennesholtz*

Meduza Launches TITAN 3D Camera

We have reported several times on the modular 3D cameras that Meduza Systems (Irvine, CA) has been developing. Now, it has announced the release of the TITAN 3D camera, which is the first fully controllable, lightweight, 3D precision single HD camera with 1080p dual sensors. It is geared toward 3D television production.

Featuring two 1080p CMOS sensors, TITAN is capable of a full range of frame rates, from 24 fps to 120 fps in 10 bit, and has fast, fully motorized inter-axial and convergence adjustments. Convergence is accurate to 1/1000 of a degree and the inter-axial to 1 micron. Meduza can also provide motors for Iris and focus control. At only 7.5 lbs (3.5 kilos), the robust and compact TITAN is crafted of a unique titanium body for lightness and durability. TITAN provides a much needed solution for on-the-fly sports field coverage and is also a powerful tool for documentary as well as narrative producers.

“We had expected theatrical productions to continue being the driving force for the growth in 3D equipment until late in 2012,” noted Chris Cary, CEO of 3D Visual Enterprises, the UK parent company of Meduza Systems. “Our plan has always been to release a 1080p only camera system for television but it was originally scheduled later in our release cycle. The huge effort being made by Sky in the UK and other broadcasters to unlock the possibilities with 3D for broadcasters has shifted the underlying demand to television.” The TITAN and its big brother, the modular Meduza MK1 (recently launched at IBC), are not intended to replace rig systems but are completely complimentary. In television where time, space, flexibility and above all budgets are tight, TITAN provides a solution.

TITAN is priced at $55,000 and can be ordered with either C mount or the new Meduza mount for the Meduza matched pair prime lens series (Delta 4KS3D). Pre-order customers can expect delivery of the TITAN in late December. *–Chris Chinnock*

Personal Eyewear

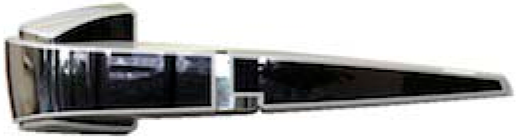
SiliconMicroDisplay Launches 1080p HMD

A new company has burst on the scene and announced a personal head-mounted display aimed at consumers. This one is different, as we believe it is the first consumer personal display to offer 1920 x 1080 resolution. The ST1080 is also a see-through device.

It is interesting to note a mini resurgence in consumer bi-ocular HMDs with recent products released by Epson (see this issue) and Sony. Epson uses a transmissive LCD panel, Sony an OLED panel and Silicon MicroDisplay an LCOS panel. All of these panels offer high resolution, but come at a price — larger display size (from 0.52 to 0.74 inches). Panels this size are more typically used in conventional front projectors. While mini-projection systems have now been developed, they are nonetheless more bulky than previous versions of consumer HMDs.

SiliconMicroDisplay has been developing this product in secret. They call themselves an LCoS microdisplay company, with offices in Cambridge, Massachusetts, and Sonoma County, California, and a factory in Korea.

The LCOS panel operates in color sequential mode using RGB LEDs. The panel runs at 240 frames per second with a field update rate of 80Hz (which means they probably flash green twice). Output is rated at 120nits and contrast at 1,200:1 (at f/2.8). The panel uses a VAN mode and a state-of-the-art 4.5-micron pixel pitch.



The ST1080 HMD can display 2D or 3D content and has a 10% see-though capability (not very much). Optics are designed to create a 45-degree diagonal field of view (16:9) that looks like a virtual 100-inch display at three meters. System contrast is 100:1 with 30 bits of color depth (from a 24-bit RGB source). The device consumes 7W and can run for five hours on a mobile battery pack.

A controller is also needed to accept content and drive the HMD. Input and output uses HDMI connectors. The HMD itself weighs 6.3 ounces and the controller 5.6 ounces.

We contacted the company to learn more but were unable to schedule an interview prior to our publication deadline. *–Chris Chinnock*

SiliconMicroDisplay, Paul Jin, 415-944-9871, info@SiliconMicroDisplay.com

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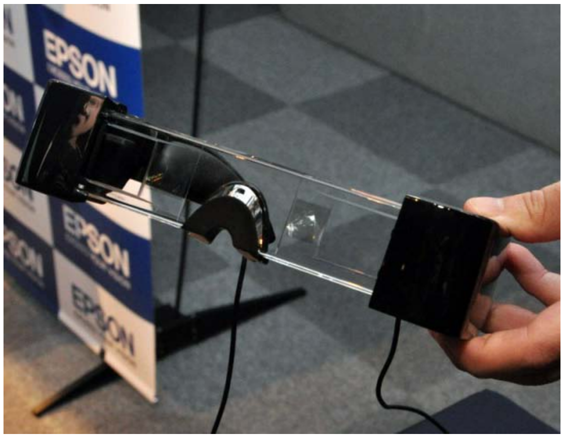
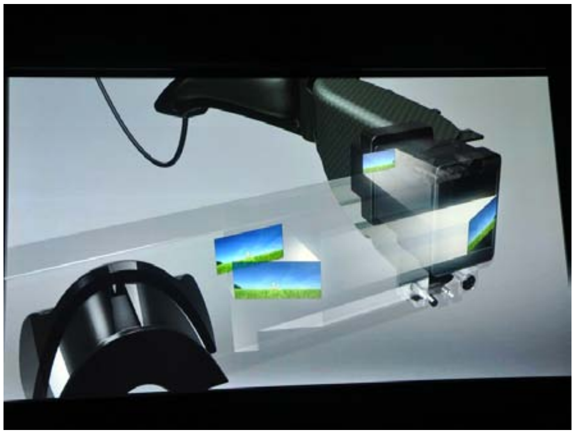
Epson Announces World's First See-Through 3D HMD

Japan-based Epson Corporation has announced the Moverio, which is a see-through 3D Head-Mounted Display (HMD), which the company claims is the first of its kind. That's not really true, as companies like Lumus Vision offer a see-through HMD already.

The Moverio creates the experience of watching 3D (or 2D) pictures on a virtual 80-inch display that's 5m away — while still being able to see what's happening around you in the real world.



The device is powered by two very large 0.52-inch-high temperature polysilicon panels with 960 x 540 resolution (similar sized panels are used in full-sized projectors too). Epson calls these panels the Ultimicro Micro Display. As shown in the diagram, a mini-projection engine illuminates two prisms (one high reflection and other half-silvered) to deliver the image to the eye. The diagram suggest this image is formed on a surface within the glasses, but there would probably have to be some optical power to this surface in order to create a virtual 80-inch image. There is also an opaque attachment for non-see-through viewing.



The Moverio's headset is sized at 205 × 178 × 47mm and weighs 240g. Notice the large nosepiece that is likely been designed to ease the weight of the device on the nose. (Sony's new HMD uses a wraparound headband that can distribute the weight over the head). There are earphones included, of course, with surround audio by Dolby Mobile.

The device also requires a small controller that offers 1GB of internal memory and a microSD card slot. It supports MPEG-4/MPEG-4 AVC/H.264 video files, including — side-by-side 3D images (plus AAC and MP3 audio files). A 2D/3D switch is included.

The device runs on Android 2.2 and includes Wi-Fi access to a Web browser and YouTube.

Epson expects to initially sell 10K units when the device hits Japanese stores on November 25 at a price of 60,000 Yen or about US$770. –*Chris Chinnock*