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Hype Cycle for Consumer Devices, 2012

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Consumer devices are converging and vendor competition is intensifying. Only technology that delivers a superior user experience will stand out. This report advises vendors on the maturity and use of new consumer devices to help with ongoing decisions in the R&D space.

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What You Need to Know

2012 marks an inflection point in the consumer devices market. With the ongoing proliferation of personal devices owned by consumers, driven by their desire for ubiquitous connectivity, pressure is mounting on vendors to differentiate their product portfolio. The cost of technology is rapidly decreasing, which allows new vendors to enter the market. This is increasing competition in an area that is already shrinking in the wake of device convergence. And maybe most importantly, the advent of the personal cloud has become the precursor to a power shift away from devices toward services, forcing many traditional device vendors to consider new business models.

Today more than ever, device vendors are looking for ways to combine design, technology and usability more effectively. Consumer devices are multiplying and a meaningful combination of hardware design and ease of use has become the key differentiator. Rapid technology changes — such as new communication protocols, cloud solutions, innovative display technologies and a multitude of available user interfaces (UIs) — are radically transforming yesterday's consumer device market, which was based on hardware specifications alone. Device manufacturers need to continue to focus on those technologies that deliver the highest return on investment by lifting a user's overall experience to the point where he or she will pay a premium for that specific device. That said, competition between vendors will continue to intensify as previously distinct device categories merge, prices begin to matter and consumers demand both value and functionality. Spending to keep ahead of the innovation cycle is key for any industry. This report helps device vendors decide where to spend their corporate R&D dollars.

Devices near the Peak of Inflated Expectations include consumer smart appliances, OLED TVs and broadband-connected TVs, as well as Ultrabooks. Just over the peak are 3D LCDs, solar power mobile devices and over-the-top set-top boxes. Meanwhile, e-book readers, all-in-one PCs, media

tablets, basic communication devices and connected portable navigation devices have moved further up the Slope of Enlightenment.

The only two transformational device hitting the mainstream in less than two years are media tablets and multitouch displays. However, e-book readers and open OS communication devices are also expected to have a significant impact in this time frame. Medium-term, between two and five years, interactive TVs, Ultrabooks and electrofluid displays will also enable new processes and alternative revenue streams.

The Hype Cycle

Undoubtedly, consumer electronics continue to capture the imagination and the wallet share of consumers. While they might have become more value-conscious when it comes to electronics, they will continue to spend on devices that they feel deliver usability and convenience and that enhance their increasingly hectic lifestyles. Gartner currently estimates that by 2016, consumers will spend 12% of disposable household income on digital technology products and services — which equates to around $3 trillion. Additionally, the continuing consumerization of IT means that consumer devices are also now found in many IT departments — either supported or unsupported.

At the same time, the consumer device market is moving away from being a collection of clearly separate product markets. Increasingly, features and applications now cross over from one kind of device to another (for example, Gartner predicts that in future the largest difference between smartphones, PCs, media tablets and TVs will be their distinct screen sizes). New portable devices such as media tablets and Ultrabooks, as well as the addition of new technologies to more static devices such as TVs, will increase the competition for consumers' interest and spending. At the same time, the need to drive market share and revenue will prompt vendors not only to innovate existing products but also to enter new, adjacent or converging market segments.

One of the key drivers of consumer demand for personal devices in 2012 is still mobility. Mobile devices are offering consumers near-constant connectivity and a multitude of readily accessible applications. The combination of touchscreen technologies and software-defined user interfaces has delivered the means to take increasingly complex devices and make them approachable and relatively easy to use. This trend is reflected in those devices which are currently most hyped, like media tablets, e-readers and open OS communication devices (aka smartphones), all of which are quickly moving up the Hype Cycle curve into the mainstream space. This year we have also added Ultrabooks and chromebooks to this segment, though in the case of the latter we assume it will be obsolete before it can reach the plateau. Ultabooks on the other hand are designed to bridge the existing gap between tablet and notebook usage and might well reignite interest in portable PCs.

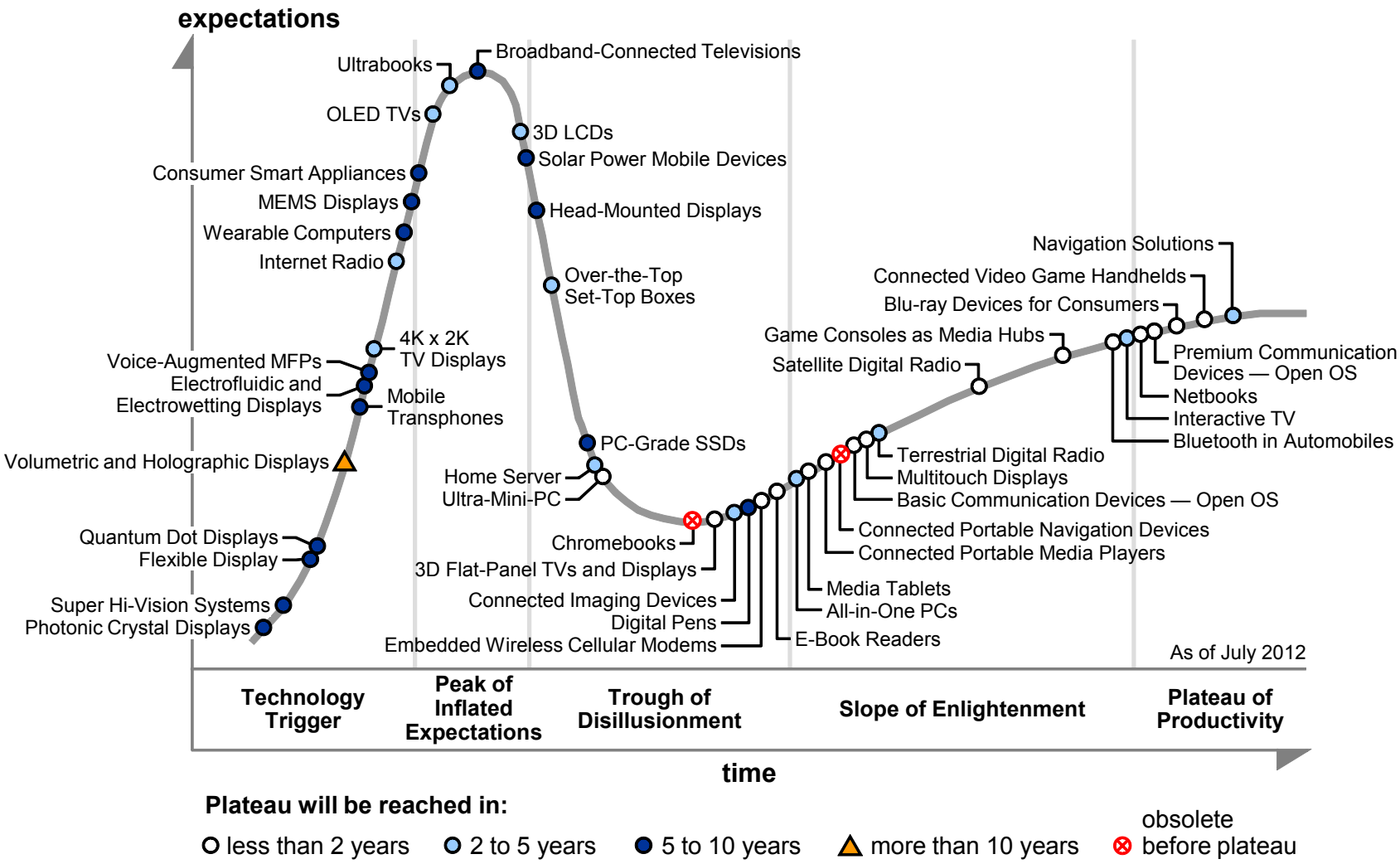
In addition to the mobile devices, this same desire for information is driving technology advances for stationary devices such as the television. Increasingly, manufacturers are envisioning a television as a display screen that can access not only premium television content but also information services and alternative entertainment, like film libraries and home video editing. We have therefore added all-in-one PCs to the Hype Cycle this year, with their sleek design and touch capabilities bridging the gap between PCs, TVs and simple screen displays. Game consoles are also increasingly taking on an additional role as Internet hubs in the home, offering several media and information services in addition to the game-play functions normally associated with these devices.

For those consumers that have no gamers in the household, we are seeing an increasing number of over-the-top set-top boxes that add connectivity to these Internet-delivered entertainment cabinets.

The increasing demand for more media content, either in the form of films, videos or photos has increased demand for high performance, alternative screen displays. This is an area that is rapidly evolving. An increasing number of display types are now on the Technology Trigger section of the Hype Cycle, driven by picture quality, increased battery life and environmental concerns. Electrowetting displays are a good example of such technology as they attempt to deliver a colored alternative to e-ink displays while maintaining low-power consumption. Also approaching the peak are micro-electromechanical systems (MEMS) displays, quantum dot displays, photonic crystal displays and, new for this year, flexible displays and volumetric and holographic displays. In terms of market potential, this is obviously a space worth watching over the next few years.

Technologies that are at the core of consumer devices are covered in "Hype Cycle for Consumer Technologies, 2012."

Figure 1. Hype Cycle for Consumer Devices, 2012



Source: Gartner (July 2012)

The Priority Matrix

The Priority Matrix maps the benefit rating for each technology against the length of time before Gartner expects it to reach the beginning of mainstream adoption. This alternative perspective can help users determine how to prioritize technology investments.

The most transformational personal device in this Hype Cycle remains without doubt the media tablet. The iPad and subsequent tablet devices have enabled users to do things in a new, always-on, always-connected way which has resulted in a major shift in the industry's dynamics. This year, media tablets based on Android 4.0 and Windows 8 software are entering the mainstream market for consumer devices. Given the high profile of the tablet category in the press and the resultant hype, the media tablet is set to move through the Hype Cycle even more quickly than previously expected.

The following devices have also been rated with high benefits in 2012:

- Premium communication devices — open OS: for driving significant changes in the way consumers handle social interactions via devices.
- Interactive TVs and e-book readers: for driving major changes in the way consumers access media content.
- Ultrabooks: for bridging the gap between tablet and notebook usage.
- Electrofluid and electrowetting displays: for leading the way into new areas of display technologies.

Figure 2. Priority Matrix for Consumer Devices, 2012

benefit	years to mainstream adoption			
	less than 2 years	2 to 5 years	5 to 10 years	more than 10 years
transformational	**Media Tablets** **Multitouch Displays**			
high	**E-Book Readers** **Premium Communication Devices — Open OS**	Interactive TV OLED TVs Ultrabooks	Electrofluidic and Electrowetting Displays	
moderate	3D Flat-Panel TVs and Displays Basic Communication Devices — Open OS Bluetooth in Automobiles Blu-ray Devices for Consumers Connected Portable Media Players Connected Video Game Handhelds Embedded Wireless Cellular Modems Game Consoles as Media Hubs Satellite Digital Radio	3D LCDs 4K x 2K TV Displays All-in-One PCs Connected Imaging Devices Home Server Internet Radio Navigation Solutions Over-the-Top Set-Top Boxes Terrestrial Digital Radio	Broadband-Connected Televisions Consumer Smart Appliances Digital Pens Flexible Display Head-Mounted Displays MEMS Displays Mobile Transphones PC-Grade SSDs Photonic Crystal Displays Quantum Dot Displays Super Hi-Vision Systems Wearable Computers	
low	Netbooks Ultra-Mini-PC		Solar Power Mobile Devices Voice-Augmented MFPs	Volumetric and Holographic Displays

As of July 2012

Source: Gartner (July 2012)

On the Rise

Photonic Crystal Displays

Analysis By: Roberta Cozza

Definition: Photonic crystal displays are reflective displays made of photonic crystalline materials that can be constructed and designed to manipulate the propagation of light (photons).

Position and Adoption Speed Justification: As a display technology, photonic crystals are currently being used in laboratories to create full-color flexible electronic paper displays, outdoor advertising displays or small reflective screens for mobile devices and consumer electronics. In such displays the spacing between the photonic crystals can be controlled so that they can reflect

colors across the entire visible spectrum when an external stimulus is applied, like electrical voltage or a magnetic field.

The whole spectrum of colors can be produced using only incident light. As a result, expensive color filters (like those found in most of the display technologies on the market) are no longer needed. As the displays are reflective, no additional power consumption is needed for backlighting, unlike transflective displays. However, being reflective means viewability is affected when in poor light conditions.

At present, the most visible use of photonic crystals in display technology comes from Canadian company Opalux, which uses photonic crystals with the potential to produce color-flexible electronic paper displays through its P-Ink technology. Commercialization of such displays is expected to be at least five years away and significant work is still needed in photonic crystal display research to improve viewing angles for each color, control single pixel saturation and color intensity.

Pixel switching speed is another key area requiring major improvement, as current switching times are still too long to support video. Alternative color display technologies will also increase competitive pressure among manufacturers. Some (like Samsung/Liquavista and Qualcomms' micro-electromechanical systems [MEMs] displays) are incorporating electrowetting technology (where small electrical charges are used to move colored oil within each pixel).

More competition will also come from LCD manufacturers improving color support for devices like media tablets and smartphones, where enhanced e-book content can be consumed.

User Advice: Research and development in photonic crystals used as a display technology is in its very early stages of development. Consumer device vendors should monitor research in this area to identify future opportunities.

Business Impact: Displays using photonic crystals can offer the competitive advantage of enabling less power consumption, as they require no backlighting. In addition, the color generated in each pixel can be maintained for a long time (days) without requiring additional power. With no backlight, high contrast and reflectivity, outdoor viewing quality is greatly improved.

Additionally, there is no need for expensive color filters, as found in most display technologies, which reduces costs. Ultimately, the fact that a single material can be used to produce the entire spectrum of colors can simplify the manufacturing processes.

Benefit Rating: Moderate

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Sample Vendors: Opalux

Super Hi-Vision Systems

Analysis By: Paul O'Donovan

Definition: Super hi-vision (SHV) is a future video broadcast system that offers 16 times the resolution of current 1080p HDTV systems. The video format is 7680 pixels by 4320 pixels in a 16:9 aspect ratio, with 33 million pixels per frame. The audio format is 22.2 multichannel surround sound, consisting of three loudspeaker layers: top, middle and bottom. There are 22 full-bandwidth channels and two low-frequency effect ("subwoofer") channels.

Position and Adoption Speed Justification: The SHV system has been in development since 2000 by Japanese broadcaster NHK's Science and Technology Research Laboratories. It was first demonstrated in 2002. Also, in April 2012, NHK demonstrated over-the-air transmission of an SHV signal at a data rate of 183 Mbps at its research facility in Japan.

A number of broadcast laboratories from Europe have collaborated with NHK to form the Broadcast Technology Futures group to develop the technology further. The ultimate goal with broadcast technologies is to deliver the most realistic images possible to the audience, and SHV is one step toward this. NHK aims to start trial broadcasts in 2015, with full service deployment between 2020 and 2025. It is also developing 3D broadcasting using SHV. Earlier in 2010 the video and audio format for SHV was standardized by the International Telecommunication Union and the Society of Motion Picture and Television Engineers. In September 2010, the BBC and NHK recorded the music group The Charlatans and broadcast the session over the Internet to Japan. There are also plans to show the 2012 Olympics from London in Japan in a number of SHV-equipped digital cinemas.

User Advice: Although the SHV system is still only at the demonstration stage, a launch of the technology — for large-venue events at least — is likely in the next five years. For consumer products, however, the likelihood is that the technology will not be on the market for at least 10 years.

Business Impact: Development of SHV could keep TV broadcasting several steps ahead of Internet-based TV services, as Internet technologies are unlikely to be able to deliver the massive data rates required until fiber to the home is ubiquitous. The technology is also creating further developments in new video codec algorithms in order to transmit the higher data rate in existing bandwidth-constrained infrastructure.

Benefit Rating: Moderate

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Sample Vendors: BBC; IRT; NHK; RAI; Siemens

Flexible Display

Analysis By: Anshul Gupta; CK Lu

Definition: Flexible displays are flat computing screen panels constructed of thin/flexible substrate that can be bent, rolled, folded or flexed without losing functionality. Flexible substrate that is used to replace conventional glass substrate can be plastic or thin glass.

Position and Adoption Speed Justification: Flexible displays include many components and supporting technologies such as flexible substrates, conducting transparent conducting oxides/ polymers, electro-optic and reflecting materials, inorganic and organic electronics, and packaging technologies. It also requires new manufacturing processes such as roll-to-roll manufacturing, coating and printing technology. Flexible display is a combination of all these components which must be co-developed to function efficiently. Multiple companies have been working on this futuristic concept to deliver flexible displays and have used components using various technologies. There is no standard flexible display with standard component technology yet as technology is still evolving at both the component and display levels.

Flexible display technology can result in many compelling applications such as:

- Large wall-sized reflective screens for use in conference room settings that could be rolled away when not in use
- Small portable rollable displays
- Irregular-shaped displays used in the steering wheel of an automobile
- Conformed displays integrated in an automobile filling up the entire dashboard
- Wristband displays that are permanently conformed throughout their lifetime

Flexible displays could be also deployed in bendable phones or tablets. We expect mobile devices with flexible displays to emerge in 2013.

User Advice: Although flexible display will be a reality, complete flexible devices may still take more time. So a consumer device with flexible display is a near-term possibility. However, a wearable wristband smartphone is still years away as that would depend on other parts such as processors, casings and batteries.

Costly, time-consuming manufacturing processes will keep costs high. Flexible displays may likely replace glass-based displays for many applications but it will be difficult for flexible displays to compete solely on cost alone in the inexpensive and small display module market or in the high-end, high-performance market (such as desktop and laptop screens). Costs can be brought down once displays can be manufactured using roll-to-roll processing instead of batch processing.

Business Impact: Flexible display could bring together laptops, tablets and smartphones into a single device. You could unroll or unfold the device to just the size needed based on what they needed to do. For instance, only unfold it to three inches by five inches to make a phone call or open it up all the way to a 10-inch display for a table, or 15 inches for a laptop and typing surface.

Benefit Rating: Moderate

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Quantum Dot Displays

Analysis By: Roberta Cozza

Definition: Quantum dots are nanocrystals made from types of semiconductor that emit colored light. They are very small, with a diameter ranging from two to 10 nanometers. The different colors emitted can be finely tuned by changing the size of the quantum dots and manipulating their chemical composition.

Position and Adoption Speed Justification: As with organic light-emitting diode (OLED) screens, the light in quantum dot displays is self-emitted, meaning that they do not require backlights and color filters like LCD displays.

When quantum dots are used in existing display technology, such as the LEDs in LCD backlights, they can improve power efficiency by reducing the number of diodes required to achieve similar levels of brightness. Because quantum dots can be tuned very precisely to emit specific colors, they also improve the overall purity of color and color rendering compared with OLED screens, for example.

The composition of these quantum particles means they are soluble, which allows greater manufacturing flexibility because they can be used with solution processing techniques such as spin coating, roll-to-roll processes and printing on large areas and flexible substrates.

In contrast, OLED screen manufacturing involves more complex techniques. Quantum dot displays are in the R&D phase and at least five to 10 years away from commercial availability as stand-alone products. Adoption to complement or supplement existing LED and LCD technology is more mature in comparison. Recently, 3M and Nanosys have announced a partnership to commercialize a quantum-dot-based technology to improve color performance in LCDs.

Some companies, such as QD Vision, have produced prototypes and quantum-dot-based solutions to improve existing OLED technology with their quantum dot LED products. Samsung Electronics' researchers have revealed a color four-inch quantum dot prototype panel. Quantum-dot-based displays are still expensive to manufacture compared with other display technologies such as OLEDs and LCDs. Most quantum dots are made of elements such as cadmium — which are highly toxic — making their presence in future commercial applications problematic. Some companies, such as Nanoco Group, are developing quantum dots that are free of heavy metals.

User Advice: R&D into quantum dots used as a display technology is at the prototype stage. Device vendors should monitor research in this area to identify future opportunities to use quantum dot applications to improve existing display technologies.

Business Impact: Displays are an essential part of the user experience for mobile devices and smartphones. As video, Web browsing, gaming and navigation apps become more sophisticated on mobile phones, display performance considerations play a key role — especially in relation to the high demands they place on the battery.

Quantum-dot-based displays promise key advantages over existing display technologies (such as LCDs and OLEDs), with improved power consumption over LCDs, better color rendering and more flexible manufacturing processes. R&D into quantum dots is vast and companies have developed some commercial quantum dot solutions — mostly around LEDs, lighting and security applications.

Benefit Rating: Moderate

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Sample Vendors: Evident Technologies; LG Display; Nanosys; QD Vision; Samsung Electronics

Volumetric and Holographic Displays

Analysis By: Stephen Prentice

Definition: Volumetric displays create visual representations of objects in three dimensions, with an almost 360-degree spherical viewing angle in which the image changes as the viewer moves around. Unlike most 3D planar displays, which create the illusion of depth through visual techniques (stereoscopic or autostereoscopic), volumetric displays create lifelike images in 3D space.

Holographic displays can recreate a 3D image, but they are not true volumetric displays.

Position and Adoption Speed Justification: True volumetric displays fall into two categories: swept volume displays and static volume displays. *Swept volume displays* use the persistence of human vision to recreate volumetric images from rapidly projected 2D "slices." One approach is to project images onto a rapidly rotating mirror inside a protective enclosure (to protect the viewer from injury, should he or she attempt to touch the images). *Static volume displays* use no major moving parts within the image display volume, but rather rely on a 3D volume of active elements (volumetric picture elements, or voxels) that change color (or transparency) to create a 3D image within the display volume. Low-resolution displays may use transparent elements such as light-emitting diodes (LEDs), while some higher-resolution displays use techniques such as pulsed lasers that are directed by scanning mirrors to create balls of glowing plasma at the location of each voxel.

Holograms can be deployed as an alternative to a volumetric display, but with a more restricted viewing angle. It should be noted that the term "holographic display" is frequently (but incorrectly) applied to any image that creates an appearance of 3D. Some current theatrical and conferencing displays allow realistic images to appear out of thin air and can, with care, allow other individuals to walk "around" them. However, they are simply 21st-century implementations of the 19th-century Pepper's Ghost illusion using high-intensity projectors and Mylar display films and not true volumetric or holographic displays.

Volumetric displays have barely emerged from the laboratory, and developments remain in the very early stages, with little movement on the Hype Cycle during the past 12 months. At Siggraph 2010, Sony demonstrated its RayModeler device (a cylindrical autosteroscopic display), but this, like most others, remains firmly in the lab environment. Several companies, including InnoVision Labs and

Realfiction, demonstrated 3D holographic images generated from their projectors, but none of them has been commercialized yet. The use of holographic techniques is, by far, the most advanced, but due to the intensive computing calculations required to generate the holographic image, the cost of generating the display image is one of the hurdles toward real-life adoption. Simpler and much lower-cost solutions would be required for mass adoption, and the growing availability of 3D displays is likely to divert demand for less-specialized applications (such as marketing and retail displays) toward these less-challenging technologies.

Swept and static volumetric displays suffer from the significant dangers of rapidly moving parts or ionized particles in the vicinity of people, especially because the volumetric nature of the generated image convinces the brain that it is solid and "real" and, therefore, can be touched. In all cases, the volume of data required to generate a volumetric image is considerable — typically on the order of 1,000 times more to create a 24-bit voxel image (1,024 layers on the z-axis) than the corresponding 2D image. In all cases, the amount of CPU processing required is equally significant compared with creating a 2D image.

3D televisions create a visual impression of depth, but rely on spatially multiplexed images that deliver different views to each eye and allow the brain to reconstruct a 3D representation. They are planar displays that simulate depth through visual effects, rather than true volumetric displays that create an image in a display volume with real depth.

User Advice: Outside of specialized areas, where budgets are not significant constraints, this technology remains firmly in the lab, rather than in commercial applications. Current technologies limit the size of volumetric space that can be displayed, and the mechanical solutions create potentially dangerous, rapidly moving parts. Until alternative approaches can be delivered (which seems unlikely in the foreseeable future), volumetric displays will remain an extreme niche product. Concurrently, the rapid growth and continuing development of 3D televisions in the mainstream markets threaten to overwhelm the continuing development of volumetric and holographic displays outside of specialized markets.

Business Impact: General applications are not well-developed for business use. To date, simple applications in marketing have been deployed — usually targeted at high-end retail environments, and there are some specialized applications for geospatial imaging to enhance 2D maps, and for use in architectural rendering. However, most of these can be achieved at much lower costs using other more-commercialized technologies, such as 3D displays (which have developed rapidly during the past 12 months) and virtual worlds. Potential application areas include medical imaging, consumer entertainment and gaming, and design, but costs will need to fall dramatically for these to be viable for using true volumetric displays. With the growing availability of affordable 3D manufacturing capabilities and 3D gestural input technologies, such as Microsoft's Kinect, there is growing interest from the arts and design fields to experiment with these technologies, and volumetric displays are already being explored in this context, with numerous experimental designs for (low resolution) volumetric displays now emerging.

Benefit Rating: Low

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Sample Vendors: InnoVision Labs; Musion Systems; Optics for Hire; Quince Imaging; Realfiction; Sony; viZoo; Zebra Imaging

Mobile Transphones

Analysis By: Monica Basso

Definition: Mobile transphones are mobile device products with an innovative and/or adaptive form factor that users can modify dynamically based on their specific contexts and needs. Some products are still at the conceptual model stage, while others are already commercially available.

Position and Adoption Speed Justification: Most smartphones accumulate a range of capabilities (the Swiss Army knife concept), without form factor optimization for most of them. As a result, people tend to adopt a combination of devices to meet their needs. For example, many use a smartphone and a media tablet.

Personalization of mobile devices is mostly about aesthetics and cosmetics — covers in fancy colors and materials, themes with images and ring tones, and accessories such as hanging items and holders. Normally, it does not concern functionality and the form factor, which are rigidly assigned to a device, depending on the target market segment. Mobile devices come with a range of capabilities and functions, but their form factors tend to be optimized on a primary function — either messaging, camera and multimedia, or Internet browsing.

Personalization can be more than that. People should get selective functions, depending on the context, for their roles and needs. Mobile devices will increasingly gain an adaptive form factor that allows personalization and optimization of use.

Today's examples of transphones include:

- Modumobile (www.modumobile.com): a touchscreen smartphone with complementary accessories that turn it into a camera, sporting equipment, and a loud speaker music player. This is the second attempt by Modumobile to the market. Initially they launched a modular, Lego-like approach, based on building blocks, to assemble and create the most appropriate form factor for a user at a given time. Due to the preliminary stage of the market, Modu went bankrupt in early 2011; its patents were bought by Google.
- Asus Padfone (www.asus.com/Mobile/PadFone/#overview): a 10-inch Android media tablet combined with a smartphone that can be placed into the tablet.
- CMIT (China Mobile Internet Technologies; www.cmitsy.com/EN/transPhone/Trans_Feature.aspx): TransPhone, with a similar concept to the Asus product.
- Motorola Atrix with LapDock accessory: the docking accessory with its battery, screen and keyboard turn the Android smartphone Atrix into a notebook.

- Nokia Morph: a concept based on the notion that, at some point, there will be innovative materials (possibly based on nanotechnologies) to enable a flexible, foldable, stretchable design, thus enabling users to transform their mobile devices into radically different shapes.

This evolutionary process for mobile devices will develop through stages. Today's stage is based on pluggable, wired, inflexible components. The next stage is likely to be based on wireless, inflexible components, as well as wireless interconnections, such as Bluetooth and Bluetooth LE. This will enable new types of peripherals, such as intelligent jewelry, that can talk to the mobile phone. Flexible is likely to start with simple flexible components talking to an inflexible handset core (for example, a flexible wrist screen talking wirelessly to more-conventional inflexible handset electronics). Before 2015, some handsets will offer separate components, such as a secondary screen and keypad. Wireless video will become a common feature, driven by the Wi-Fi Alliance's standardization efforts.

User Advice: Organizations should monitor future innovations that will drive more personalization of mobile devices. This will enable them to better meet the needs and expectations of different user groups (per demographics and gender) in their employee and client bases. Handset manufacturers not yet active in this area should investigate people's expectations and plan to deploy one or two transphone products to judge user acceptance.

Business Impact: Mobile transformer products will not significantly affect businesses until similar products become available and they become a priority for anyone involved in the mobile device ecosystem, such as mobile operators, service providers and application developers. We do not expect this market shift to happen before 2015.

Benefit Rating: Moderate

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Asus; Google; LG; Nokia

Recommended Reading: "Social Trends Are Influencing the Adoption of Mobile and Web Technology"

"Emerging Technology Analysis: Mobile Transphones, Mobile Device Technologies, 2009"

"Device Portability Is Subjective and Contextual"

"Future Technology: The Plastic, Flexible Gigabit Phone"

Electrofluidic and Electrowetting Displays

Analysis By: Hugues J. De La Vergne

Definition: Electrowetting displays use an electrical charge applied to a water interface to move a colored oil interface, to either show color (no voltage), or become partly transparent. Electrofluidic

displays are a variation of electrowetting that use voltage to pull pigment in and out of a reservoir and spread it as a film behind the viewing substrate.

Position and Adoption Speed Justification: As new introductions to the display landscape, these technologies are at a precommercial stage. Initially, they are being proposed as a color alternative to black-and-white displays, which have dominated e-readers until the recent launch of color displays by competitors. The technology offers a low-power, compact solution that delivers a brighter and higher-contrast display (versus reflective LCD) that is fast enough to display video content at high frequencies. This feature set opens up the potential market for this technology to other consumer electronics device applications, such as status screens, keypads and larger displays. Furthermore, electrowetting leverages existing LCD fabs, meaning that displays can be produced in refurbished LCD production facilities, thus lowering the cost and risk associated with bringing a new technology to market.

Samsung acquired Liquavista in early 2011 to expand its presence in this space and to potentially expand the new technology throughout its vast display portfolio, including mobile phones and larger displays, such as televisions, which is a key reason Gartner continues to move the technology further along the Hype Cycle. Market expectations are for a product launch in 2013. Pricing will be competitive with organic light-emitting diodes and will need to approach that of LCDs in a few years' time to be adopted as a mass-market technology. Time to market will be critical, as the biggest challenge for electrowetting will be competitive technologies.

Multiple vendors offering different technologies are going after this segment. E Ink, which currently dominates the e-reader display market, has introduced color displays, while micro-electromechanical systems display vendors (such as Qualcomm) have launched products (such as mirasol) to try to expand into this space. Other vendors include:

- Electrowetting — Samsung-Liquavista, advanced display technology (adt)
- Electrofluidic technology — Gamma Dynamics

User Advice: E-reader and consumer electronics vendors should closely monitor developments in this nascent technology, especially given a suspected 2013 launch. It provides improvements over traditional e-ink by adding an element of color and support of full-motion video, as well as performance improvements that can be adapted to larger-scale displays.

Business Impact: This technology will compete with other technologies to bring an alternative for product categories that currently use e-ink displays.

Benefit Rating: High

Market Penetration: Less than 1% of target audience

Maturity: Embryonic

Sample Vendors: advanced display technology; Gamma Dynamics; Liquavista

Voice-Augmented MFPs

Analysis By: Sharon McNee; Ken Weilerstein

Definition: Voice-augmented multifunction products (MFPs) supplement the usual control panel, indicators and display with voice generation and/or voice recognition. They help overcome the limitations that visual user interfaces impose when users retrieve print jobs, make copies, send faxes, and scan documents, and when they perform such chores as replacing paper and supplies or clearing paper jams. In some cases, they will allow people to do something they could not do before. Voice-augmented MFPs benefit both disabled and able-bodied users.

Position and Adoption Speed Justification: Voice-augmented MFPs are in the early stages of commercialization. The few products that are available help disabled people operate the basic MFP functions. However, these products do not exploit the full potential for able-bodied users. The problem isn't really technology. Advances in voice recognition and processing technologies used in other applications, such as navigational devices in automobiles, are lowering the cost and difficulty of developing and manufacturing voice-augmented MFPs. At the moment, voice-augmented MFPs are held back by a lack of customer awareness, by a lack of commercialized examples, or even beta cases, and by the lack of a standard cross-brand development platform. One promising development is that Nuance, which specializes in the speech recognition used in a variety of industries, such as medical dictation (Dragon) and automotive applications, also owns eCopy, a company that specializes in smart MFPs. eCopy's middleware is already widely used in smart MFP applications, and Nuance is well-positioned to make the case to MFP vendors to voice-augment their products.

User Advice: Aside from some specific applications involving disabled users, voice-operated MFPs are not yet available. IT and sourcing departments charged with selection of MFP vendors should, nevertheless, ask what built-in capabilities are found in the latest models, which partners they are working with, and what plans they are prepared to discuss under a nondisclosure agreement. MFPs typically remain in place for three to five years, so the choices you make today could allow you to implement a forthcoming function later on. At minimum, this will reduce the need to switch vendors in a few years when today's plans and lab designs are implemented on future MFPs. Enterprises should investigate how voice-enabled MFPs could help you secure your own documents and reduce the need for technical support calls. Ask for voice-enabled MFPs in your RFPs to encourage vendors to bring more of them to market. As products come to market, trial them and see how effective and accurate the voice-recognition functions are. With the voice-generation function, ask nearby users if they notice the sounds it generates and if it bothers them.

Business Impact: Voice-augmented MFPs will eventually be found in all office settings. Likely early adopters are security-conscious enterprises with card-swipe pull printing authentication, such as healthcare providers. Public-sector enterprises may also move to voice-augmented MFPs for the same reasons as other customers, and also to comply with disability mandates.

Benefit Rating: Low

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Canon; Nuance

Recommended Reading: "SWOT: Nuance, Imaging Division, Worldwide"

"Using Voice Recognition Technology to Capture Criminals"

4K x 2K TV Displays

Analysis By: Paul O'Donovan

Definition: 4K x 2K is a screen resolution for next-generation HDTVs. The screen format is 3840 pixels by 2160 pixels, which offers a total resolution of 8.3 megapixels. This is a four-fold improvement in resolution compared with current 1080 HD screens, which offer only a total resolution of 2.1 megapixels. 4K x 2K is also a digital cinema format.

Position and Adoption Speed Justification: Just like memory and processing power, screen resolutions are set to increase as real-time processing power and new video algorithms enable data rates capable of supporting ever higher resolutions for TV displays. In May 2012, Toshiba has already launched a 55-inch 4K x 2K TV for the European market and LG Display has announced that by the end of 2012 it plans to bring to market a 50-inch model TV with content available on Blu-ray discs. Samsung has also announced plans to introduce these next-generation displays in the next 12 months to 18 months, and other manufacturers have announced that they are developing TV displays with the 4K x 2K format.

User Advice: Some consumers might consider today's 1080 HD displays as offering enough resolution, and that higher resolutions only make sense for very large displays over 60 inches. However, few if any consumers would buy a 2 megapixel camera today, yet this is the highest resolution that the 1080 HD display can resolve. The higher the resolution the better the range of colors and textures that can be resolved, on a wide range of screen sizes, from 32 inches upward. This improvement in colors and textures is exactly why consumers would consider buying a digital still camera with a minimum resolution of 8 megapixels. So most consumers will appreciate the need for screens to catch up with camera resolutions.

Business Impact: For TV manufacturers the increase in resolution offers a future upgrade road map for consumers, which will last at least 10 years, starting in 2012. Content will initially be offered through Blu-ray discs, but with the emergence of improved video codec algorithms, broadcast 4K x 2K content will become available, as will content over high-speed broadband connections. There are also a large number of 4K movies available as these have been produced since 2004 for the digital cinema market. Sony Pictures for example has a backlog of over 40 movies in the 4K format.

There is also a significant opportunity with telepresence displays where operators are keen to develop higher quality video. 4K x 2K technology is also supported by the International Telecommunication Union's Radiocommunication Sector's Study Group 6, which has agreed on a draft of a new recommendation on the technical details for "Ultra High Definition Television" or "UHDTV." The draft has now been submitted for approval.

Benefit Rating: Moderate

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Cisco; LG Display; Panasonic; Polycom; Samsung; Sharp; Sony; Tandberg; Toshiba

Internet Radio

Analysis By: Thilo Koslowski

Definition: Internet radio streams music that is stored on a server to an Internet-connected vehicle by using embedded wireless networking technologies (such as a connected "infotainment" head unit) or via a wireless consumer device that is connected to the vehicle (such as a user's smartphone). In both cases, music is accessed online, without storing any music files in the car's head unit or consumer device. In some instances, the streaming service provider allows for caching tracks to listen to when the user is in offline mode.

Position and Adoption Speed Justification: Internet radio has been offered for a few years on connected consumer devices, personal computers and the Internet, but has only been introduced recently as a way to offer music content in automobiles. The projected growth of Internet access in automobiles for mature markets will accelerate the adoption of Internet radio in automobiles during the next five years, in particular, but broad adoption will take up to 10 years.

Faster and more ubiquitous third generation (3G) and fourth generation (4G) cellular data coverage, as well as the ever-growing range of music-enabled and music-optimized devices, are factors driving interest in music streaming. However, the most important and latest developments driving interest and uptake are the wider adoption of smartphones and connected vehicles, coupled with the availability of music-streaming applications that offer PC-based online services, such as Pandora or Spotify, for users on the go.

User Advice: Automotive companies and technology and service providers offering Internet radio and music streaming should:

- Ensure usability via specifically designed user interface solutions that take distraction and functionality aspects into consideration while operating a vehicle. Radio content access and management must be intuitive and combined with other user input technologies specifically used in a vehicle context (i.e., speech input).
- Carefully balance other radio options, such as digital satellite and terrestrial radio offerings, in their feature portfolios.

Business Impact: Offering Internet radio and music streaming will provide automotive companies with additional revenue opportunities (such as sharing of subscription fees or advertising revenue) and will meet consumer needs for new digital infotainment content.

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Aupeo; Pandora; Spotify; Stitcher

Recommended Reading: "U.S. Consumer Demand for Vehicle ICT Expands From the Connected Vehicle to the Connected Driver"

"Smart's Connected Vehicle Solution Combines Engineering Expertise With Mobile Device Ingenuity"

"Automobile of the Future: The Ultimate Connected Mobile Device"

Wearable Computers

Analysis By: Adib Carl Ghubril

Definition: Wearable computers and their interfaces are designed to be worn on the body, such as a wrist-mounted screen or head-mounted display, to enable mobility and hands-free/eyes-free activities. Traditional uses are for mobile industrial inspection, maintenance and the military. Consumer uses include display peripherals, computer-ready clothing and smart fabrics. MIT has also demonstrated SixthSense, a gesture-controlled necklace device that projects digital information onto real-world objects and locations.

Position and Adoption Speed Justification: Wearable computers remain primarily a niche market for the military (in which EXO legs have been used to run or walk longer/faster before getting tired) and for industrial/healthcare "hands-busy" applications (in which exoskeletons can help nurses lift patients in hospitals or can help workers lift heavy loads in warehouses). And finally, there are of course bionic limbs for amputees.

Within these niche markets, the technology is relatively well-established, but it has not been adopted more broadly in enterprise or consumer markets beyond simple control capabilities (such as fabric controls on a bag or sweatshirt that holds an iPod). Elements of the technology (particularly fully functional input techniques) must progress before they can have a broader impact.

Voice input with voice or text output is often used in industrial applications. Touch is also emerging as a viable one-handed input technique for handheld devices (such as on the iPhone) that may be adopted for wearable technology. Gesture interfaces are also evolving, and the availability of low-cost motion sensors may drive simple gesture-controlled wearable devices, such as music players. Yet, given the relatively slow development and adoption of new user interface technologies in general, wearable computing will take at least five years to move beyond niche and early-adopter status.

Material science is at play as well because these devices come into a more intimate contact with the user, such as smart fabrics that can measure the user's biostatistics, whisk away perspiration faster or provide force feedback, via a haptic response, to help tweak the user's movements.

Indeed, wearable devices for biomonitoring are a growing segment in electronic devices for the health and fitness markets, and incorporating fashion concepts of fit, form and texture will help in the development of this technology.

User Advice: Focus wearable-computing implementations on mobile users with a compelling need for hands-free interaction.

Explore longer-range opportunities for always-on information access through head- or arm-mounted displays or voice input/output feeds, but evaluate risks before investing heavily.

Objects that are meant to go on human bodies have to be comfortable, so weight and power consumption reduction is key, as well as style, because as these objects become a means for self-expression, their characteristics, such as color, could be made to reflect the mood of the wearer, for example.

Blurring the lines between clothing and IT helps to lower the barriers of adoption, particularly in the consumer space, in which the layman may be apprehensive about using new devices that are perceived to be more complicated.

Business Impact: Wearable computers offer benefits in mobile industrial inspection and maintenance, as well as other mobile applications, such as customer check-in. Google's Project Glass promises to provide an augmented reality environment that allows users to interact with their physical environment, take pictures and communicate with others through speech and gesture commands. This could prove to be a very significant boost in productivity for workers on factory floors or for laboratories trying to assess a certain condition by conducting literature searches while communicating with each other and viewing the issue at hand.

Benefit Rating: Moderate

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Eleksen; Eurotech; Fitbit; General Dynamics Itronix; Google; LXE; Motorola; Vuzix

Recommended Reading: "Fellows Interview: Thad Starner, Wearable Computing Pioneer"

MEMS Displays

Analysis By: Tuong Huy Nguyen

Definition: Micro-electromechanical systems (MEMS) displays are ultra-low-power reflective displays in which pixel brightness and color are controlled by physical movement within a MEMS cell.

Position and Adoption Speed Justification: MEMS technology used for low-powered displays for mobile devices is still a relatively new technology, and deployment remains limited. There have been a number of different, competing display solutions available, primarily based on either transmissive

or reflective technology, but the market has become more streamlined due to refocusing and consolidation.

Qualcomm's mirasol solution is currently the leading MEMS solution. It is a reflective display technology based on interferometric modulation (IMOD) technology, with MEMS structure at its core. Qualcomm's IMOD display solution operates by using spatial multiplexing mirrors to generate color using interference and the reflection of ambient light. Qualcomm's mirasol solution is a low-power, color, video-capable and sunlight-viewable display that has proven commercially available solutions. This solution improves on electronic ink by providing color and is able to show video/ multimedia. Despite this, as a reflective technology, the color aesthetic is softer than that of standard displays because of the natural-light source. It produces a more "washed out" color compared with LCDs and organic light-emitting diodes (LEDs).

Furthermore, Qualcomm has recently demonstrated an embedded front light with LEDs that's controlled by an ambient light sensor in the e-reader solution — to improve overall usability. This solution is initially positioned to challenge electronic ink in the e-reader market. It is currently used in the Hanvon c18, Kyobo eReader, Bambook Sunflower and Koobe eReader.

The Pixtronix solution combines the sequencing of microshutters and LEDs, as a backlight, to modulate the light. The technology claims lower power consumption and greater brightness, contrast, ambient viewability, and color depth for stills and video than traditional LCDs, partly because the liquid crystals, filters and polarizers are replaced with MEMS shutters. As of 2Q11, the company has developed small- and midsize-form-factor prototypes with Hitachi Display, Chimei Innolux and Samsung. As of December 2011, Pixtronix has been acquired by Qualcomm.

User Advice: Consumer electronics vendors should implement these solutions only if doing so improves the cost structure and utility of devices. They should also evaluate competing technologies, such as electrowetting displays from Samsung, when these are perfected. As a low-power solution, MEMS displays are applicable for handset vendors as green solutions, for developing markets (where access to electricity is limited), and as solutions to extend battery life (still a key concern for consumers). Consumer electronics vendors can also consider applications beyond the main screens on mobile phones, such as "status" screens found on consumer electronics products, on accessories such as headsets, or on secondary displays on phones.

Business Impact: MEMS displays in connected portable devices are expected to be a more-energy-efficient display technology than current LCD screens and to decrease costs (as they scale). This technology currently lacks scale (and requires infrastructure investment), so the benefits are offset by the added price. Moreover, it is in its early stages, with a limited number of commercially available products. With the only commercially available MEMS display solutions, Qualcomm is best-positioned for current adoption of these technology offerings. Its enhanced performance (color and video capability) over the current e-reader solutions makes it a viable solution for vendors to implement. However, adoption is further affected by its ability to meet demand.

Benefit Rating: Moderate

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Pixel Qi; Qualcomm; Texas Instruments

Recommended Reading: "Emerging Technology Analysis: MEMS Displays Cut Mobile Device Power Consumption"

At the Peak

Consumer Smart Appliances

Analysis By: Angela McIntyre

Definition: Smart appliances have the ability to connect to a network, either through an existing computer network, such as Wi-Fi, or through a purpose-built energy management network. Smart appliances also respond to control signals received through the connected network, either directly from the user in the form of remote commands, or based on programmed user preferences in response to pricing (or demand response) signals from the utility. An examples would be washing machines that are connected to the Internet and can be controlled remotely.

Position and Adoption Speed Justification: Consumer adoption of smart appliances will occur initially because of the convenience of controlling them remotely, and only a small percentage of consumers are likely to pay for this convenience. Smart appliances will remain niche until utilities implement variable rate pricing for electricity, which would enable consumers to save on their electric bill using smart appliances. GE, Kenmore, LG, Whirlpool and others will have a few smart appliance models available on the market in 2012 or 1213. Appliance manufacturers are taking a cautious approach to making smart appliances available for purchase. They recognize that until utilities offer variable rate electricity pricing, consumers would not be able to recoup the premium paid for smart appliances. Utilities are piloting smart grid solutions in a handful of pilot programs globally. Leading appliance manufacturers are participating in these programs to document the benefits of smart appliances for the household. Appliance manufacturers are being careful not to introduce smart appliances too far ahead of consumer needs. Smart appliances are being made available first to builders and to consumers through a small number of retailers.

User Advice: Appliance manufacturers should engage in market research to learn about how smart appliances would be used in the home. Adhere to relevant Home Energy Management (HEM) and Home Automation System (HAS) platforms to make sure solutions run well with your appliances. Lead with messages about the convenience and lifestyle that Internet-connected appliances can bring, especially for remote control of the device, remote diagnostics and maintenance.

Appliance manufacturers should encourage software developers to deliver applications that enable consumers to remotely control appliances from their mobile devices (smartphones, tablets and PCs) and to monitor home energy use. Partner with software and service providers for home energy management solutions in which data about electricity used by the appliances can be stored on a PC, a dedicated storage device or in the cloud. At first, consumers' adoption of smart appliances will be driven by their ability to control appliances remotely on whatever mobile device is most convenient.

Utilities should work with state and federal efficiency standards bodies to move toward smart appliance standards. Additional pilot projects and joint research will speed along this important technology. Smart appliance pilots are frequently linked to automated metering infrastructure deployment and dynamic pricing market tests. They extend the advanced metering infrastructure (AMI) communication link into customer premises to provide pricing information or control signals through a home area network (HAN) using technology, such as Wi-Fi or ZigBee.

Business Impact: Appliance manufacturers and their suppliers can benefit from offering smart appliances in the following ways:

- Closer connection to the consumer, including data about appliance duty cycles and remote repair diagnostics
- Uplift in price per unit — smart appliances provide convenience and energy management for which consumers could pay more.
- Competitive differentiation with smart features
- Potential to partner with utilities for distribution smart appliances

Because of the long lifetimes of home appliances, which often last 10 years or more, replacing the installed base of older appliances with new ones that can communicate with smart meters will take time. In five years, 10% to 20% of home appliances will be able to communicate with smart meters.

With smart meters, utility companies can reduce the load on the electricity grid by lowering price-responsive consumer demand. By raising electricity rates during hours of peak use, the utilities can discourage use during those times. Smart appliances are frequently considered an extension, or a component, of a demand-response program and critical for capturing the customer and environmental benefits of advanced metering infrastructure projects.

Benefit Rating: Moderate

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: GE; LG Electronics; Samsung; Whirlpool

Recommended Reading: "Competitive Landscape: Smart Appliances, Worldwide"

"Forecast: White Goods Energy Consumption, Worldwide, 2010-2015"

OLED TVs

Analysis By: Paul O'Donovan

Definition: Organic light-emitting diodes (OLEDs) are a type of LED with an emissive electroluminescent layer made from organic compounds. The layer is composed of either short-chain molecules or long-chain polymers that emit red, green or blue light when a voltage is applied.

A matrix of lines and columns creates an array of pixels that can be deposited onto a range of substrates. The response time of the individual pixels is rapid, and with no backlight — as in a liquid crystal display — OLED displays are high-quality, high-contrast.

Position and Adoption Speed Justification: We expect to see OLED TVs of approximately 55 inches or more within the next six to 12 months, and panels around 32 inches within the next two to three years as the market develops. Currently, active-matrix OLED displays are used in handheld portable applications such as smartphones, digital media players and digital still cameras. Recent technical developments in the manufacturing process have improved production costs and are enabling large TV panels over 50 inches to be manufactured in high volumes, offering an alternative to LCDs and, ultimately, a replacement TV display technology within the next 10 years.

User Advice: Although there have been developments to improve the lifetime of light-emitting compounds, early OLED TVs that came to market in 2010 were small-panel models of less than 22 inches. These are not designed for normal living room use, but as the second or third TV in the home because of the limited number of hours they will be used for. This is not such an issue for the smaller OLED screens in mobile devices, because the lifetime of handheld and mobile products tends to be much shorter than that of fixed video displays in the home. Ongoing developments have already increased the lifetime of the blue compounds to 34,000 hours, which means manufacturers are now able to produce 32-inch and larger OLED TVs in mass-market volumes.

Business Impact: OLED display panels will continue to find multiple applications in handheld and mobile devices, as well as in the consumer TV market. We see OLEDs as successors to the LCD panel, offering overall lower power consumption, higher contrast ratios and thinner, lighter displays. OLED panels are already being developed for laptop computers, reducing the average weight by at least 30%. For the TV market, when OLED TVs reach lifetimes of more than 60,000 hours and recent developments in manufacturing costs enable the same or lower cost levels as current LCD panels, OLEDs will displace LCD as the de facto TV display technology for the mass market. The potential for flexible OLED displays opens up a wide range of applications, including displays such as projector screens which can be rolled up. This could have a significant effect on the enterprise market for meeting room displays, and lead to a resultant decline in sales of video projectors.

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: DuPont; LG Display; Panasonic; Samsung Electronics; Sony; Universal Display

Ultrabooks

Analysis By: C.G. Lee; Angela McIntyre

Definition: Ultrabooks are a specific type of ultramobile notebook, defined by Intel. They are thin, lightweight and offer longer battery life by utilizing new low-power CPUs integrated with instant-on capability, all without compromising performance. Although Intel is likely to update its requirements for what constitutes an Ultrabook, it currently has the following attributes: less than 21-mm thick,

instant-on, minimum battery life of five hours, security features, a screen size of 11 inches or more, and Intel processors based on Ivy Bridge architecture.

Position and Adoption Speed Justification: Ultrabooks were launched at Computex Taipei in 2011, with Intel Capital providing $300 million in funding to reinvigorate end-user sales and the ecosystems of mobile PCs, including innovative convergence of form factors and user experiences through applications that compete against media tablets. Mobile PCs have matured in terms of their performance, but they have not appealed to users who want increased portability with less weight and longer battery life. The success of media tablets in creating a new market demonstrates that users want PC makers to offer mobile devices that are always connected and have outstanding portability.

Ultrabooks have similar features to Apple's MacBook Air models, though at a lower price point. With competition from Ultrabooks, Apple may be motivated to offer a MacBook Air model with a starting price of $799, or else to make improvements to current specifications for MacBook Air models.

The adoption of Ultrabooks depends in part on price. Gartner is expecting that the share of Ultrabooks will reach 12% of the consumer mobile PC market in 2012. According to a Gartner survey, 47% of mobile PCs were priced between $500 and $799 in 2011. Intel's 2012 price target for lower-end consumer Ultrabook models is $699. It aims to announce more than 110 Ultrabook models available for purchase in 2012, with an average selling price of $799. However, with such a highly qualified specification for Ultrabooks, it may take some time to bring prices down, given the economies of scale needed for the totally different design and components compared to regular notebooks.

The multitouch functions now available in mobile devices offer a far richer user experience than ever before. Ultrabooks are expected to ultimately include multitouch functionality, and they will also attract the attention of users who want to purchase Ultrabooks with Windows 8, expected to launch at the end of this year, allowing touch capability based on the metro user interface. In addition, Intel cooperates with Nuance to optimize Dragon, a voice recognition application, for Intel's architecture. Dragon allows Ultrabook users to use voice commands for easy-to-operate applications, media play, updating social networking sites, and checking emails and schedules.

User Advice: For businesses, Ultrabooks provide features like fast responsiveness, improved mobility, full-scale PC performance and enterprise-class security performance. IT decision makers should feel confident that Ultrabooks will meet enterprise needs. Subsequently, they will help increase productivity by offering higher levels of work flexibility. Enabled high-speed connectivity maximizes users' needs to be always connected, while integrated low-power consumption CPUs extend battery life to satisfy the needs of users who are business travellers or always on the move. Enterprises worried about security are likely to prefer desktop PCs over mobile PCs due to risks of loss, theft and document leakage. However, Ultrabooks will appeal to enterprises with enhanced security already in place.

Consumers' enthusiasm will grow for Ultrabooks due to the improved user experience, various form factors, fashionable design and enhanced performance with longer battery life. Ultrabooks are fully

functional PCs with significant computing power due to their Core i3 and Core i5 processors. They have more computing capability than devices with ARM-based or Atom-based processors.

Enterprises may wish to roll out larger-scale deployments of Ultrabooks when Intel's Haswell-based architecture (the successor to Ivy Bridge) becomes available in 2013, as it will lead to much-improved performance. Haswell consumes 20 times less power in standby mode compared to processors based on Ivy Bridge. It will enable eight hours of active use between recharging the battery and at least 10 days of power in standby mode. In addition, Intel's design guidelines for Ultrabooks allow flexibility in terms of design and components. For example, PC vendors provide Ultrabooks with either solid-state drives (SSDs) or with hard-disk drives, combined with a caching SSD. PC vendors may experiment with convertible and hybrid models, such as the Asus Transformer. However, PC vendors are making choices about the quality and component specifications in the Ultrabooks they offer, which may lead to differences in reliability and form factors among providers.

With improvements coming, such as Haswell and innovations from third-party suppliers, the Ultrabook category will mature in performance and may diversify in form factor over the next one to two years.

Business Impact: Intel is spending hundreds of millions of dollars to market Ultrabooks and to invest in third-party development of hardware and software innovations. Intel hopes that this investment will lead to faster replacement of current PCs in the enterprise with better-performing Ultrabooks. However, since enterprise IT departments are already interested in cloud computing, bring your own device (BYOD) and alternative client computing delivery architecture, they will adopt Ultrabooks for selected business roles only and not for the entire enterprise. Consumers will purchase a media tablet or Ultrabook according to their needs and based on when they need to replace their existing PC.

Intel hopes that its investments in Ultrabooks will cause consumers to replace their existing PCs with an Ultrabook one year earlier than they otherwise would. With Intel's projected notebook refresh, it projects a $35 billion revenue upside for the industry. However, Gartner does not expect Ultrabooks to significantly shorten the PC replacement cycle, because consumers already have media tablets and smartphones as mobile computing purchases that could take priority over buying a PC, particularly in times of economic troubles, such as in Western Europe.

The market share among Ultrabook providers may change dramatically over the next one to two years as PC providers vie to differentiate their offerings via marketing, pricing and features.

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Emerging

Sample Vendors: Acer; Apple; Asus; Dell; HP; Lenovo; Samsung Electronics; Sony

Recommended Reading: "Competitive Landscape: Ultraportable PCs"

"Search Analytics Trends: Are Enterprises Ready to Adopt Ultramobile Notebooks?"

"International CES Tradeshow 2012 Is Centered Around the Multiscreen Experience"

"Quarterly Statistics: Personal Computers, Worldwide by Region, 1Q12 Update"

"Quarterly Statistics: Personal Computers, All Countries Forecast Database, 1Q12 Update"

Broadband-Connected Televisions

Analysis By: Mike McGuire; Andrew Frank

Definition: Broadband-connected televisions utilize connectivity to a broadband network to deliver streaming video and other Web services directly to the television via an Ethernet or Wi-Fi connection to a broadband home network. Services are delivered via applications or virtual channels. Apps can be invoked via a TV remote control or a smartphone- or tablet-based application. TV manufacturers are deploying proprietary and standards-based software on the device.

Position and Adoption Speed Justification: Market demand for connected TVs has sharpened in the past years, with companies such as NPD reporting that sales in 2011 for connected TVs grew 50% over 2010. Forecast penetration is predicted to hit as high as 70% of TV shipments in 2016, according to various market estimates. Connected-TV solutions were prominent at the International Consumer Electronics Show (CES) in 2012, and Internet connectivity seems to have trumped 3D content in terms of core TV technologies contributing to new sales. Consumer interest in online video, and the growth in online video distributors (e.g., Netflix), provides the consumer demand, which justifies hardware manufacturers using connectivity as a differentiator. There are some factors that will impede rapid widespread adoption:

- Diversity of vision and standards for software functionality
- Relatively long TV replacement cycles
- Relatively low penetration of broadband connectivity for consumers in developing markets

Yet, for semiconductor manufacturers, broadband-connected TVs offer an important new target for the latest generation of chipset designs, as evidenced by ARM's push into the space, while for broadcasters, broadband-connected TV offers a potential to extend consumer engagement with interactive content and offers more value to advertisers. For consumer-facing brands, such as Google, Apple and Yahoo, and startups such as GetGlue, Miso and Boxee, broadband-connected TVs represent some opportunities for creating unique, converged TV-Internet experiences.

As noted in last year's Hype Cycle, broadband-connected TVs continue to " ... raise vexing questions about the future relationships among broadcasters, communication service providers (CSPs), media cloud providers, manufacturers, and entities that regulate TV transmission and licensing agreements." However, Gartner believes that while online content will continue to find its way onto TV screens, second-screen applications (which include the ability to transmit content from the device screen to the TV screen), over-the-top set-top boxes (OTT/STBs) (e.g., Roku and Apple

TV) and game consoles are likely to eat into any strategic opportunity for broadband-connected TVs, particularly in the U.S. The longer it takes for software and application standards to emerge — and 2012 saw increases in the sales of connected TVs but no major shifts in software standards — the greater the opportunity for these alternatives. For that reason, we are shifting the benefit rating to moderate.

Because of the disruptive potential of this technology, Gartner expects adoption to be relatively slow overall, with different adoption rates for different regions. It is more likely that consumers, especially in the U.S., will adopt OTT/STBs, or second-screen apps on mobile devices, thus insulating their TV hardware investments from the vagaries of application and software standards.

User Advice: Consumer electronics manufacturers need to pursue common standards, especially in application development environments to drive wider adoption. Conversely, CSPs should press for adoption of their applicable standards in a uniform way by manufacturers.

Broadcasters and content companies need to take the strategic view that broadband-connected TVs and second-screen applications (on smartphones and media tablets) are likely to be competing with OTT/STBs for consumers looking to access online content and content from TV service providers as indicators for the need to start or maintain investments in centralizing and automating licensing and rights management platforms. The ability to exploit Internet-based content delivery options will continue to be a pressing requirement and leverage point.

Broadcasters should also work with their industry associations to negotiate with manufacturer associations to specify standards for how control might be passed directly from a video signal to broadband user agent software, to provide a competitive alternative to CSP plans to control this essential access point, which is of high value to advertisers.

Business Impact: The delivery of broadband-delivered content to the television is likely to add value to the television at a time when the Internet and the PC are drawing attention away from television. Technology advances in connectivity for the television should significantly accelerate the opportunity for broadband services delivered to the television.

The disruptive potential for broadband-connected TVs to supply an alternative distribution channel for video programming on TV will focus attention on net neutrality issues as a key factor in the future role of TV service providers.

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Sample Vendors: LG; Samsung; Sharp; Sony

3D LCDs

Analysis By: Mikako Kitagawa

Definition: Three-dimensional liquid crystal display (3D LCD) technology enables users to view 3D images either with 3D glasses (stereoscopic LCDs) or without 3D glasses (autostereoscopic LCDs). For smaller screen sizes (typically up to 10 inches), directional backlight 3D is a cost-effective technology that uses the LCD's backlight to change the viewing fields for the left and right eyes sequentially, thereby creating image depth.

Position and Adoption Speed Justification: 3D LCD technology has been on the market for some time. However, it remains a niche market aimed at a limited audience of home users (mainly gamers) and select industries, such as aerospace, healthcare and automobile design.

The awareness and momentum behind 3D technology increased with the success of the movie "Avatar," released in December 2009, as its success encouraged more industry collaboration and creation of 3D content. However, consumer adoption and expectation is still minimal, so PCs with 3D viewing capability never took off and remain very niche products.

Development of "glasses free" solutions could extend the market for 3D LCD products, as wearing the head gear is one inhibitor to 3D adoption by consumers. Additionally, glasses-free 3D can also be adopted in areas like advertising and museum exhibitions to deliver a more immersive viewing experience. The switchable 2D and 3D displays that have been developed for convertible content may also help to expand this market.

Almost all major PC vendors now offer at least one 3D-enabled laptop. However, the PC industry has lost some of its enthusiasm for 3D, as it could not drive consumer interest, as well as the limited availability of 3D content.

For the first time, Toshiba introduced glasses-free 3D laptops in May 2012. This solution may draw more consumer interest, but the price premium on 3D capability will be a major issue to its adoption.

User Advice: 3D LCDs remain niche products, although technological developments are in progress that could widen their appeal.

The technology has uses in both professional and consumer markets, for example:

- In the professional market, 3D technology has been adopted in select industries such as healthcare and research. Recent falls in the price of 3D-enabled devices could stimulate adoption in other industries. Professional users should monitor the development of 3D, especially for application development and assess whether the benefits of this technology justify the price.
- In the consumer market, 3D LCDs (large and small) have gained traction during the past three years. However, the continuing lack of 3D applications remains a major obstacle to mass adoption.

Business Impact: 3D LCDs are used in a variety of devices, including notebook PCs, all-in-one desktop PCs, PC monitors, games consoles, TVs, mobile phones, GPS units, medical equipment and large-scale design environments. 3D-enabled products are unlikely to achieve mass adoption,

but takeup should increase gradually as more products and applications become available. Device vendors need to work closely with application developers to create attractive 3D applications.

PC vendors should also expect takeup of 3D LCDs to remain slow in both professional and consumer markets, as these products are unlikely to show significant growth, but 3D-enabled PCs could generate good margins and strengthen vendors' claims to be technological leaders.

3D media tablets are available, but the market is still very small. 3D viewing capability is not a strong selling point for media tablets, as consumers have low expectations of these devices and they are unlikely to pay the price premium. Vendors should formulate development plans, bearing in mind that joint development of 3D applications for smartphones and media tablets is possible, but they should not expect 3D media tablets to achieve mass-market adoption, as 3D could amount to just a "value-add" feature from which vendors can derive additional revenue.

Device vendors should look into developing glasses-free 3D technology, as this aspect is one of the issues hindering consumer 3D adoption.

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Sample Vendors: Acer; Asus; Dell; Eastman Kodak; Hitachi; Holografika; HP; JVC; LG; NEC; Nvidia; Samsung; Sanyo; Sharp; Toshiba

Solar Power Mobile Devices

Analysis By: Annette Zimmermann

Definition: A phone equipped with solar cells that converts sunlight into electrical power, reducing or removing the need to charge the device from an electrical power source.

Position and Adoption Speed Justification: The idea of solar-powered mobile devices has been around for some years, but has never seen any significant uptake. Solar-powered mobile chargers have been on the market for years, serving the need of frequent travelers. Prototypes and developments were announced some years ago by the Chinese vendor High-Tech Wealth, Japanese firm NTT Docomo and the German research institute, Fraunhofer-Gesellschaft. In 2009, Samsung, LG and ZTE started selling new solar-powered devices. The main selling point has been for users in emerging markets. The GSM Association (GSMA) estimated that around 500 million mobile users in emerging markets do not have regular access to electricity and would benefit from alternative charging solutions, such as solar devices, solar chargers or operators' solar powered charging stations that have recently emerged. Tier 1 vendors including Samsung, LG and ZTE sell low-end devices in several African, South-East Asian and Latin American countries.

Since about mid-2011 it seems that Tier 1 vendors have lost interest in this technology — the number of new product launches has diminished significantly, of which Samsung had been one of the most active vendors. Only niche players seem to be still active, like Intivation, which launched

the Umeox Apollo at Mobile World Congress 2011, an Android-based phone with a solar panel. In mature markets, Samsung used to launch high-end devices with solar panels on the battery cover, labeling them as "green," a strategy that in Gartner's view was debatable due to the solar cell's rather long return on energy investment time, or charge back time. We believe that Samsung has realized that consumers in mature markets do not really see the value in this technology, not even in the context of environmental preservation. It is an expensive technology to adopt (see barriers to adoption below), and it has not really brought the desired return on investment to the vendor (or the user).

The general view of the industry is that it takes about 18 months to two years of energy consumption to equal the amount of energy consumption used in manufacturing the solar cell. This value depends on the size of the cells as well as the location (for example, those exposed to bright sunlight most of the time as in the Sahara, compared to a location in Scandinavia). The time scale also assumes constant exposure to sunlight, so the time required for solar cells on mobile phones to reach their potential is on average much longer (than 18 months to two years). This suggests that the actual environmental benefit sets in only when users keep their devices for longer than 18 months to two years. This is less of a concern in emerging markets where device replacement cycles last longer than 24 months, but in developed markets users sometimes replace their devices after 12 to 18 months.

Apart from the Tier 1 device vendors (which have lost interest now), startup company Intivation is investing in this market. Intivation provides a photovoltaic (PV) cell technology platform based on a single solar cell and boost converter — SunBoost3 — that powers mobile devices with sunlight. The strength of this technology lies in its capability to allow charging in indoor and low-light conditions. Devices with Intivation's technology have been deployed in 30 countries in less than two years — primarily Africa but also India, China and Germany. Device vendors that are using Intivation's technology include ZTE, Sharp and Umeox.

Barriers to adoption:

- Power efficiency: These PV solar cells take a significant amount of time to charge the phone for even a short phone call.
- Bill of materials (BOM) cost: PV solar cells such as these may add between $3 and $9 to the BOM for a mobile phone, depending on the size, technology, quality and power output of the solar cells involved. This represents a significant fraction of the cost for a phone, without a clear market demand for it at present. For comparison: a 3.5-inch capacitive touchscreen currently costs between $15 and $20, while a GPS chip costs less than $2.
- Usage patterns: The most common user habit — carrying a phone in one's pocket — causes the main problem and minimizes the chance to make full use (if any) of solar charging.

Given that this technology has lost some momentum and support from Tier 1 vendors and we don't expect any Tier 1 vendors to focus on this in the near-term, the technology has maintained the same position on the Hype Cycle as last year.

User Advice: **Device vendors:**

- Gartner advises against marketing campaigns that highlight the positive environmental impact of high-end solar devices, particularly those to be used in developed markets. This is in light of the fact that a small solar panel has a return-on-energy time span that exceeds by far the average life of a phone in developed markets. Using recycled material and offering efficient chargers are much better ways to put an environmental strategy into practice.
- When offering solar devices, consider incorporating technologies that help to preserve battery life. Examples are micro-electromechanical systems (MEMs) and organic light-emitting diode (OLED) screens.
- When offering such products in emerging markets it is recommended to focus on low-cost phones. This meets the needs of the main target audience and the chances are higher that the solar panel will be effective, as opposed to in high-end devices with high energy consuming features.

Operators in emerging markets. Analyze the business case for offering solar devices as it could offer additional revenue streams due to potential higher service usage.

Battery companies. Check now what new requirements there are for batteries when used in conjunction with solar panels, and work closely with handset vendors.

Business Impact: The impact is limited to: (1) users in emerging markets with infrequent access to electricity, as the technology works best in countries with high availability of solar energy. However, price could be an issue; (2) frequent (business) travelers, as the technology offers convenience for these users; and (3) engineers, miners, developers, people in nongovernmental organizations and military personnel, who spend a significant amount of time in rural locations without access to electricity.

Benefit Rating: Low

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Intivation; LG; Samsung; Sharp; ZTE

Recommended Reading: "Cool Vendors in Consumer Devices, 2012"

Sliding Into the Trough

Head-Mounted Displays

Analysis By: Brian Blau

Definition: Head-mounted displays (HMDs) are small displays or projection technology integrated into eyeglasses or mounted on a helmet. Heads-up displays (HUDs) are a type of HMD that does not block the user's vision, but superimposes the image on the user's view of the real world. An emerging form of HUD is one where the display is either integrated into contact lenses or else

"painted" directly onto the user's retina. In all cases the user perceives the virtual image to be at an ideal viewing distance even though no screen is present.

Position and Adoption Speed Justification: Commonly deployed in military applications (such as driver, flight and combat training), the technology is well-developed but has yet to find a vehicle for broad adoption in the enterprise and consumer markets. Several HMDs have targeted the gaming and video markets with little success. The availability of stylish, consumer-grade video eyeglasses may eventually drive adoption; for example, as a peripheral device for private video viewing on planes. However, recent attempts at this market have failed to take hold, such as Myvu's Crystal Personal Media Viewer, despite it being sold relatively broadly in gadget stores and enjoying considerable press in 2009.

In 2012, Google previewed the Project Glass research initiative, a wearable computing device that includes a wrap-around pair of glasses with a see-through display. While the project includes an HUD, it also incorporates an intelligent system designed to augment your view with information typically found in your smartphone.

Despite Google's augmented reality project, and due to a lack of new HMD products, renewed interest in the broader consumer market, and significant user experience barriers, we expect continuing disillusionment for HMD technology during the next few years. On the positive side, the growing popularity of augmented reality on mobile devices may provide some crossover impetus for similar functionality on a head-mounted form factor (for example, from Vuzix). Further improvements will focus on resolution, field of view, battery life, comfort and cost — all of which are constraining current adoption.

User Advice: Consider HMDs for wearable or augmented reality applications where the user's hands are occupied with a task or where the user needs to be moving while accessing information — for example, to review work instructions, schematics or customer data. Content and service providers should monitor Project Glass from Google and be prepared to plan for integration, but must balance out factors such as user experience, being first to market, and finding business models that support product and market growth.

Business Impact: Outside of simple video viewing, impact areas will be in vertical markets where combining key information with real-world views improves safety and productivity (medical or engineering, for example). Long-term uses will be in entertainment, gaming and mobile communication, as well as in computing devices, simulation and training.

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Google; MicroVision; Rockwell Collins; Sensics; Vuzix

Over-the-Top Set-Top Boxes

Analysis By: Mike McGuire; Van L. Baker

Definition: Over-the-top (OTT) set-top boxes (STBs) are consumer devices that utilize broadband connections to deliver IP-based content, including video and audio from Internet-based distribution providers to a TV. Some variants of the OTT STBs augment their online delivery of content — live or on-demand — with built-in digital TV tuners and antennas to allow a user to watch free-to-air broadcasts.

Position and Adoption Speed Justification: Segments of TV consumer audiences are increasingly attracted to the notion of either "cutting the cord" to their pay-TV provider or "thinning the cord" (keeping broadband and basic pay-TV services, but eliminating their premium subscriptions) and consuming more video content via the Internet. This has contributed to the increased appeal of OTT STBs. Consumer adoption of streaming services, such as Netflix, has contributed to their appeal as have incumbent TV-network-friendly services, such as Hulu Plus. Freedom from a broadcast schedule is one appeal of the OTT STB/online video distributor combination, as is the ability to utilize connected devices, such as media tablets and smartphones, as consumer content options. All of this on-demand behavior is causing consumers to increasingly appreciate and expect that content will be available via the Internet.

This expectation bodes well for OTT STBs, as consumers become comfortable with entertainment content delivered via broadband. The rise of broadband-connected TVs is likely to complement OTT STBs, drawing additional attention to OTT services and applications. Consumers who have made a recent purchase of an HD-enabled TV set, however, will likely opt for the less expensive OTT STB path to getting online video onto their TV. As some OTT service providers develop second-screen apps for smartphones and media tablets, it will be important for OTT STB vendors to ensure their devices are capable of enabling consumers to push signals from those apps to the TV screen.

Additional stimuli for OTT STB offerings are online movie rentals and the continued market opportunities for OTT service companies such as Netflix (the company's expanded from the U.S. to a growing number of countries in Latin America, as well as launching in Ireland) and Lovefilm (in the U.K.). OTT STBs that support Netflix, Wal-Mart Stores' Vudu, Amazon's Instant Video, Lovefilm, Best Buy's CinemaNow, Hulu and Hulu Plus, and Apple's own OTT STB, the Apple TV, are becoming more commonplace at consumer electronics outlets.

User Advice: Traditional consumer electronics manufacturers should assume that these devices will continue to gain in popularity as segments of consumers look to augment their content experiences with online sources, and have a way to link their media tablets and smartphones to the TV. The key will be for manufacturers to push for some standardization — wireless connectivity to enable devices to use the set-top to display content on the device.

Programmers should consider the adoption of OTT STBs as more evidence of the increasing competition between incumbent and Internet-based distributors, and exploit this competition when licensing negotiations are at hand. Incumbent TV distributors need to co-opt the OTT movement with their own OTT service options, with a particular focus on niche-programming lineups. Incumbents should also develop strategies that enable them to extend their service offerings

beyond their legacy geographical footprint, with particular attention on possible international opportunities.

For OTT content distributors, getting sports broadcast licenses to distribute live sports programming, as shown by satellite TV, is integral to efforts to reach more mainstream consumer audiences. Sports programming is one of the, if not the most significant, assets that incumbent TV service providers have in the battle against cable-cutters. OTT content distributors must also develop, or partner to develop, compelling second-screen applications that work across the popular devices, especially if development of such apps become a strategic (and tactical) requirement for any licensing agreements.

Business Impact: This technology will be disruptive to traditional television platforms and the personal computer alike. However, it also presents an opportunity to combine traditional premium content delivery with enhanced services from the Internet. We are beginning to see adoption beyond the early-adopter segment in the OTT STB market, but traditional service providers are enhancing their services as well to combat the encroachment of OTT STB services. All these changes benefit an increasingly demanding consumer.

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Emerging

Sample Vendors: Apple; Boxee; Roku; Samsung; Sony

PC-Grade SSDs

Analysis By: Vishal Tripathi

Definition: Solid-state drive (SSD) technology is a nonvolatile (flash-based) or volatile (RAM-based) semiconductor replacement for conventional hard-disk drives (HDDs) that serve as the primary storage in computing environments. SSDs are infrequently removed and should be considered a semipermanent storage solution that can be "agnostic" of form factors and interfaces, although currently, most SSDs mimic HDD technology; from that perspective, there is a trend under way for new SSDs that use smaller form factors.

Position and Adoption Speed Justification: SSD technology has been prohibitively expensive compared with HDDs for use as primary storage in computing applications, but with SSD price points reaching $1 per gigabyte in mid-2012, it is becoming a more attractive alternative for users with low local storage needs. The overwhelming challenge is that SSDs are still far too costly for capacities of 120GB and greater, and the real benefits of SSDs are still not well-known except among enthusiasts. Although SSD technology has gained support from all major PC OEMs, ongoing and enhanced support from operating system vendors will be required to fully exploit the potential performance advantages of SSDs, as well as to educate the market and promote the value proposition for users. PC operating systems and new flash optimization software for PCs have been designed to identify and communicate with SSDs to provide greater performance and enhance

reliability. Gartner expects that software will continue to play a key role in driving wider SSD usage through more tangible benefits. Furthermore, the MacBook Air and Intel Ultrabook solutions have garnered attention for new SSD form factors and thinner mobile computing devices based on flash technology.

More than 100 vendors are investing heavily in SSD technology, but the range of SSD quality is wide and likely to widen in coming years, and this circumstance has led to confusion regarding the technology.

The total number of SSD vendors will continue to ensure fierce competition and innovation, which will help to drive down prices. However, market penetration and acceptance will depend on performance, data integrity and reliability, which will be increasingly challenged as flash technology continues to degrade in reliability terms as it becomes less expensive. SSDs will not become economically viable — at about $100 in the 120GB capacity range — until 2013 or 2014, depending on the channel of purchase (aftermarket versus PC OEM). At that time, the technology should become more compelling as a high-performance alternative to traditional HDDs.

User Advice: For most enterprise environments, SSD technology will continue to be prohibitively expensive through most of 2012. Only businesses with specific PC total cost of ownership (TCO) concerns and strict performance and durability criteria should consider purchasing the more expensive nonvolatile technology over conventional HDDs in the near term.

SSD technology will become economically attractive in PCs, and the market will gain considerable traction, shipping more than 28 million units, when the end-user price for a PC-grade 120GB SSD reaches about $100 by the end of 2012, but without compromise on performance and reliability. At that point, companies should evaluate their local storage requirements and the inherent benefits of SSD technology versus HDD technology (which will continue to deliver roughly 10 times the capacity at roughly the same price).

Early adoption of PC-grade SSDs might occur in ruggedized systems, as well as tablet PCs and Ultrabooks, which meet the demands of highly mobile workers for reliable storage and compact form factors. PC-grade SSDs will be attractive to any organization experiencing a higher-than-average level of HDD failures (the normal range is 4% to 7% for new notebooks, and 8% to 12% for older notebooks) and limited local-storage requirements.

Users must consider the HDD-SSD flash hybrid solution to have the instant-on feature.

Business Impact: PC-grade SSDs can enable improved access times, lower TCO through greater reliability and productivity, and modestly better power efficiency, but at a significant price premium. In the near term, this technology is mostly beneficial for low-cost, ruggedized and performance-conscious applications, to accommodate low-storage needs and compact form factors. The Ultrabook will also use more SSD flash for instant-on features.

As prices fall at the projected rate of roughly 30% per year, SSDs will become much more attractive in mainstream PCs. Consistent and compelling marketing will clearly articulate the advantages of SSDs to justify the premium. The total market penetration will remain highly dependent on the

degree of quality and performance that PC-grade SSD vendors can provide as NAND technology advances to greater densities.

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Intel; Samsung; SanDisk; Toshiba

Home Server

Analysis By: Stephen Kleynhans

Definition: Home servers are used to aggregate storage on consumer home networks. Although similar to less-expensive home network-attached storage (NAS) devices, home servers are more sophisticated devices geared to aggregating a broader range of services on a home network. These services center on storage/media streaming (e.g., music, photos and videos) and home PC backup, but also include Internet gateway services, as well as remote access to home PCs.

Position and Adoption Speed Justification: The explosion of personally owned digital content has created two problems for consumers: how to make all the content universally available throughout the home, and how to ensure that personal digital memories are not lost due to a computer-related issue, such as a faulty hard drive. Although many users attach external hard drives to their PCs for backup, a networked solution, like home servers, provides a more flexible solution for consumers with multiple PCs.

Home servers are targeted at technology enthusiast consumers looking for centralized backups of PCs and storage for personal digital media assets. Although products built on Microsoft's Windows Home Server have gained critical acclaim, they still haven't made a significant mark with general consumers, who don't realize they exist or are often scared off by the perceived complexity. The future of Windows Home Server is uncertain beyond the release of Windows 8.

At the same time, rapidly declining price points for storage are encouraging mainstream users to simply add ever-larger external drives for backup purposes. Furthermore, consumers who are only interested in distributing music through the home are purchasing media-sharing appliances built on the Digital Living Network Alliance (DLNA) specification, which usurps one of the strongest potential usage models for the home server. Some users are also opting for higher-end desktop systems to act as servers, leveraging the built-in capabilities of Windows 7. Perhaps the greatest challenge is the emergence of the personal cloud and associated cloud-based storage solutions. These are proving to be a compelling option for more casual users, who find them more convenient, easy to use and flexible.

For home servers to gain significant mainstream success, the marketing will need to focus on ease of operation and on broadly compelling usage models that can't be fulfilled by locally attached external drives, or inexpensive NAS devices and are able to leverage cloud storage solutions.

User Advice: Home servers are best-suited to moderately technical users looking to share resources other than just storage among multiple PCs. Ultimately, we expect the lines between home NAS devices and home servers to blur, with the key difference being extensibility through add-on software on the server side.

Although most units are easy to set up, variations exist across different providers depending on the software and hardware design. Buyers should understand the limitations of particular devices (types of clients supported, expandability of drive space, security options, fault tolerance and management options) and should match these to their needs. Integration with personal cloud services is also becoming a critical factor, particularly for photos, music and videos. Many users without the specific need for sharing or streaming would be better-served by less expensive external hard drives. Those looking purely to share music are likely to find more straightforward, although less flexible, appliance-based solutions.

Business Impact: Work-at-home users may find home servers a useful addition, with appropriate policies about data backup and security in place.

Benefit Rating: Moderate

Market Penetration: Less than 1% of target audience

Maturity: Adolescent

Sample Vendors: Acer; Cisco (Linksys); D-Link; HP; Lenovo; Microsoft; Seagate

Ultra-Mini-PC

Analysis By: Tracy Tsai

Definition: Gartner's definition of mini-PCs includes desk-based PCs with volumes of less than 15 liters. Thanks to low-voltage CPUs, mini-PC volumes can be down to 1 liter. This report focuses on volumes less than 4 liters, ultra-mini-PCs. Two categories of ultra-mini-PCs are available: 1 to 2 liters and 3 to 4 liters. Examples in the 1- to 2-liter category include Apple Mac mini, Acer Revo, and Lenovo's ThinkCentre M92p and IdeaCentre Q180. The 3- to 4-liter category includes the Dell Inspiron Zino HD.

Position and Adoption Speed Justification: Improvements in CPUs and graphic processors with lower power consumption are continuing and include combining CPUs and graphic processors to enable better visual computing and performance per watt. Examples are Intel's Atom and AMD's Neo. Software, however, remains a separate and distinct problem because of the cost of Windows and the complexity of adopting Linux OS for general users. The price range for ultra-mini-PCs with Windows 7 Home Premium or Professional remains $300 to $600. They are positioned as media gadgets, entry-level PCs or space-saving commercial PCs.

For homes, the ultra-mini-PC is used mainly by niche users and early adopters in mature markets. One of the major applications is a dedicated small PC to run digital media content on TV. However, increasingly, there are alternatives that can perform the same functions. The alternatives include Internet TV from Sony's Bravia Internet TV and Samsung's Smart TV; game consoles, such as

Sony's PS3 and Microsoft's Xbox; IP-based set-top boxes; media players priced as low as $199; and more mobile computing devices, such as smartphones, media tablets and mobile PCs. Strong competition has slowed adoption and development of ultra-mini-PCs as media gadgets for TV. But due to the unique features of ultra-mini-PCs that include space-saving, low-voltage CPUs and sufficient computing power, this segment remains in the market to serve different purposes, such as a dedicated storage PC for downloading large files, as a home server, as a low-cost home PC or as a home media player. The major brands include Apple, Acer, Dell, Lenovo, Asus, MSI and Shuttle; the many smaller brands include AOpen.

For businesses, ultra-mini-PCs, with their low costs and low power usage, are usually used for loop display, advertising and some direct computer applications. In May 2012, Lenovo launched its ThinkCentre M92p. It is the first ultra-mini-PC with Intel vPro technology, providing superior computing power in a space- and energy-efficient form factor. It also supports as many as four monitors in mosaic mode or three independent monitors without the need of a graphics card. Adoption of ultra-mini-PCs is expected by businesses with particular issues on limited space for desktops in some vertical markets. Adoption may be accelerated by the increased business demand for hybrid solutions involving desktop virtualization and offline computing, in which an entry-level PC "is enough." However, this requires bundled solutions and security, along with management support.

Total worldwide shipments of mini-PCs less than 15 liters were about 7.4 million units, or 5% of total desktop PCs in 2011. Estimated shipments of ultra-mini-PCs were slightly more than 2 million units, or 1% of total desktop PCs in 2011; Apple is the lead vendor, followed by Acer, Dell, Asus, MSI and others. To accelerate the adoption of ultra-mini-PCs into the mainstream market, major efforts, such as lower software cost and an integrated solution for application and UI, would be needed from the players. This can possibly be achieved with a system-on-chip solution, and an easy-to-use UI and remote control that could be a media tablet, which would enable basic and intuitive users to navigate and play the media content.

User Advice: For businesses, ultra-mini-PCs can be a cost-effective solution that provides sufficient computing capability for entry-level tasks or business applications that must run 24 hours while reducing space requirements. To serve enterprise clients, the ultra-mini-PCs with Intel vPro technology must be available with configurations for enterprises — implying a three-year warranty, consistent components, image stability, etc., which will increase adoption of ultra-mini-PCs in business.

For homes, adoption will be driven by home media centers or as an alternative to space-saving, low-cost desktop PCs for people in mature markets who don't want an all-in-one PC. It is essential that ultra-mini-PCs be available with better software solutions. Currently, Windows remains costly for this type of equipment, while Linux-based media center solutions are not ready to be bundled as a standard product package for general home users. All these factors will delay adoption..

Business Impact: Windows-based PCs provide the most-compatible platform for different applications and media files. Ultra-mini-PCs can serve as a media gadget and a home server with flexibility provided by PC capabilities.

Intel's third-generation Core vPro processors, with lower power requirements and better cooling, will help not only to shrink the desktop-size requirement, but also to improve the performance of ultra-mini-PCs beyond the Atom CPUs.

The impact of ultra-mini-PCs on overall PC growth will be minimal as they remain a niche alternative for business or home.

Benefit Rating: Low

Market Penetration: Less than 1% of target audience

Maturity: Adolescent

Sample Vendors: Acer; Apple; Asus; Dell; Lenovo; MSI

Recommended Reading: "Emerging Technology Analysis: Ultra-Mini-PCs as Media Center"

Chromebooks

Analysis By: Angela McIntyre; Isabelle Durand

Definition: Chromebooks are cloud-based notebooks that run Google's browser-centric Chrome OS. They have a clamshell form factor and wireless broadband connectivity, such as Wi-Fi, 3G/4G cellular or LTE. Acer and Samsung are some of the few providers of Chromebooks, and their devices have 16GB solid-state drives (SSDs), Intel Atom processors and 11- to 12-inch screen sizes.

Position and Adoption Speed Justification: Hype around Chromebooks was strong when Google announced Chrome OS in May 2011, but notebooks based on the Chrome OS are likely to become obsolete even before they reach mainstream adoption levels. Gartner has a strategic planning assumption that by 2013, Google will rationalize its different OSs around the Android platform (see, "Predicts 2012: The Success of Consumer Devices Will Rest on Delivering the Ultimate Experience"). There has been little improvement to the Chrome OS over the last year because Google is focusing on the Android OS because of its success in smartphones and potential success in tablets. Chromebooks may quietly disappear from the market in two years to be replaced by cloud-based notebooks that run future versions of the Android OS, starting with Jelly Bean that releases later this year.

Even though Chromebooks are floundering in the market, a new user interface for the Chrome OS, called Aura, is available as a beta to developers. Although current Chromebook models are x86-based, Chromebooks with ARM-based processors, such as the Nvidia Tegra 2 or Qualcomm Snapdragon, may come to market from vendors such as Sony. However, with the release of WindowsRT, Chromebooks would have competition from Microsoft's Windows-based notebooks on ARM platforms. In addition, the selection of applications available for Chrome OS would need to improve because the current number of applications in the Chrome Web Store is too limited compared with offerings for other OSs.

The proportion of data stored in the cloud now remains limited. Gartner's user survey in 11 countries (both mature and emerging) reveals that consumers still prefer to store data locally since they seem concerned about privacy, security and accessibility of their personal data on the Web. Consumers store less than 3% of their data on the Web (see "Survey Analysis: Consumers Avoid Cloud Storage"). This is low, and it is questionable how quickly that behavior could be changed to accommodate the Chromebook's usage model. If browser-based notebooks, such as Chromebook, are to be successful, it will be because they will have become low-cost devices, compared with tablets and notebooks, for using applications downloaded from the Internet or accessed through Web portals. Such a scenario could emerge as cloud services start to become mainstream in the next three to five years.

User Advice: Few Chromebooks have come to market in part because of their perceived lack of end-user value compared with media tablets and low-end notebook PCs. The pricing of Android-based media tablets is similar to Chromebooks, in the $349 to $449 range. Consumers who want an integrated keyboard may consider a Chromebook over a media tablet, but would be better served buying a notebook PC because one of the drawbacks of Chromebooks is the reliance on ubiquitous, free or inexpensive Internet connectivity.

Compatibility with other applications seems to be difficult on the Chromebook, and also cloud storage does not appeal to users. Cloud computing is still at an early stage, and privacy could be a concern for users since up to now they have stored data on hard-disk drives and may not be comfortable saving data in the cloud. Also, users need to have stable network access to get their content.

Business Impact: Business use of Chromebooks, or more likely notebooks based on Android OS, may grow in three to five years if cloud-based services for productivity suite applications, such as word processing, spreadsheets and presentations, become comparable in quality, compatibility and cost to those residing on PCs. For businesses, Chromebooks are currently far too expensive to justify their limited functionality and are in direct competition with low-end notebooks and tablets. It is not clear whether PC OEMs will continue to invest in Chromebooks because there is more opportunity in the tablet and ultraportable markets, and notebooks based on the Android OS may be coming to market later this year.

Benefit Rating: Low

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Acer; Samsung

Recommended Reading: "Search Analytics Trends: Why Chromebooks Lack Market Attention"

"Market Trends: The Personal Cloud From Consumers' Perspective"

"Browser Vendors' HTML5 Strategies Are Not the Same"

"Survey Analysis: Consumers Avoid Cloud Storage"

3D Flat-Panel TVs and Displays

Analysis By: Paul O'Donovan

Definition: Two main technologies are used for 3D TVs and displays: polarization 3D, which uses a pattern retarder and polarized glasses; and alternate-frame sequencing, which uses active shutter glasses and requires high-refresh-rate displays. Alternative autostereoscopic displays — which use lenticular lenses or parallax barrier technology built into the display panel and which do not require glasses to view the 3D effect — are used primarily in digital signage and have limited penetration of the consumer market.

Position and Adoption Speed Justification: The revival of 3D movies has enthused the cinema-going public, so display manufacturers have been rushing to provide 3D display technologies for the home. However, bringing the technology to the consumer TV market is proving more difficult than its successes in the cinema. There is still a lack of available 3D content two years after launch, and differing display technologies (most of which still use glasses) are confusing many consumers at this early stage. Currently, the most popular method of displaying 3D content on LCD and plasma-enabled TVs and displays requires the user to wear electronic shutter glasses. However, there is no standard developed for the technology in these electronic glasses, so they are all proprietary and one manufacturer's product cannot be used with another manufacturer's display. Some form of standardization would certainly help user takeup of 3D TVs and displays, but current development is limited. Standards apart, the fact that glasses are needed at all is probably the biggest stumbling block to mass-market adoption, along with a lack of content that has a wide audience appeal. Film success stories such as "Avatar" are few and far between.

User Advice: 3D TVs and displays will do well in the video game market. There are already some game consoles available that offer alternate-frame sequencing, and portable games machines with glassless 3D single-user viewing. However, the development of handheld 3D games machines has not been as well received in the market as Nintendo had expected.

Business Impact:

- The development of 3D TVs and displays for the consumer market could well benefit computer-aided design applications, as well as medical imaging, especially in medical schools and training institutions.
- Some industrial applications already use 3D image capturing, and 3D displays featuring lenticular lenses or parallax barriers are used for some public digital signage.

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Sample Vendors: LG Display; Panasonic; Samsung Electronics; Sharp; Sony; Toshiba

Connected Imaging Devices

Analysis By: Jon Erensen

Definition: Connected imaging devices include digital still cameras (DSCs) and digital camcorders with embedded wireless LAN (WLAN) or wireless WAN digital cellular connections. The wireless connection is typically used to send photos to a PC, an online photo service or social networking site, or as an attachment to an email. The advantage is that you can send photos or videos as soon as they are taken instead of waiting until they are downloaded to a PC.

Position and Adoption Speed Justification: Makers of digital imaging devices have been experimenting with embedded wireless connectivity since 2005, but the feature has failed to gain significant traction. Many Tier 1 vendors have tried to integrate Wi-Fi into DSCs, but we are not aware of any attempts by major manufacturers to embed digital cellular connections. DSCs initially used Wi-Fi to send photos directly to a PC or printer, but companies have been trying to add more capabilities, such as emailing photos directly from a camera or uploading them to social networking sites. While experimentation has been going on for some time with respect to DSCs, we have seen limited activity in digital camcorders because video files are much larger. But there have been solutions, such as TransferJet, that are designed to transfer video from camcorders to the PC or TV, although these have gained limited traction.

The challenge is integrating the wireless functionality in a way that is easy to set up and use. Wi-Fi technology has coverage limitations and can make products difficult to set up and use, especially because most DSCs do not have a full Web browser. A Web browser is critical to connect to public hot spots. A digital cellular WAN can overcome these problems, but WAN connections typically come with a tie to a service provider and a monthly service fee. It will take time to settle on business models with wireless carriers that work for consumers. Business models for wireless WAN connectivity are easier to devise when products use relatively small amounts of bandwidth, which is not the case with DSCs or digital camcorders, especially as the resolution of pictures increases and video transitions from standard definition to high definition. There is competitive pressure coming from smartphones with improved picture and video capture capabilities. And because smartphones have a standard digital cellular connection, they have certain advantages over unconnected imaging devices. One area to watch is the emergence of shared data plans from major carriers, as this may allow consumers to link a connected imaging device to an existing wireless data plan for a relatively low price.

User Advice: Vendors that want to position products at the high end of the market should consider WLAN or a third-generation cellular connection as a potential differentiator, as long as reasonable data plans can be worked out with wireless service providers. The key with any wireless integration is to ensure that it is simple to set up a connection, and that it is tightly integrated with any application and service planning to use it.

Business Impact: This category of product will have limited impact on businesses. However, connected imaging devices may be useful in some industries in which immediate access to video or photos shot in the field has value.

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Sample Vendors: Eye-Fi; Nikon; Samsung Electronics; Sony

Recommended Reading: "Competitive Landscape: Digital Still Camera Companies, Worldwide"

"Market Trends: Digital Camera Functions in Mobile and Consumer Electronics, 2011"

"Forecast Analysis: Digital Still Cameras, Worldwide, 2011"

Digital Pens

Analysis By: Angela McIntyre; Leslie Fiering

Definition: Digital pens have built-in sensors that capture and digitize handwriting as the user creates an ink-on-paper copy. Some use paper printed with tiny patterns (each page with a unique pattern) so that the software can recognize which specific document the pen is writing on, even when changes are made to the document at a later time. Some pens can read bar codes to associate a document with a specific item. Others enable digital handwriting or drawing directly onto a non-touch-enabled computer screen.

Position and Adoption Speed Justification: Digital pens offer acceptable levels of accuracy for many data capture applications, but they are struggling to find a role that will take them beyond niche applications. While digital pens work for some individuals, there are challenges in managing a large deployment in terms of data management, backup and discoverability. Furthermore, many of these pens require special paper that adds a high consumable cost to the initial investment for the pen itself. The handwriting captured with some digital pens can be converted into editable text on a PC. The healthcare, insurance, education, financial services and field service industries all have some limited level of adoption. However, to date, the highest rate of adoption has been for classroom note taking.

The current flood of media tablets will provide an increasingly attractive alternative as innovative interfaces and peripherals are developed for touch interaction. For this reason, digital pens remain in the Trough of Disillusionment, with very little forward movement.

User Advice: Consider digital pens for:

- Applications in which there is value in simultaneously capturing a digital and handwritten copy of data, especially in situations in which there may be a legal requirement to maintain paper documents with original signatures (such as financial transactions, drug sample receipts or sales contracts)
- Paper-based forms (such as enrollment forms, healthcare forms or consumer-based surveys) to reduce time and cost of processing the forms
- Lab books

- Individuals who may not have full-time access to a computer in the field
- Individuals who prefer handwriting to digital input
- Note taking in classrooms or social situations in which computers are not acceptable or available
- Other applications in which tablet use is not convenient or feasible (for example, for marking up large-scale schematics in the field)

Ensure that deployments of digital pens for anything beyond individual productivity include solutions for data upload and management. In many applications, digital pens will be a stopgap solution that will ultimately be replaced with input into media tablets and other mobile devices; therefore, invest for tactical value, rather than as a strategic solution.

Business Impact: Digital pens can shorten the amount of time required to fill out forms for digital capture, as well as reduce transcription error rates and costs, through simultaneous paper-form completion and electronic data capture in areas such as field service, maintenance, insurance, financial services and healthcare.

Benefit Rating: Moderate

Market Penetration: Less than 1% of target audience

Maturity: Emerging

Sample Vendors: Adapx; Anoto Group; Dane-Elec; Digital Pen Systems; EdgeCast; ExpeData; HP; IOGear; Iris; Keytec; Pegasus

Embedded Wireless Cellular Modems

Analysis By: Hugues J. De La Vergne

Definition: Embedded wireless cellular modems are modems embedded in notebook computers and other consumer electronics devices to provide cellular connectivity. Because of the increase in speeds of cellular technologies to High-Speed Packet Access and Long Term Evolution (LTE), along with smaller form factors, such as media tablets, embedded wireless cellular modems have seen rapid growth.

Position and Adoption Speed Justification: Although removable modems are a mature technology, embedded modems have started to gain momentum as more end users want their PCs and consumer electronics devices to be regularly connected to the Internet. Growth in the embedded segment was limited historically because of users' concerns about having a device that supports an out-of-date cellular technology and the high prices of rate plans. End users preferred the flexibility that removable USB dongles offered, protecting buyers from rapid cellular technology changes. Historically, such changes have come several times faster than the normal laptop replacement cycle. Although USB modems often have lower durability and performance than embedded cellular modems, the payback comes from greater notebook asset protection, because

obsolete modems can readily be swapped out, whereas an embedded cellular solution can be difficult or impossible to change. In addition, USB dongles can easily be shared in an organization. With embedded cellular modems, the software differences from operators provide challenges from a common image perspective.

User Advice: The launching of LTE allows wireless networks to offer an improved user experience as speeds are comparable to those of the wireline experience, in some cases. With the expansion of multidevice data plans, small business and consumers should see improved pricing and should look to add embedded wireless cellular devices, such as media tablets and mobile PCs, to their network as opposed to Wi-Fi-only devices.

Business Impact: Embedded modems will affect telecommunications strategies and economics for mobile users with notebooks as organizations choose among the wireless communications options available.

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Early mainstream

Sample Vendors: Huawei; Kyocera; Novatel Wireless; Option; Pantech Wireless; Sierra Wireless; ZTE

Recommended Reading: "Forecast Analysis: Cellular Modems, Worldwide, 2009-2016, 1Q12 Update"

"Forecast: Removable and Embedded Cellular Modems, Worldwide, 2009-2016, 1Q12 Update"

E-Book Readers

Analysis By: Allen Weiner

Definition: E-readers are devices that facilitate screen-based reading of books and periodicals. These are devices for which reading is the sole purpose or among the leading uses. E-readers today primarily include black-and-white e-readers using e-ink technology; tablet devices, which offer color, allow access to rich media, and support enhanced e-book content as well as newspapers and magazines; and smartphones, such as the iPhone, and Android- and Windows-based phones.

Position and Adoption Speed Justification: The justifications for current positioning on the Hype Cycle are:

- A rapid increase in the sales of e-books, which now constitute up to 20% of all revenue of U.S. publishers, and about 10% of revenue from European publishers. Revenue from e-books outside the U.S. will rise as Amazon and Kobo increase distribution of black-and-white e-reader devices, in some cases in conjunction with regional retail partners.
- Retail cost dropping to $99 for Pearl screen black-and-white e-readers.

- Sales of the two top e-readers in the U.S., Amazon's Kindle and Barnes & Noble's family of Nooks. (Neither company will release sales figures.)
- An increase in the number of newspaper and magazine content applications available for tablets.
- The emergence of enhanced e-books and platforms, such as Vook and Inkling, creating platforms for new e-book apps suited for tablets.

During the next year, a number of developments will impact the placement of e-readers on future Hype Cycles:

- Increased distribution of color e-paper screen devices such as the Kyobo (Korea) reader based on Mirasol's color screen technology. New color screens with features that mimic black-and-white e-paper screens, produced in large quantities, will impact the sales of black-and-white e-readers, dropping even the most advanced of the lot to near commodity pricing. New entrants into the tablet market that will come close to giving Apple a challenge for marketplace dominance also could drop prices and increase choices to content-consuming customers.
- An increase in the digitization of books, especially backlist and out-of-print titles. An increase in the depth and breadth of content will appeal to the e-reading consumer.
- Settlement of the legal charges of price-fixing against Apple and major publishers will affect e-book efforts of publishers that find it difficult to yield a profit from models such as Amazon's wholesale-retail scheme.
- Advances in the development of engaging magazine and newspaper content applications will round out content offerings across the reading landscape.

A few data points from Pew Internet and American Life Project reveal the pace of adoption of e-reading and the need for publishers across all sectors to be well beyond the early stages of developing a digital strategy:

- Ownership of e-book readers and tablet computers has been growing slowly but steadily for the past few years. However, during the most recent holiday season, there was a major spike in ownership. In mid-January, the organizations reported that 19% of adults ages 18 and older owned an e-book reader, and 19% owned a tablet computer, up from 10% ownership for each device in mid-December.
- When asked the question of adults 18 and older in a survey from 20 January to 19 February 2012, the number of readers of e-books in the previous year had increased to 21%.

User Advice: Book publishers must embrace digitization and e-books; however, they must face the reality of a market in which digital goods have less perceived value. Publishers must develop leaner operations to decrease the cost of goods while developing higher-margin products that provide added value to consumers in an area generally called "enhanced books." Simply adding video or audio to a title will not drive a higher price point. This leads to the use of new development platforms that allow publishers to create engaging "transmedia" products, such as those from Inkling, Vook and Touch Press.

Business Impact: If you are in the publishing business as a content owner, publisher or distributor, or in an adjacent area such as advertising, you are impacted by the future trajectory of e-readers. The same goes for anyone in the digital value chain supporting content for e-readers, as well as device manufacturers that not only want to provide the screens but also the content marketplaces to feed device owners.

E-readers are fundamentally altering the business model and supply chain for all forms of printed content: eliminating inventory considerations; creating new approaches to the promotion, design, and production of published content; and putting brick-and-mortar bookstores at risk. Tower Records and Blockbuster tell cautionary tales of the impact of digital distribution on content retailers, as Internet giants like Google, Amazon and Apple move to reconfigure the publishing value chain.

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Amazon.com; Barnes & Noble; Motorola; Plastic Logic; Samsung; Sony

Climbing the Slope

All-in-One PCs

Analysis By: Tracy Tsai

Definition: Gartner defines all-in-one (AIO) PCs as desk-based PCs that have the monitor housed within the system casing. The monitor is a flat screen, which can be a touchscreen. Examples include Apple's iMac, HP's TouchSmart, Lenovo's ThinkCentre Edge, Dell's Inspiron One, Acer's Z5801, Asus' E-Top and Sony's VAIO VPC.

Position and Adoption Speed Justification: AIOs had been in a high-end niche segment priced well over $1,000 until 2009, when Asus launched a low-cost, Atom-based, 15.6-inch model priced as low as $399. However, low price alone could not drive market demand for AIOs. Consumers demanded better configuration, such as more computing power, a larger screen and Blu-ray technology, so the AIOs could be used as a family-shared entertainment PC. Vendors like Acer, Lenovo, Dell and MSI developed more AIO models with better specifications but kept the price low and competitive. The mainstream price range of an AIO has remained $500 to $799. Growth of AIO shipments was quite strong in 2009 and 2010, and began to drop in 2011. Total AIO shipments for the consumer market in 2011 was approximately 7.8 million, about 14% of total consumer desktop PCs. It is expected that the share of AIOs in total desktop PCs will continue to expand for the next five years.

The broadly available streaming video services, such as Hulu or Netflix, was one of the major AIO drivers as they are Internet connected. However, emergence of connected TV with its Internet already providing an even better viewing experience for streaming videos started to cut demand for

AIO PCs in 2011. In addition, the economic slowdown in the U.S. and Western Europe, together taking 50% of total AIO shipments worldwide, also impacted AIOs with nearly flat growth in 2011. Because of the relatively higher price level of AIOs over regular desktop PCs and notebooks, the AIO is sold mainly in mature markets to those who need a second PC or a slimmer desktop PC. It is expected that the 2H12 release of Windows 8 with Metro Touch will bring a new dynamic experience to AIOs and generate more consumer interest as there will be more touch-based applications developed for the Windows 8 platform.In the professional market, AIO PCs are adopted for various vertical applications, such as information kiosks or space savers for banking, healthcare, hotels, classrooms, government, retail or any business preferring a PC with fewer connection wires. Also, with more 3D application development, AIOs with 3D viewing capability can be adopted for store displays or product demonstrations. Shipment growth of AIO PCs took off slower in the professional market than the consumer market in 2009, but then grew faster with 62% and 19% growth in 2010 and 2011. AIOs in the professional market totaled 3.5 million in 2011, about 4% of total desktop PCs.

User Advice: Vertical industry business users who need touch UI for interactive applications may want to start evaluating AIO PCs with Windows 8 professional and Intel's third-generation Core vPro when the new products are released in 2H12. The selection of screen size should be based on the distance between the user and the screen. Screen-size offerings range from 16 inches to 27 inches. For applications like digital signage and information kiosks, the screen size may be larger, but for a bank clerk with limited space, 16 inches to 19 inches is preferred. For basic computing tasks that require little computing power, an entry-level AIO with the right screen size could be a viable alternative to existing thin-client usage models that require more graphics-driven applications.

For consumers, AIO PCs can be positioned as a good compromise between a mobile and a traditional desktop PC, or as an addition family PC with multiple touch features and Windows 8 providing a true touch-enabled PC experience. The success of the AIO in the consumer market will rely highly on large numbers of applications and attractive content for family usage, such as gaming, educational, creative or social.

Business Impact: Along with media tablets adopted largely by business and consumers users, more touch-based applications are being developed for different vertical industries. One major business purpose is providing a better experience and satisfaction to customers. It will be natural for people to assume any device screen is touch-enabled if the AIO is located in a public space. It is expected that the launch of Windows 8 in 2H12 will help the adoption of AIOs as both business and consumers acquire touch-based applications from the Windows store. To simulate the experience of media tablets on AIOs, a couple of new AIO PCs are designed to be adjusted to 180 degrees flat, permitting a more ergonomic way of relaxing the arms or hands when doing multitouch interaction over the large "media tablet"-like AIO. However, the price remains a major obstacle, especially as the overall economic situation remains unstable in mature markets. Windows 8 plus Intel's new generation vPro Core processors will help make new AIO PCs thinner, and more power efficient and secure. This will help broaden AIO adoption, particularly in areas needing interactive touch input, such as information kiosks in public areas and educational applications at schools. With various and numerous touch-based applications, AIO PC applications will expand from just saving space. AIOs also have the advantage of saving IT costs, as less hardware must be managed compared with

standard desk-based PCs. AIOs will not be a mainstream desk-based PC for most organizations, but rather a niche product for selected organizations with certain usage models, such as information kiosks or limited working space.

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Apple; Lenovo

Recommended Reading: "Forecast Analysis: PC Forecast Assumptions, Worldwide, 2011-2016, 1Q12 Update"

Media Tablets

Analysis By: Angela McIntyre; Roberta Cozza; Van L. Baker

Definition: A media tablet is a device based on a touchscreen display, typically multitouch, that facilitates content entry via an on-screen keyboard. The device has a screen with a diagonal dimension that is a minimum of five inches. Media tablets feature connectivity via Wi-Fi or via 3G/4G cellular networks. Tablets typically offer day-long battery life and lengthy standby times, with instant-on access from a suspended state. Examples of media tablets are the Apple iPad, Asus Eee Pad Transformer, Motorola Xyboard and Samsung Galaxy Tab.

Position and Adoption Speed Justification: It is tempting to assume, with the success of the iPad, that the media tablet is at or near maturity, but this is not the case. While competitive tablets have not enjoyed much success to date, we believe that other manufacturers are committed to this hardware platform and will continue to improve their offerings. Future iterations may also incorporate control by gesture and voice. The success of the tablet form factor has been primarily in the consumer market, and it is just beginning to capture the attention of the business market. This alone will contribute to sustained hype for some time to come.

Media tablets include screens that are five inches and larger and come with a supplementary input device, such as a keyboard or pen. The primary focus for media tablets has been content consumption, but media tablets with screens 10 inches or larger are increasingly used for light content creation.

This device category has disrupted the consumer PC market, with the greatest impact being on the mini-notebook (netbook) segment. The media tablet offers an attractive alternative to mini-notebooks and ultra-thin and light notebooks for consumers who are focused on content consumption. The content creation capability of media tablets is improving. Its instant-on capability and long battery life give it a convenience that appeals to consumers, and a wireless keyboard can be added for extended periods of typing.

Media tablets may have "open source" OSs, such as Android, under the control of the OS vendor with modifications from the device maker, or an open OS under the control of the OS vendor, such

as Apple's iOS 4 or Windows 8. The OSs offer open programming APIs and development environments for third-party developers to create applications that can be downloaded from online stores, such as the Apple App Store, Google Play and the Amazon Appstore.

The rapid growth of tablet-optimized applications has contributed to the success of the tablet market, while the success of the e-book and magazine reader applications for tablets has significantly altered the e-book reader market. Media tablet capabilities for content creation, such as photo and video editing, as well as productivity applications, have improved dramatically in the last year, making the device more practical as a general-purpose tool. This trend is expected to continue. Given the high profile of the tablet category in the press and the resultant hype, the media tablet may move through the Hype Cycle quickly. Although more than 60 million tablets were shipped worldwide in 2011, they have been adopted by less than 5% of their potential users. Gartner's forecast model shows that tablet penetration will not plateau until after 2020 in mature markets and later than that in some emerging markets.

User Advice: Enterprise IT architects should prepare for media tablets to continue to gain traction in their employee base as the devices increase in popularity with consumers. In many cases, these devices have already entered the enterprise as employees use their own media tablets for work. IT managers should apply the managed diversity model for these devices. For tablets with the Android OS, IT managers should select device makers on the strength of their security road maps and adherence to OS updates. Apple iOS 5 has improved security features for iPad. Windows RT tablets are likely to need different management and security products than future x86-based Windows 8 tablets. IT should decide whether the security features of tablets are sufficient to address the risks associated with the job roles and application needs of mobile users.

Media tablets should also be considered for business-to-consumer applications for delivering content, providing high-quality graphics in sales situations and/or driving customer engagement where it is required for navigating through marketing materials. During the next three years, media tablets will be used in business for customer-facing roles — for example, by sales (to give presentations to clients), by realtors and by executives. The adoption of tablets by businesses will depend on the development of software that incorporates touch in ways that significantly enhances the user experience or improves productivity because there is a lack of multitouch-centric user interfaces in mainstream productivity applications.

Business Impact: The adoption of multitouch technology in both the smartphone and media tablet categories has elevated multitouch use models to mainstream devices that consumers carry every day. Additionally, the availability of instant-on access has driven strong adoption as consumers have come to place a high value on this feature. The proliferation of multitouch and instant-on capabilities in media tablets and smartphones has put additional pressure on the PC industry to offer multitouch and instant-on functionality in notebooks. The Ultrabook PC designs incorporate media tablet features popular with consumers, such as long battery life and instant-on access. This disruption of tablets in the market has put an emphasis on industrial design that was lacking in the market before the arrival of the media tablet.

Manufacturers of consumer electronics need to broaden their efforts to address the full user experience and avoid focusing on hardware features as they develop tablets for the market.

Consumers have shown that they are much more concerned with usability and software that is well-designed for use with a multitouch tablet environment than they are with hardware features. Manufacturers should avoid products designed on existing mainstream OSs that are ill-suited for use on a multitouch system.

PC manufacturers will increase experimentation with controls, such as gesture and voice, in addition to multitouch. Media tablets, in conjunction with smartphones and cloud-based services, have the potential to fundamentally change PC use models in the longer term. This impact extends beyond the user interface to application design and product design, with increased expectations for additional performance and a more appealing industrial design aligned with consumer aesthetics.

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Early mainstream

Sample Vendors: Acer; Apple; Asus; Lenovo; Motorola; Samsung Electronics

Recommended Reading: "Market Definitions and Methodology Guide: Consumer Devices"

"Apple iOS 5 Enterprise Improvements for Tablets and Smartphones"

"iPhone and iPad Security Assessment"

"Android Smartphone and Tablet Security Assessment"

"Quarterly Statistics: Personal Computers, All Countries Forecast Database, 2Q12 Update"

"Windows on ARM May Not Be What Many Enterprises Expect"

Connected Portable Media Players

Analysis By: Jon Erensen

Definition: Connected portable media players (PMPs) have a screen size of less than 5 inches and embed a Wi-Fi or wireless WAN (WLAN) digital cellular connection to connect to services designed to enhance the media playback experience, including direct-to-device content downloads, music ID capabilities, music discovery features, social networking features and streaming Internet radio functions. The most popular products in this category are based on Apple's iOS and Google's Android, which allows them to run applications and browse the Web.

Position and Adoption Speed Justification: PMP vendors have been experimenting with wireless connectivity as far back as 2004, when the first players with WLAN connectivity were introduced. The WLAN was primarily used for music downloads and Internet radio at that time, but it has expanded to include other applications, such as social networking features, music discovery features and applications not related to music, such as Web browsing and gaming. The most successful product in this category is the Apple iPod touch, which dominates the high end of the

PMP market. Android-based PMPs are expected to challenge the iPod touch as they become available in greater numbers, but thus far their impact has been minimal.

Even with the success of the iPod touch, the majority of the PMP market remains unconnected because of the difficulty of integrating the wireless functionality with the key software and applications. WLAN technology has coverage limitations and can make products difficult to set up and use, especially if there is not a full Web browser on the device. PMPs have so far not included integrated cellular WAN connectivity, which can overcome these problems, but WAN connections typically come with a tie to a service provider and a monthly service fee. The PMP market continues to decline as competition from smartphones increases significantly. And since smartphones have a standard digital cellular connection, they have certain advantages over dedicated PMPs in terms of being always connected. Media tablets will also compete with large-screen PMPs, and aggressive pricing for 7-inch tablets is expected to significantly impact the high-end PMP category. Wireless integration will be an important feature if the high-end and midrange segments of the PMP market are to remain viable.

User Advice: PMP vendors that want to position products at the high end of the market need to include WLAN as a standard feature. The key with any wireless integration is to ensure that it is simple to set up a connection and that it is tightly integrated with any application and service planning to use it. Vendors looking to compete with Apple should focus on Android-based PMPs that will provide the ecosystem to compete.

Business Impact: This category of product will have limited impact on businesses. However, some users may try to attach connected PMPs to corporate networks, so IT departments should have policies to deal with this possibility. Users that attempt to do this represent a potential security risk for file management or more serious matters.

Benefit Rating: Moderate

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: Apple; Philips Electronics; Samsung; Sony

Recommended Reading: "Forecast: Electronic Equipment Production and Semiconductor Consumption by Application, Worldwide, 2008-2015, 4Q11 Update"

"Market Trends: Worldwide, Apple's Competitors Expand Their Media Tablets Into Low-Tier Markets, 2011"

Connected Portable Navigation Devices

Analysis By: Jon Erensen

Definition: Portable navigation devices (PNDs) are handheld products that receive GPS signals to determine location. Connected PNDs embed a WAN digital cellular or Wi-Fi connection to connect

to services designed to enhance the navigation experience, including traffic information, local searches and other location-based services. PNDs are used in cars to provide turn-by-turn directions and location-based services.

Position and Adoption Speed Justification: The PND market has declined every year since 2009 due to increasing competition from smartphones with GPS capability. Although there has been much hype surrounding connected PNDs, penetration remains low. There are many advantages to having a connected PND, including access to updated maps, real-time traffic using floating car data and local search capabilities. Wireless LAN (WLAN) alone does not provide acceptable coverage, so most connected PNDs combine WLAN with a WAN digital cellular connection or use a WAN digital cellular connection exclusively. The challenge with the WAN digital cellular connection is that vendors need to negotiate with wireless carriers to use their network, which typically results in a monthly service charge, although in some cases the cost of the connection can be built into the initial retail price. The main inhibitor to connected PNDs is competition from GPS-enabled smartphones. Both Google and Nokia have made turn-by-turn navigation a standard feature on their smartphones, and numerous apps are available for iOS and other smartphone operating systems.

User Advice: Competition has increased significantly from smartphones with built-in GPS capability. This class of phone typically has a 3.5- to 4.8-inch screen that will allow it to be used effectively for turn-by-turn directions, and it has a standard WAN digital cellular connection that will enable it to provide the same services as connected PNDs. Vendors of PNDs need to be aware of the competitive threat posed by smartphones and find a way to differentiate their products. Larger screens and simplicity should be the focus.

Business Impact: Location-based services tied to PNDs are more effective when they have real-time access to up-to-date data. Connected PNDs make this possible, but they come with the downside of being connected to a particular service provider and a monthly service fee. This presents an opportunity for wireless carriers if they can price these services realistically.

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Sample Vendors: Garmin; Magellan; TomTom

Recommended Reading: "Forecast Analysis: Mobile Services, Worldwide, 2008-2016, 2Q12 Update"

"Forecast Analysis: Automotive GPS Fixed Navigation Systems, Worldwide, 2009-2015, 2Q11 Update"

Basic Communication Devices — Open OS

Analysis By: Carolina Milanesi

Definition: As voice-centric hardware, basic communication devices have support for data services such as basic Internet capabilities, although a fully integrated experience can be supplied across all devices. They are more likely to run one of the widely implemented OSs such as Android than utility devices, although proprietary OSs are still used in this sector. Usability remains low.

Position and Adoption Speed Justification: The differences between basic and premium devices are based on the hardware specifications (for example 3.5G or Long Term Evolution, single or multiple processor core, Wi-Fi support or Near Field Communication) and on what those specifications provide for consumers in the way of richness of user experience when it comes to applications and services.

These devices are similar to feature phones but are differentiated by their open OSs. Symbian-based devices started out in this category but, over the past year, have been overshadowed by Android-based devices which are coming down in price.

Several manufacturers including HTC, Sony Ericsson, Huawei and ZTE have announced a broader portfolio of midtier devices, mainly based on Android, which will reach the market in 2011. Some of these manufacturers (notably Alcatel and ZTE) are expanding their channel reach and working closely with communications service providers (CSPs) to aggressively push these devices into new markets. This is the area in which white box vendors will try to dominate as their lack of expertise in software, content and services does not allow them to deliver a rich experience. We expect this to be the catalyst for smartphones truly going mass market with improvements in quality and overall user experience. Nevertheless, this category will always be a step behind its premium counterpart on the Hype Cycle.

We have given basic communication devices a high benefit rating, as the devices bring several benefits to key players in the value chain including vendors (better margins), operators (opportunity for data revenue) and developers (widening of the addressable market).

User Advice: CSPs should treat these devices the same way they treat feature phones and should limit the amount of subsidies they give to subscribers as the return on investment will be lower than for premium devices.

Business Impact: Although these devices are based on open OSs, they might not be optimized to deliver a higher average revenue per unit for CSPs. They might be better suited to users more interested in the features of the hardware than in the richness of the software.

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Sample Vendors: Alcatel; Huawei; LG; Nokia; TCL Corporation; ZTE

Recommended Reading: "Forecast: Communication Devices, Worldwide, 2008-2015, 2Q11 Update"

Multitouch Displays

Analysis By: Angela McIntyre; Jon Erensen; Leslie Fiering

Definition: Multitouch refers to a touchscreen interaction technique in which multiple simultaneous touchpoints and movements can be detected and used for screen navigation or to control objects (such as sorting a series of pictures) on the screen. Various combinations of two or more fingers may be used together to create control gestures. A user may, for example, zoom into a picture by placing a thumb and an index finger on a touchscreen and then moving them apart. To zoom out, a user would move the same two fingers back together in a pinching motion.

Position and Adoption Speed Justification: Products such as the Apple iPhone, iPod touch, iPad and Android-based smartphones and tablets are rapidly advancing the adoption of multitouch technology. The inclusion of this technology in Apple's products has attracted wide attention from competitors in these markets and vendors in adjacent markets looking to use multitouch to improve user interface and create a differentiator with competing products.

Gestures can create shortcuts for performing a group of actions with a pen or a finger. The direction and shape of the gesture can dictate the exact actions. Good implementations provide visual clues regarding the effects of the gestures on the applications and even build on the gestures — for example, by providing acceleration if a "flick" or sweeping gesture is held long enough. Multitouch gestures supported by Apple's iOS are a default standard. Multitouch-capable touchscreens are becoming expected features by consumers on smartphones and media tablets. But other devices, such as PCs, can use multitouch-enabled touchpad pointing devices instead of mice as external peripherals, integrated into the keyboard of desktop PCs, or built into laptops near their keyboards. Multitouch screens add $60 to $100 to the bills of materials of mobile PCs, which is low enough to encourage consumer adoption. Multitouch can be implemented in multiple touchscreen technologies, including capacitive, resistive and optical. Multitouch technology continues to evolve, and in-cell displays are expected on iPhone 5 this year. With in-cell displays, the touch module resides inside a display's color filters rather than above them, allowing for a thinner touch panel.

Interest in multitouch technology is considerable, but to work well it requires tight integration between software (OS, user interface and applications) and hardware. Adapting an existing OS for multitouch capabilities takes considerable effort, but operating systems in addition to the iOS have added multitouch capabilities, including Microsoft Windows 7, the BlackBerry OS, Android, webOS, Ubuntu and Apple's Mac OS X Lion, and Microsoft Windows 8 (expected in October 2012). There is strong momentum in the software application ecosystem for multitouch technology, and the adoption of multitouch is increasing rapidly in mobile phones, media tablets and portable consumer electronics devices. Multitouch applications on PCs have struggled to prove their value to consumers, but the inclusion of multitouch in OSX Lion accelerated consumer demand for this feature in PCs.

User Advice: Multitouch is an enabling technology and does not, by itself, guarantee successful products.

Apple's successful introduction of the iPad will increase OEM experimentation on the market with new media tablet designs and innovative form factors for multitouch PCs. Of the thin ultraportable mobile PC models brought to market this year, about 15% will have touch-enabled screens.

However, flooding the market with multitouch-enabled devices is no guarantee that consumers will embrace multitouch computing on PCs in 2012. Hardware OEMs must ensure that multitouch capabilities are tightly integrated with their devices' user interface, OS and applications.

Software developers need to ensure that their applications apply consistent gestures and user interface design rules throughout.

Semiconductor vendors targeting the touchscreen market need to provide user interface solutions and complete reference designs to capitalize on emerging opportunities. They must understand how many resources are required to customize touchscreen products for the consumer market. They must also plan ahead — using in-house software, applications and systems expertise — to shorten the time-to-market for new design wins.

Business Impact: We expect multitouch-enabled touchscreens or touchpads to be widely adopted in smartphones, media tablets, notebook PCs, all-in-one desktop PCs and portable consumer electronics devices. Multitouch technology has the potential to transform the way consumers interact with the electronics they use every day, enabling totally new input and control mechanisms. As a result, multitouch will impact usage models and have a significant impact on product design. This impact can already be seen in handsets with full-screen devices lacking hardware keypads and buttons. Multitouch could have similar impact in the PC market on traditional keyboard/mouse input devices, especially if the media tablet form factor continues to gain traction.

In five to 10 years, PCs with multitouch capabilities are likely to grow from a negligible percentage of the market to the majority. Although most touch-enabled PCs are shipped for commercial use, the future transformation to multitouch PCs will be led by the consumer market and will be slower in business until touch-based, productivity applications have demonstrated proven benefits. Microsoft may lose significant market share to Apple if the Windows 8 OS does not provide a multitouch user interface on par with Apple iOS and Mac OS X Lion.

Benefit Rating: Transformational

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: 3M Touch Systems; Apple; Atmel Corporation; Cirque; Cypress Semiconductor; Samsung; Synaptics

Recommended Reading: "iPad and Beyond: What the Future of Computing Holds"

"Multitouch Will Be One of the Most Disruptive Technologies of the Decade"

"CES 2012: Multitouch Voice and Gesture Interfaces Combine on Future Devices"

"Competitive Landscape: Touch Controller Market, Worldwide, 2011"

Terrestrial Digital Radio

Analysis By: Thilo Koslowski

Definition: Terrestrial digital radio is the broadcast of digital radio signals. This technology uses the Digital Audio Broadcasting and Digital Radio Mondiale standards (in Europe, Canada and parts of Asia/Pacific), in-band on-channel (called "HD radio" in the U.S., which is used, for example, by Clear Channel Entertainment), and digital multimedia broadcasting (in South Korea and China). Digital radio enables multicasting, and the auto industry is promoting capable radio head units as optional or standard car equipment.

Position and Adoption Speed Justification: Terrestrial digital broadcast radio is offered by most major radio stations. The number of digital radio receiver suppliers continues to increase, and products can be found at regular retail outlets. Automakers, especially in the U.S., are offering factory-installed digital radio options for new vehicles across most models. The technology will continue to mature quickly because of the benefits of digital over analog and the broad adoption by automotive companies.

The question remains as to whether consumers will continue to adopt the technology given new Internet radio choices and improved features for satellite radio. Adoption will also depend on continued support by automakers to offer the technology in their vehicles, as well as content quality to create sufficient market demand. Especially, Internet radio will become an alternative consumer choice and will also create interest among OEMs, which may harm the midterm and long-term adoption of terrestrial digital radio.

User Advice: Leverage digital radio's data capabilities to offer other vehicle-centric information services, such as real-time, on-demand traffic information. Consider using the data capabilities in a broader telematics approach (such as digital radio in combination with a safety- and security-related application). Balance digital radio among other infotainment options based on cost considerations and customer expectations.

Business Impact: Terrestrial digital radio gives automotive companies another source for media content and expands the automotive industry infotainment choices for consumers. The technology can also be used to broadcast certain data (such as weather information) to consumers, which expands the value proposition of traditional radio offerings.

Benefit Rating: Moderate

Market Penetration: More than 50% of target audience

Maturity: Early mainstream

Sample Vendors: Blaupunkt; iBiquity Digital; Panasonic; Sony

Recommended Reading: "German Consumer Vehicle ICT Study: Demand for In-Vehicle Technologies Continues to Evolve"

"U.S. Consumer Demand for Vehicle ICT Expands From the Connected Vehicle to the Connected Driver"

Satellite Digital Radio

Analysis By: Thilo Koslowski

Definition: Home and car systems receive stereo radio broadcasts from subscription satellite services that are available across entire continents. In the U.S. and Canada, many channels are commercial-free.

Position and Adoption Speed Justification: The rate of subscriber growth for satellite radio has improved during 2010 and 2011 as a result of increased car sales, which benefits the Sirius XM Radio OEM business. However, Sirius XM continues to face competition from emerging content services (such as HD radio, the Internet and podcasts) and device offerings (such as music downloads on mobile phones and in-vehicle Internet radio). Sirius XM needs to expand its reach by offering continuous innovation for its service and data offerings (for example, traffic and weather information). It also needs to expand to new device platforms, such as smartphones, beyond its iPhone application. In addition, Sirius XM must secure continued support from its strongest allies, vehicle manufacturers, to compete against Internet radio offerings like Stitcher and Pandora.

Sirius XM's 2.0 platform, which is planned to launch later in 2012, will allow users to pause, rewind or fast-forward through programming that is stored in a buffer. It will also add new programming and provide an electronic programming guide to enable better user engagement. These changes will improve the attractiveness of satellite radio, but competition from Internet radio options remains. Sirius XM's main differentiation is its programming and unique content.

User Advice: Automotive companies must consider Sirius XM's role in long-term product-planning decisions. The company's programming should be assessed independently from its satellite technology infrastructure because the company can offer alternative broadcast solutions (Internet-based). Companies must also collaborate with the satellite radio company to keep dealers updated on any changes regarding the business model or programming/service offerings. Automakers are likely to offer customers the choice between digital satellite radio functionality and Internet radio until reliable wireless networks become available ubiquitously — at which point, Internet radio will become a standard offering.

Business Impact: Satellite digital radio represents a revenue opportunity for vehicle manufacturers and can support a company's telematics offerings (data communications to the vehicle, such as traffic information).

Benefit Rating: Moderate

Market Penetration: More than 50% of target audience

Maturity: Mature mainstream

Sample Vendors: Sirius XM Radio

Recommended Reading: "U.S. Consumer Demand for Vehicle ICT Expands From the Connected Vehicle to the Connected Driver"

"Potential Satellite Radio Merger Is in the Automotive Industry's Interest"

Game Consoles as Media Hubs

Analysis By: Mike McGuire

Definition: Game consoles as media hubs describe the proprietary software applications that, along with broadband connectivity, enable game consoles, with their inherent TV connectivity, to deliver broadband premium content services, including movie, TV and music offerings (such as Netflix and Hulu). The Microsoft Xbox 360 and Sony PlayStation 3 are the leading vendors, while the Nintendo console does support a somewhat limited set of nongaming content. Most content options are delivered on demand, but live TV programming is also available.

Position and Adoption Speed Justification: Game consoles have become fully connected consumer electronics, with the majority of the current-generation consoles being connected to the Internet. The gamer population has moved online, with multiplayer gaming becoming the norm, versus the niche it was when the Xbox 360 and PlayStation 3 were introduced. Gamers are also avid consumers of nongaming content, and they are not the only users in the household that are interested in its delivery. Microsoft and Sony have been increasing the services they offer to include movies, television shows and other services. The positioning of game consoles as media hubs has expanded, as an increasing number of consoles are connected to broadband. Microsoft's Xbox 360 and Sony's PlayStation 3 now offer a robust set of content, ranging from movies via broadband streaming services, such as Netflix and Epix, to the whole slate of TV programming from ESPN. However, these are game consoles at their core that are evolving into a more central role as a "media hub," meaning they can enable access to TV, movie and music content from various over the top (OTT) services that were typically tied to a PC. However, at close to $300 at retail, with additional $100 for a Kinect sensor (for Xbox), game consoles are considerably more than the $100 or less that OTT set-top box (STB) manufacturers are charging. That said, by opening up their platforms for applications from content or service companies, consoles have an expansion capability that OTT STB vendors might be hard-pressed to match.

In 2012, Gartner expects to see Microsoft and Sony, in particular, continue to position these platforms as their platforms of choice in the battle for the "digital living room" with Apple, Google and Amazon, among others. Additionally, long-term strategic bets may also be placed on game-consoles-as-media hubs by some multichannel video programming distributors (MVPDs) considering the creation of so-called "virtual STBs," which can load onto the game consoles, and provide authentication and billing/provisioning capabilities normally handled by a proprietary STB. This content is rapidly migrating toward Internet streaming services, as broadband distribution of content becomes more commonplace in all households. The user interface has been improved on the high-end game consoles, and the variety of content that is available continues to grow. The Wii brought gesture and motion to the controller market and continues to evolve with the upcoming tablet controller. Microsoft and Sony controllers have also evolved with the release of Microsoft's Kinect, which incorporates gesture controls and a camera, and PlayStation Move, which also facilitates gesture controls in the game environment. These controllers will expand in functionality beyond games and into the overall entertainment platform. The installed base is large enough that most media companies see the market as a viable one. Fully featured consoles with significant

onboard or cloud storage options are seeing increased adoption in response to their growing role as media hubs in the home.

Throughout 2011 and into 2012, Microsoft and Sony exchanged a series of announcements focused on nongaming content. From Microsoft's support of multiple online video streaming services, to the development of Kinect-enabled applications that allowed content providers, such as ESPN, to allow consumers to access and consume sports TV programming in new ways, to Sony's launch of its Sony Online Entertainment Network, the product enhancements matched the rhetoric around nongaming content. Microsoft's latest tactic is to offer the Xbox 360 for $99 in exchange for the consumer signing up for a two-year subscription, at $15 per month, to the Xbox Live Gold service.

User Advice: Movie studios, cable networks and others that develop and distribute original video content should view game consoles, as well as their attendant gamer audiences that value games as well as premium content, as a willing and able ecosystem, and as participants in creating new interactive features to increase audience engagement — HBO's work with the "Game of Thrones" and its interactive features, for example — which are enabled via the Xbox 360 and the Kinect sensor. Not all content will be appropriate for such treatment, but serial content that has an affinity with gaming genres is ideal.

Content companies already licensing content to the console manufacturers through aggregators, such as Netflix or Hulu, should explore more aggressive experiments with release windows — for example, more of the premium rental windows. These one-time rentals usually involve a premium over and above a typical movie rental of titles that are either in the theatrical or initial broadcast (of a TV show) windows. As (relatively) secure terminals in a living room, with an integrated store and billing capability, the consoles are alternatives to Apple and Google hardware hegemony in the battle for the connected living room.

Gesture and voice recognition capabilities are at the early stages of deployment for nongaming content, but show potential for creating new ways for consumers to browse, sample and discover content in the growing libraries of online and cloud-based content. Experienced interactive content application developers will be in demand by content companies and MVPDs looking to differentiate content offerings on the consoles.

Business Impact: The business impacts are mainly in incremental distribution market opportunities for media companies. Advertising opportunities — that is, beyond the in-stream advertisements that could come with the content a la Hulu — are uncertain. However, for pay content services, game consoles represent another (relatively) secure distribution point in the connected-device universe, with unique, at least in the near term, interactive capabilities. In particular, content companies can create new demand for premium content subscriptions, providing a distinct set of advantages to programmers that can master such techniques early.

Benefit Rating: Moderate

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: Microsoft; Nintendo; Sony

Entering the Plateau

Bluetooth in Automobiles

Analysis By: Thilo Koslowski

Definition: Bluetooth is a short-range wireless technology that facilitates data exchange between applications, devices and an automobile.

Position and Adoption Speed Justification: Most vehicle manufacturers continue to add Bluetooth to their vehicle lines, including standard-brand automobiles for hands-free telephony, and protocols are being added to increase bandwidth and functionality (for example, for audio streaming). Bluetooth technology continues to have the most significant presence of any short-range communication technology in the automotive industry. Technology advancements have enabled Bluetooth to become capable of streaming media-rich audio and video, which addresses the most significant application scenarios for the automotive industry (streaming audio content from personal music players and re-creating the video content from a mobile-phone-based navigation solution). Interoperability between new Bluetooth-enabled devices and Bluetooth-equipped vehicles continues to be an issue for the automotive industry.

User Advice: Create a flexible connectivity strategy that will be able to accommodate other wireless technologies, if needed. Take advantage of Bluetooth technology as a viable point-to-point communication technology that doesn't require the creation of industrywide standards that have traditionally failed. Design Bluetooth-based applications and integration solutions that ensure data security and minimize power consumption requirements for integrating portable devices in the vehicle. Explore the use of the new Bluetooth protocols in future vehicle releases to enable high-speed wireless data transfers, but evaluate user benefits (for example, video streaming) versus the additional cost and reliability requirements. Establish a focus on Bluetooth protocol management that is intuitive for users and dealers. For example, automate the process of uploading new protocols onto a user's memory stick and of transferring files from the memory stick into the vehicle without a complex menu structure. Version control of Bluetooth protocols and new devices continues to be a satisfaction factor with users and dealers. Consider offering in-vehicle guidance for Bluetooth pairing to help consumers with their device integration (for example, via showing a video on the vehicle's head unit).

Business Impact: Bluetooth accelerates the integration of mobile devices (such as mobile phones) in the vehicle as consumer demand for such applications continues to grow. It enables the automotive industry and others (such as service companies and network providers) to offer low-cost telematics solutions.

Benefit Rating: Moderate

Market Penetration: More than 50% of target audience

Maturity: Early mainstream

Sample Vendors: Broadcom; CSR; Wavecom Solutions

Recommended Reading: "U.S. Consumer Demand for Vehicle ICT Expands From the Connected Vehicle to the Connected Driver"

"Economy Impacts U.S. Consumers' Vehicle ICT Preferences"

"Bluetooth in Automobiles: A Reality Check"

Interactive TV

Analysis By: Andrew Frank; Mike McGuire

Definition: Interactive TV can be defined as television programming (that is, licensed video content professionally produced for a home-viewing audience) made interactive by the addition of overlays or other synchronized signals indicating that a viewer response is enabled (for instance, to vote in a poll, play a game, or indicate interest in an advertised product).

Position and Adoption Speed Justification: This is the last year interactive TV (ITV — not to be confused with the U.K. broadcast network) will appear on Hype Cycles. This change in status is being driven by market and technology forces that threaten to make the current definition obsolete in fundamental ways. First, much of the functionality fueling the promise of ITV — allowing users to respond to programming elements or respond to cues (such as voting) — is actually showing up in second-screen applications utilizing automatic content recognition (ACR) technology. Second, some of the more audience-to-audience interaction usage models and applications are being covered under social TV solutions.

With the growing use of the Internet to deliver TV programming (sometimes referred to as "over-the-top" [OTT] services) to a variety of devices, including connected TVs, Blu-ray players, game consoles, PCs, media tablets and smartphones, there is a parallel universe to the set-top box (STB)-based notion of ITV. The advent of second-screen apps, especially on media tablets and OTT STBs such as Roku or Apple TV, has made this parallel universe even more compelling than the STB-based method for ITV because they directly channel the rich interactivity of the Internet.

For advertisers and marketers, the high value of interactivity is twofold: It is a direct-response mechanism that can lead directly to a sale (often referred to as t-commerce), and it has been proven to significantly increase brand recall, purchase intent and other metrics of high importance to brand marketers. These factors have contributed to the growth of Internet advertising into the second-largest ad medium behind television, although television still has a significant lead overall.

Many of the difficulties multichannel video programming distributors (MVPDs) have had with ITV can be traced to the high cost of replacing consumer premises equipment, combined with 10-year-old decisions to deploy digital STBs whose cost constraints made them nearly obsolete at the time of their deployment (compared with the capabilities of contemporary PCs). In 2001, as the first Internet bubble was bursting and MVPDs were transitioning to digital cable and satellite services, the threat that broadband Internet would soon re-emerge to mount a credible challenge to multichannel digital

TV technologies for delivery of even high-definition TV programming seemed remote to most service providers, who were understandably more focused on near-term economic trade-offs.

The U.S. cable industry has tried to make the most of its base of legacy STBs by developing and deploying Enhanced TV Binary Interchange Format (EBIF), an in-band CableLabs standard for basic interactivity that is currently installed on about 25 million U.S. STBs. In early 2010, Canoe, a joint venture of the six largest U.S. cable companies, launched a request for information (RFI) product that leverages EBIF to provide advertisers with a text overlay to a TV commercial to which viewers can respond with their remotes. Market challenges have forced Canoe to retrench entirely, and it appears EBIF implementations will be surpassed by IP-based second-screen applications.

In Europe and South Korea, Digital Video Broadcasting Multimedia Home Platform (DVB-MHP) is available over the air on at least 20 million STBs, often with a telephone-service-based return path (wired or wireless), while in the U.K., MHEG-5 has been deployed by Freeview (a digital terrestrial TV service reaching 81% of U.K. households as of February 2012) and Freesat (a joint satellite venture between the BBC and ITV), and OpenTV has been deployed by Sky TV satellite service. These deployments offer interactivity, but no return path. To address this, BBC, ITV, Channel 4 and Channel 5 are collaborating on a project called YouView (formerly Project Canvas), which is scheduled to launch sometime in 2012, according to the official YouView site (www.youview.com). These developments suggest that, for these regions, ITV is becoming a reality with less contention than seen in the U.S.

As ACR and "social TV" advance, as embodied in second-screen applications, they will likely surpass efforts of the STB-based ITV contingent to successfully overcome the difficulties inherent in designing compelling interactions based on a standard remote control pointed at a screen about 10 feet away (this is sometimes called the "10-foot interface problem").

For these reasons, Gartner will carefully monitor market and technology developments during 2012, but will likely move ITV to obsolete before the plateau and focus on ACR and social TVs as technologies that will deliver the benefits of interactive TV to consumers, advertisers and TV service providers that ITV could not.

User Advice:

- Service providers also need to focus on multiscreen strategies (TV, PC and mobile) for service bundling, integration and development (or licensing) of second-screen applications to drive true interactive TV experiences and advertising opportunities.
- Manufacturers should resist the temptation to create differentiation on the level of standards implementations that would undermine interoperability, and should seek advantage on the application level instead (such as better support for Internet TV and video device controls).
- Advertisers and ad agencies need to press for control over metrics and reporting standards, and work to ensure full transparency and openness in interactive TV advertising markets, with a particular emphasis on second-screen applications.

- All commercial parties should focus in the near term on partnerships and alliances in the newly forming "ecosystem" for interactive TV services, and hedge their bets on any single technology solution.

Business Impact: TV service providers — multichannel video programming distributors (MVPDs) and online video distributors (OVDs) — have a substantial opportunity to increase their revenue share from advertisers and direct marketers by offering interactive features that can support transactions and consumer engagement. Consumer electronics, middleware and STB vendors face potentially decisive competition over where to strike the right balance between features and cost. TV networks and advertisers, for which DVR-based ad skipping and Internet advertising spending shifts are significant disruptive trends, rely on interactive features, along with more dynamic targeting, to shore up the value of the TV medium to advertisers.

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Sample Vendors: Apple; BBC; Canoe; Ensequence; Ericsson; Google; Intel; Invidi; Microsoft; Nielsen; OpenTV; Rovi; TiVo; Yahoo

Recommended Reading: "New Television Meets Context-Aware Computing"

"A Scenario for the Future of Television in the Cloud"

Netbooks

Analysis By: Annette Jump; Angela McIntyre

Definition: Netbooks are mobile computing devices that have a screen size of five to 10 inches and run a full version of the client OS, such as Windows 7, Windows XP or a Linux PC OS. They have a clamshell form factor.

Position and Adoption Speed Justification: Netbooks are losing popularity among consumers, with sales dropping from 17% of the mobile PC sales in 2010 to only 12% in 2011. The market for netbooks has been challenged in the last 12 months by tablets and a lack of innovation. Ultrabook mobile PC launching in 2H12 will be netbooks' next challenge. Based on that, the position of netbooks on the Hype Cycle has shifted 20% in the last 12 months from trough to pre-plateau. It is very likely that by 2013 netbooks will be out of the Hype Cycle completely, as the hype and innovation moves to other newer devices. Consumers who purchased netbooks may choose to replace them with a media tablet or Ultrabook for better functionality with similar portability.

The low price points of netbooks made them well-suited in the recession, but they did not live up to the performance expectations. In 2008, consumers purchased a netbook at the $499 price point. Now consumers can find a selection of standard notebooks with 15.6-inch screens for less than $500. The main target audience for netbooks has been consumers in mature markets. A total of

24.4 million netbooks were shipped worldwide in 2011. Netbooks' share of mobile PC shipments approached 12% in 2011, down from 17% in 2010. However, netbook appeal still exists in emerging markets, where this device is considered the least expensive "productivity" PC. Mid- to long term, the majority of netbook volume will come from the emerging markets and special education/government projects. Gartner forecasts that netbook shipments will decline in 2012 and will decrease their portion of mobile PC shipments. Netbooks are expected to be only 5% of mobile PCs shipped by 2015.

Consumer purchases drive 85% of netbooks in mature market regions as the second or third PC for the household. Gartner has a strategic planning assumption that by 2012, 20% of netbooks sold in mature markets will be for children 12 years old and younger because of their relatively low price. Consumers looking for bargain prices can find 10-inch netbooks for $269. A major driver of consumer PC purchases is children's education, and netbooks are purchased by parents for their children's use.

User Advice: Netbooks are not a replacement for standard mobile PCs and should be marketed differently. They are primarily a content consumption device and should have features such as enhanced graphics for watching video, as well as a touchscreen and a possible convertible keyboard. The typical uses for netbooks are email, instant messaging, Internet browsing, reading documents, watching video, taking and sending photos, social networking and taking notes in class. The primary consumer purchase drivers for netbooks include a compact and light PC for commuting or travel, children's education and achieving work-life balance. Consumers purchase mini-notebooks for Internet access on the go, especially when they prefer to take notes on a standard keyboard. Netbooks should not be marketed as a primary computer because they are not intended for long periods of typing or manipulating large files. The Intel Atom processors, which are standard for netbooks, give markedly less performance than Intel Core i3 or AMD Llano processors.

To convince buyers to purchase mainstream notebooks with a higher margin, PC vendors and retailers should highlight use limitations of netbooks, such as reduced photo-editing capability or lower performance on high-end video games. The screen resolution for most mini-notebooks is 1024 x 600, which means that most standard Web screens or data forms are truncated at the bottom, leading to users scrolling or toggling back and forth.

To target netbooks for parents purchasing a PC for their school-age children, offer ruggedized designs with options of a carrying case and an extended warranty. Include a camera that pivots for videoconferencing versus taking photos. Include multiple USB ports and a card reader for multimedia. Netbooks with hard-disk drives (HDDs) are preferred for their 120GB to 250GB storage capacity over models with solid-state drives, which have 4GB to 6GB of storage. Bundle with discounts on skins and stickers so children can personalize their netbooks. Offer in mass retailers, such as Walmart and Carrefour, and in consumer electronics stores, such as Best Buy. Link into school fundraising efforts by marketing to parents with brochures provided through the schools. Give a percentage of the revenue to classrooms for orders that parents make through the schools for their children's netbooks.

Business Impact: For PC manufacturers, netbooks are losing their mass-market appeal. The peak of netbook shipments was in 2010. Instead of buying another netbook, most consumers will

purchase a media tablet, a value-based notebook with a 15-inch screen or an ultraportable notebook, such as the Apple Macbook Air or Ultrabook with an 11.6-inch to 14-inch screen size.

Benefit Rating: Low

Market Penetration: 20% to 50% of target audience

Maturity: Mature mainstream

Sample Vendors: Acer; Asus; Dell; HP; Lenovo; Samsung; Toshiba

Premium Communication Devices — Open OS

Analysis By: Carolina Milanesi

Definition: Offering a deeper and richer experience than basic devices, premium devices support rich features and high-quality Internet access. They predominantly use widely deployed operating systems (OSs) like iOS, Android, Windows Phone or BlackBerry OS that have a Software Developer Kit available to assist programmers to write apps using native APIs. This can be supported by a sole vendor or multiple vendors. It can be open source, but does not have to be. They have good connectivity with high data rate connections and typically support Wi-Fi.

Position and Adoption Speed Justification: In mature markets, the shift from feature phones to premium communication devices and open OS continued to accelerate over 2011 as new vendors entered the smartphone area using the Android platform. Chinese vendors such as ZTE and Huawei increased their presence in Western European and North American markets, leveraging relationships with communications service providers and flooding them with cheaper devices than the Tier 1 players. Moreover, while a year ago the quality-of-delivery of these new entrants might have been questioned, it has become clear from more recent announcements that performance is certainly increasing. Strong competition to win market share and drive upgrades is putting pressure on prices, which is bad news for vendors but good news for consumers. This, coupled with more affordable dataplans, has certainly accelerated the shift away from feature phones.

Due to the higher cost of these devices, penetration will remain somewhat limited, with higher relevance in mature markets where consumers have higher disposable income and operators offer generous subsidies. The lower average selling prices in mature markets and the transition to Android that many white box Chinese vendors are making has helped move penetration to over 20% and confirm the early mainstream status of these devices.

User Advice: Devices and OS developers need to continue to innovate on user interfaces so that owners can take full advantage of the capabilities that premium communication devices and open OS have to offer.

OS developers need to continue to invest in building a rich, easy-to-navigate application store with varied purchasing options as applications are at the core of these devices' popularity.

Business Impact: Premium communication devices have already proved popular with enterprise users and will continue to penetrate businesses with or without the approval of IT departments. This increases the security risks and, in many cases, requires a revision of a company's device management policy.

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Sample Vendors: Apple; HTC; Research In Motion (RIM); Samsung

Recommended Reading: "Predicts 2012: The Success of Consumer Devices Will Rest on Delivering the Ultimate Experience"

Blu-ray Devices for Consumers

Analysis By: Hiroyuki Shimizu

Definition: Blu-ray is an optical disc format like CD and DVD. Blu-ray discs can hold more information than other optical media, because of the blue lasers that the disc drives use. A single Blu-ray disc can hold up to 25GB of data. Dual-layer Blu-ray discs will be able to store 50GB of data — equivalent to four hours of HD content. In 2010, the Blu-ray Disc Association (BDA) announced formal specifications for a new Blu-ray disc XL (BDXL) format that boasts a maximum storage capacity of 128GB.

Position and Adoption Speed Justification: The market for Blu-ray drives has entered a stage of fully fledged growth, because the technology has become *the* de facto standard after the demise of the HD DVD format in 2008 — which was followed by an increase in Blu-ray movie releases and the availability of affordable Blu-ray players. To make Blu-ray players appealing to general consumers — other than early adopters and heavy users of home entertainment systems — their unit price needs to fall below $100. Meanwhile, those interested in this market should pay attention to the emergence of video distribution services, such as downloading video on demand from the Internet, or competing platforms such as over-the-top set-top boxes which take advantage of the highly advanced communication environment that will compete with Blu-ray players. In fact, the growth rates for Blu-ray players and Blu-ray recorders have been declining in the consumer market in 2011 and 2012. Gartner forecasts that Blu-ray players will grow 36.0% in 2011 and 18.9% in 2012, and Blu-ray recorders will grow 21.2% in 2011 and decline 11.2% in 2012 due to weak demand in the Japanese market.

Furthermore, when the next generation of video games consoles feature Blu-ray drives they will compete with Blu-ray players. Gartner expects the next generation of games consoles to be released in 2012 or 2013. These will coexist with Blu-ray drives, because consumers will always want to keep a copy of video content such as quality documentaries and classic movies. Blu-ray drives are also entering the PC market as a means to store high-density data, music or video. Because the price of PC Blu-ray drives and the accompanying discs are still higher than those of DVD drives, penetration of Blu-ray into the PC market remains low.

User Advice: Existing Blu-ray drive vendors should prepare for more severe competition with many more vendors, especially the Taiwanese and Chinese players. It is important for vendors to reduce costs, add advanced features, establish a strong strategy and execute on it. Some vendors are already using original design manufacturers/electronics manufacturing service companies for their development and/or manufacturing. Blu-ray player manufacturers should plan on introducing players into the consumer market that are compatible with 4K x 2K image resolution by the end of 2012, to supply the emerging 4K x 2K HDTV displays that are expected to arrive in the market in 4Q12.

Business Impact: Blu-ray will have a limited impact on business. However, Blu-ray drives may be useful in some industries where there is a need to store high volumes of data, video or photos.

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Mature mainstream

Sample Vendors: LG; Panasonic; Samsung Electronics; Sony

Recommended Reading: "Market Trends: Worldwide Blu-ray Player Market Grows Amid Competition, 2011"

Connected Video Game Handhelds

Analysis By: Jon Erensen

Definition: Connected video game handhelds use an embedded WAN digital cellular or Wi-Fi connection to link to services designed to enhance the gaming experience — including online gaming and downloading games and game content, such as new levels and features. The two dominant video game handheld vendors are Nintendo and Sony.

Position and Adoption Speed Justification: The portable consumer electronics market is moving rapidly from traditional products to Internet-connected devices. Video game handhelds have been at the forefront of this transition and have had integrated Wi-Fi since 2004, when the Nintendo DS and the Sony PlayStation Portable (PSP) were introduced with this as a standard feature. In the past year, Nintendo and Sony introduced next-generation video game handhelds with improved connectivity. The Nintendo 3DS has 802.11b/g Wi-Fi capabilities to allow players to exchange game data, download content and to play online. The 3DS can update its operating system, new software and content automatically when connected via Wi-Fi. It can also exchange updated information when in range of other 3DS handhelds. The new Sony PlayStation (PS) Vita is available in two versions, one with Wi-Fi-only for $249 and a version with both Wi-Fi and third generation (3G) digital cellular connections for $299. The PS Vita is the first video game handheld to be available with an optional digital cellular connection. The digital cellular connection can address some of the shortcomings of Wi-Fi, but it comes with the additional cost of a service plan. For example, in the U.S., AT&T offers 250MB for $14.99 or 3GB for $30 with no long-term contract. We expect 3G adoption to be low until consumers are allowed to bundle multiple devices with a single data plan.

Connectivity in video game handhelds has been used primarily for peer-to-peer gaming, online gaming and to download full games and additions to existing games — including new levels and features. It has also been used for limited Web browsing and to download nongaming content; but this has not been the central focus of these systems. Competition from smartphones, media tablets and portable media players, with improved gaming capabilities, has increased significantly. In particular, the rise of Apple's iOS and Google's Android as gaming platforms has shifted the balance of the portable video game market. The installed base of the iOS and Android mobile platforms is growing rapidly and attracting game developers at the expense of the traditional gaming handhelds. This presents a significant challenge, and it will be difficult for the cyclical video game handheld industry, which is based on the introduction of new video game handhelds, to gain momentum at the start of a new generation. The 3DS and the PS Vita are entering a market with a different competitive landscape than the previous-generation Nintendo DS and Sony PSP.

User Advice: Because smartphones have a standard 3G cellular connection, they have certain advantages over dedicated video game handhelds in terms of online gaming and access to content. Consumers are also used to paying for a data plan with smartphones. To compete effectively, video game handheld vendors must develop wireless capabilities and must offer differentiation to provide the best gaming experience. Making use of wireless connections will be critical if this category is to continue to grow.

Business Impact: This category of product will have limited impact on businesses.

Benefit Rating: Moderate

Market Penetration: More than 50% of target audience

Maturity: Mature mainstream

Sample Vendors: Nintendo; Sony

Recommended Reading: "SWOT: Nintendo, Worldwide"

"Market Trends: Gaming Ecosystem, 2011"

Navigation Solutions

Analysis By: Thilo Koslowski

Definition: Satellite navigation systems are based on the Global Positioning System (GPS) and other national and multinational satellite initiatives (for example, Glonass and Galileo) with applications in consumer and commercial markets. Satellite navigation systems are embedded in vehicles, available as portable units (personal navigation devices [PNDs]) or offered as applications in mobile phones, with an internal or external GPS antenna, and can be complemented with cellular tower or Wi-Fi-enabled triangulation (assisted GPS).

Position and Adoption Speed Justification: Market adoption for navigation solutions continues to grow rapidly, primarily as a consequence of increasing consumer demand for navigation applications on mobile devices like smartphones. Embedded satellite navigation solutions, while still

popular in vehicles, are facing competition from portable solutions that are less costly and no longer tie navigation to a single vehicle. This is putting price pressure on vehicle manufacturers and suppliers. Profit margins for traditional PND offerings are decreasing due to increased competition, although overall product demand is still relatively strong. Planned PND products that wirelessly connect to the Internet are needed to protect margins going forward and will provide mobile application opportunities for PND manufacturers. However, mobile-phone-based navigation offerings can also provide such functionality by using consumers' existing data plans. Recent free-of-charge mobile phone navigation offerings by Nokia and Google are intensifying the need for navigation solution providers to define new value propositions that go beyond traditional routing. Innovation areas regarding navigation are centering on improved point-of-interest information (for example, real-time search), addition of social networking aspects and other contextual elements.

User Advice: Vehicle and device manufacturers must reduce prices for embedded and PND navigation solutions to compete with alternative platforms (that is, mobile phones) and market them as part of a complete telematics offering. Seek differentiation via partnerships and collaboration to offer added functionality in the form of dynamic, location-based services (for example, useful traffic information, buddy finders and enabling device integration).

Business Impact: Additional revenue streams are possible, especially with expanded feature sets and the potential integration of telematics services or location-based services that use Internet content (for example, advertising or preferred listings). Navigation offerings are becoming the foundation for more advanced and relevant search, discovery and social networking functions that will be positioned as premium features.

Benefit Rating: Moderate

Market Penetration: More than 50% of target audience

Maturity: Mature mainstream

Sample Vendors: Garmin; Google; Magellan; Navigation Solutions; Nokia; OnStar; TeleNav; Telmap; TomTom

Recommended Reading: "German Consumer Vehicle ICT Study: Demand for In-Vehicle Technologies Continues to Evolve"

"U.S. Consumer Demand for Vehicle ICT Expands From the Connected Vehicle to the Connected Driver"

"Nokia's Ovi Maps Expands LBS Experience in China"

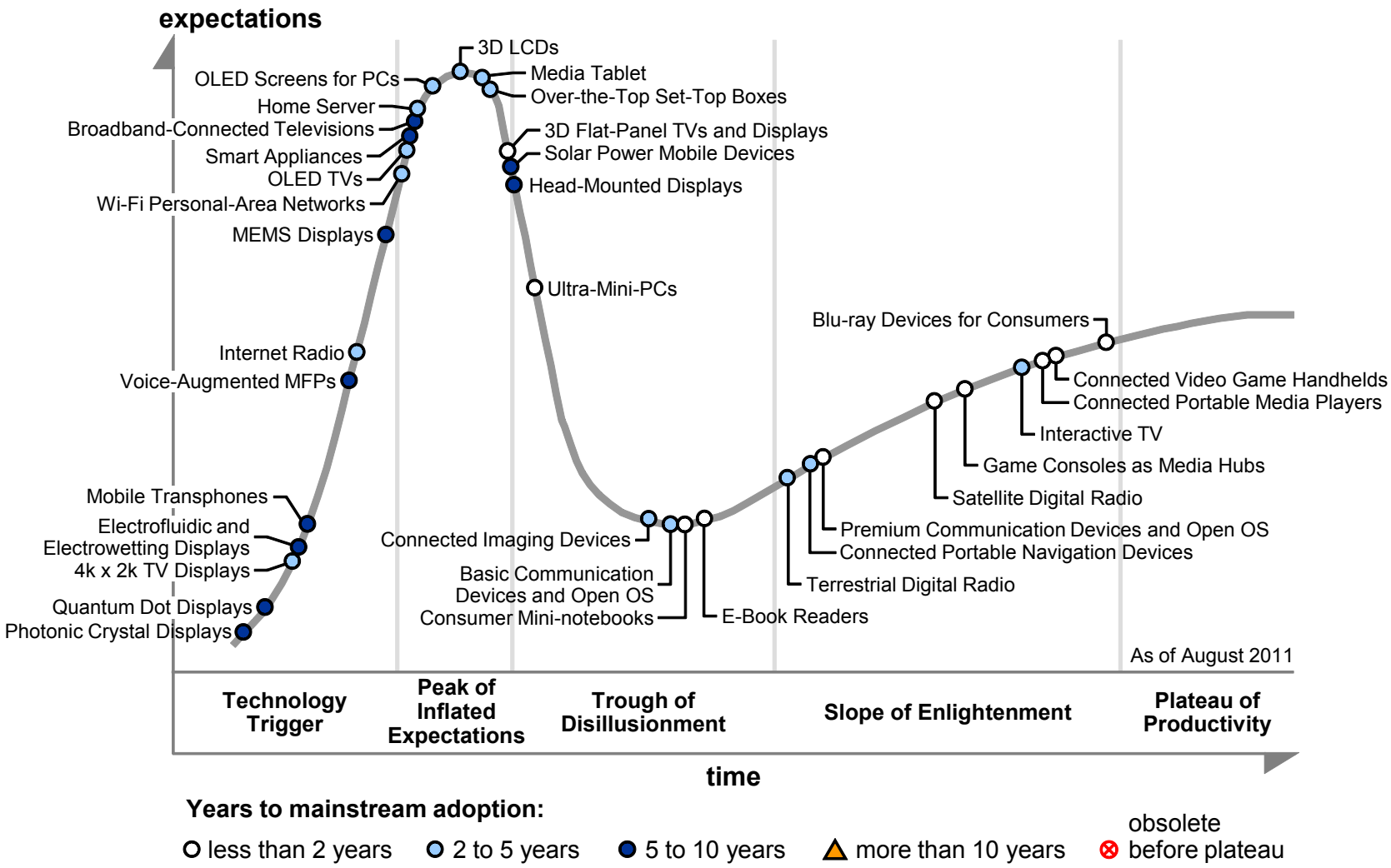
"Google Buzz Shows Navigation's Social Potential"

"Google Creates Navigation Evolution Milestone"

"Vehicle Navigation Must Evolve or Face Commoditization"

Appendixes

Figure 3. Hype Cycle for Consumer Devices, 2011



Source: Gartner (August 2011)

Hype Cycle Phases, Benefit Ratings and Maturity Levels

Table 1. Hype Cycle Phases

Phase	Definition
Technology Trigger	A breakthrough, public demonstration, product launch or other event generates significant press and industry interest.
Peak of Inflated Expectations	During this phase of overenthusiasm and unrealistic projections, a flurry of well-publicized activity by technology leaders results in some successes, but more failures, as the technology is pushed to its limits. The only enterprises making money are conference organizers and magazine publishers.
Trough of Disillusionment	Because the technology does not live up to its overinflated expectations, it rapidly becomes unfashionable. Media interest wanes, except for a few cautionary tales.
Slope of Enlightenment	Focused experimentation and solid hard work by an increasingly diverse range of organizations lead to a true understanding of the technology's applicability, risks and benefits. Commercial off-the-shelf methodologies and tools ease the development process.
Plateau of Productivity	The real-world benefits of the technology are demonstrated and accepted. Tools and methodologies are increasingly stable as they enter their second and third generations. Growing numbers of organizations feel comfortable with the reduced level of risk; the rapid growth phase of adoption begins. Approximately 20% of the technology's target audience has adopted or is adopting the technology as it enters this phase.
Years to Mainstream Adoption	The time required for the technology to reach the Plateau of Productivity.

Source: Gartner (July 2012)

Table 2. Benefit Ratings

Benefit Rating	Definition
Transformational	Enables new ways of doing business across industries that will result in major shifts in industry dynamics
High	Enables new ways of performing horizontal or vertical processes that will result in significantly increased revenue or cost savings for an enterprise
Moderate	Provides incremental improvements to established processes that will result in increased revenue or cost savings for an enterprise
Low	Slightly improves processes (for example, improved user experience) that will be difficult to translate into increased revenue or cost savings

Source: Gartner (July 2012)

Table 3. Maturity Levels

Maturity Level	Status	Products/Vendors
Embryonic	▪ In labs	▪ None
Emerging	▪ Commercialization by vendors Pilots and deployments by industry leaders	▪ First generation High price Much customization
Adolescent	▪ Maturing technology capabilities and process understanding Uptake beyond early adopters	▪ Second generation Less customization
Early mainstream	▪ Proven technology Vendors, technology and adoption rapidly evolving	▪ Third generation More out of box Methodologies
Mature mainstream	▪ Robust technology Not much evolution in vendors or technology	▪ Several dominant vendors
Legacy	▪ Not appropriate for new developments Cost of migration constrains replacement	▪ Maintenance revenue focus
Obsolete	▪ Rarely used	▪ Used/resale market only

Source: Gartner (July 2012)

Recommended Reading

Some documents may not be available as part of your current Gartner subscription.

"Understanding Gartner's Hype Cycles, 2012"

"Hype Cycle for Consumer Technologies, 2012"

"Hype Cycle for Consumer Services and Mobile Applications, 2012"

"Hype Cycle for Media Industry Publishing, 2012"

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