

TECHNOLOGIES TO **watch**



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FIVE TECHNOLOGIES TO WATCH **Introduction****5****The Future is Now**

Digital technology has forever changed the way consumers stay connected, informed and entertained. Our products save fuel, promote health, provide entertainment, allow communications, enable teleworking and drive new business models.

Our industry continues to introduce new technology whether it is the VCR, the DVD, HDTV, the Internet, wireless telephony, digital radio or digital cameras. A whole range of new products from DVD recorders to digital cameras to desktop video editing and production tools, has shifted control of content to consumers.

Consumers have become the new creative community. They can now create, manipulate and distribute content whenever they want – something that was not possible a few years ago. These new products and services also enable brand new business opportunities.

The industry is changing and to help keep you informed of some of the groundbreaking work, *Five Technologies to Watch* highlights five areas that show promise. For the 2006 edition, CEA market research staff selected recordable high-definition content, domestic robotics, the digital home studio, interactive gaming and innovative displays.

Five Technologies to Watch also has a section that looks at the more futuristic work being done in labs such as biometrics, conductive surfaces, holograms, nanotechnology, robotics and wearable computers that influence not only the market but society as well.

The consumer electronics of tomorrow will be even more convenient, more personalized and far more powerful than the products we are familiar with today. Countless technologies which promise to change our lives are on drawing boards, in development labs and in focus groups, waiting to burst into stores everywhere.

For example, fuel cells are poised to make life easier and more environmentally friendly as our electronics begin to run longer on renewable energy. As biometrics spreads, it will make life less anonymous and keep our valuables more secure. Embedded RFID chips will do everything from order our groceries to shorten airport security lines. Finally, nanotechnology, quite possibly the most anticipated emerging technology, will usher in an industry-wide revolution, including the next step in the miniaturization of computer data and processors.

We are part of a booming \$124 billion-plus industry that continually reinvents itself. To learn more about the digital devices that are transforming our lives, I invite you to come to see the hottest digital devices when they are introduced at the International CES on January 5-8, 2006. For more information, visit www.CESweb.org. I hope to see you in Las Vegas!

Gary Shapiro
CEA President and CEO

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THE IMPACT OF RECORDABLE **High-Definition Content**

Before the VCR first emerged on the consumer electronics landscape in 1977, consumers were constrained by “appointment television”. If you missed a show when it aired, you were out of luck. Consumers were at the mercy of broadcast networks.

In a glorious revolution that marked the beginning of the modern CE industry, the VCR liberated consumers from TV bondage. Although TV networks worried about a decrease in the number of eyeballs watching advertisements (and a consequential loss in revenue), their doomsday predictions never materialized.

Because of the VCR, and its ability to time-shift and place-shift content viewing, new industries were born, including movie rentals and pre-recorded VHS tape sales. In 1996, 20 years after the introduction of the VCR the lucrative video rental business generated revenues of \$7.7 billion, according to the Video Software Dealers Association (VSDA).

The once competing interests of consumers and content creators on the battleground of home video reached a peaceful stability in the late 1980s then through the dawn of the 21st century.

Indeed, 20 years after the first VCR was sold, a new innovation hit the street. The first DVD player was purchased in 1997, and

A NEW AGE IS ABOUT TO DAWN WITH THE WIDESPREAD ABILITY TO RECEIVE AND RECORD HD CONTENT AT HOME.

the home video market went through another, even faster, evolution. Consumers lapped up this new technology because of its vastly improved picture and sound capabilities compared to VHS tapes, increased ease-of-use and added content and special features. Quick adoption by consumers also was stoked by the DVD’s resemblance to the CD; the DVD was not a radically new concept. Studios were quick to make content available on DVD, and, by 2004, the video sale and rental market had more than tripled \$24 billion, according to VSDA. The DVD, as the

When Products Were Sold in the U.S.	
Year	Product
1977	First VHS VCR
1997	First DVD player
1998	First high-definition television (HDTV)
1999	First digital video recorder (DVR)
2004	First high-definition (HD) DVRs
2004	First portable HD recordable device, using MiniDV tape
2005	First high-definition DVD player/recorder

Source: CEA Market Research

VCR before it, had proven its appeal to consumers and its value to the content industry.

Soon after the emergence of the DVD came a rapid succession of new home video technologies that have set the stage for the next evolution in home video viewing and recording. The most important of these is high-definition television (HDTV). HDTV is now in 15 percent of U.S. households and poised to surge even faster due to increasing consumer awareness, increasing HD content and federal mandates regarding inte-

gration of digital tuners in TV sets and conversion of broadcast analog signals to digital.

DVD is now in more than 75 percent of U.S. households, and HD recording via DVD is just around the corner. Another new entrant to the home video recording scene, the digital video recorder (DVR), finally is making inroads in both cable and satellite markets as household penetration is nearing one-in-ten, and HD recording capabilities in these devices is starting to become a driver.

A new age is about to dawn with the widespread ability to receive and record HD content at home.

How will the ability to record high-definition content, the next rung on the home video evolutionary ladder, affect the home recording industry?

It is no surprise as soon as HDTVs hit the market, industry players were fast at work designing the next generation of recording devices to store and playback video content. Several competing options have emerged.

Blu-ray Disc

Blu-ray, also known as Blu-ray Disc (BD) is the name of a next-generation optical disc format first developed by Sony, and now officially supported by the Blu-ray Disc Association (BDA), which includes Apple, Dell, Hitachi, HP, JVC, LG, Mitsubishi, Panasonic, Pioneer, Philips, Samsung, Sharp, TDK and Thomson. Several movie studios and broadcast networks also support this format including Sony Pictures, Disney, Miramax, Touchstone, MGM and ESPN.

This allows data to be packed more tightly and stored in less space, so it's possible to fit more data on the disc even though it's the same size as current CDs/DVDs.

Blu-ray supports direct recording of MPEG-2 used by digital broadcasts, which makes it compatible with global standards for digital TV. This means HDTV broadcasts can be recorded directly to the disc without any quality loss or extra processing. To handle the increased amount of data required for HD, Blu-ray employs a 36-Mbps data transfer rate, which is more than enough to record and playback HDTV recordings while maintaining the original picture quality. In addition, by fully utilizing an optical disc's random access features, it's possible to playback video on a disc while simultaneously recording HD video.

The good news for consumers is that Blu-ray devices are completely backward-compatible with existing DVDs. One potential downside, however, is the cost to produce Blu-ray discs is likely to be higher (at least initially) than HD DVD discs (a competing format), due to the need to build new production lines. HD DVDs on the other hand can be produced with existing DVD media manufacturing equipment.

THE GOOD NEWS FOR CONSUMERS IS THAT BLU-RAY DEVICES ARE COMPLETELY BACKWARD-COMPATIBLE WITH EXISTING DVDS.

A single-layer Blu-ray Disc can hold 25 gigabytes (GB), which can be used to record more than two hours of HD programming or more than 13 hours of standard-definition (SD) programming. There are also dual-layer versions of the discs that can hold 50 GB and record more than four hours of HD material and 26 hours of standard-definition TV (think whole seasons of programming on one disc).

While current optical disc technologies use a "fatter" red laser to read and write data, the new format uses a blue-violet laser instead. The benefit of using a "skinny" blue-violet laser is that it has a shorter wavelength than a red laser, which makes it possible to focus the laser spot with even greater precision.

HD DVD

HD DVD is another next-generation optical disc format developed by Toshiba and NEC, and is supported by Sanyo and (recently) Microsoft. In addition, four major studios support HD DVD: New Line Cinema, Paramount Pictures, Warner Brothers and Universal Studios. This standard also officially is supported by the DVD Forum, an organization composed of more than 220 companies.

While the current storage capacity of an HD DVD is smaller than a Blu-ray disc (15-GB and 30-GB HD DVDs vs. 25-GB and 50-GB Blu-ray discs), Toshiba recently announced devel-

opment of a 45-GB HD DVD. Thus, while there are competing claims about the amount of content each format can hold, this likely will be a moot issue.

HD DVD uses the same blue laser as does Blu-ray, so, nothing different there.

HD DVD also supports the direct recording of MPEG-2 used by digital broadcasts and the 36-Mbps data transfer rate, same as Blu-ray. It also supports playback of next-generation MPEG-4, as does Blu-ray.

One slight hiccup is minor modifications need to be made to the HD DVD optical components in order to be completely backward-compatible with existing DVDs. It is almost certain manufacturers will make these modifications to ensure success and not alienate consumers with extensive DVD libraries.

HD DVR

Because of the high-profile public relations war between the Blu-ray and HD DVD camps, little attention has been paid to the high-definition digital video recorder (HD DVR). HD DVRs are simply hard drive-based devices capable of recording and playing back HD content. Unlike Blu-ray and HD DVD, no removable media is needed; everything takes place inside the “black box”. HD DVRs and/or cable or satellite set-top boxes can be in a stand-alone device or part of a home computer.

HD DVRs currently are sold or rented by both satellite providers, Dish Network and DirecTV, as well as by at least one major cable operator, Cox Communications. TiVo, a supplier of software for the DirecTV boxes, also is working to develop the software for Comcast’s new DVR, (it is unclear whether this will support HD recording), and likely will produce its own branded HD DVR box in the next year or two, based on public statements by company officials.

One of the limitations of both Blu-ray and HD DVD is the storage capacity of the disc. HD DVRs do not face the same type of constraint since hard disk drive (HDD) storage is constantly increasing and becoming less expensive. DirecTV has a 250-GB box that can record up to 30 hours of HD. Plus, con-

sumers will be able to archive programs onto external hard drives or media center PCs, freeing room on the HD DVR.

With the popularity of TiVo and similar devices growing, it is logical to consider whether consumers will forego “shiny discs” altogether.

Why not record your HD programs onto a hard drive and watch them whenever you like with the same features (pause, rewind, etc.) that Blu-ray and HD DVD players allow? In the same vein, why not have HD movies streamed on-demand to your HD DVR? It is quite possible the format war between the Blu-ray and HD DVD camp could become a footnote in electronics history if HD DVRs take off.

The Real Difference in the Three Recording Options

From an engineering standpoint, Blu-ray and HD DVD are two totally different formats. However, to the consumer, there really is no difference. Other than the content available in each format. It is likely that whoever has the most compelling content will be the victor. On the other hand, there is a huge difference between the HD DVR and the disc formats. The discs are portable; the HD DVR content will not be easily portable for some time to come.

Currently, there is not much desire among consumers to move their recorded video content from device to device, unlike their insatiable desire to move audio content. However, this could change. In fact, some companies already are rolling out software to make the movement of video content possible. TiVo is one player with its TiVoToGo™ software, and Microsoft is in the mix by enabling TiVoToGo on Windows-based portable media players. Both of these companies are making it possible to transfer video files from the TV or PC to laptops and other portable devices. It remains to be seen if this application will resonate with consumers.

In the end, the ideal situation for the consumer, and for com-

pany profits all around, is for the HD DVD camp and the Blu-ray camp to come together with cross-compatible devices that are backward-compatible with existing DVDs and for the HD disc-based recorder to be combined with HD DVRs. In the end, consumers will want to watch TV and movies when they want, where they want and on the device of their choosing.

People Who Say Their Next TV Will Definitely Be an HDTV	
Year	Percentage of People
2005	21%
2003	12%
2001	8%
1999	12%

Source: CEA Market Research

Will Consumers Record and View HD Content?

The number of HDTV owners is growing quickly and currently stands at about 15 percent of U.S. households. While HDTV households are still a minority, all the data points to consumers soon clamoring for HDTV recordability.

1. Consumers want HDTV. According to the latest CEA Market Research (*HDTV Update*, March 2005), nearly half (47 percent) of all consumers polled said their next TV definitely or probably will be an HDTV. Among those who say they are likely to buy a TV in the next year, that figure rises to 55 percent. These figures are the highest on record in more than eight years of HDTV research by CEA. In addition, sales of HDTV units have taken off. In 2004, just fewer than 7 million HDTV displays were sold to retailers, and 2005 should see this number shoot up to nearly 11 million sets (roughly 45 percent of all TV sets that will be sold). By year's end, more than 20 percent of households will have an HDTV.

2. Consumers now are recording using DVD recorders and DVRs. According to research conducted by CEA in 2002, 41 percent of all consumers recorded television programs at least once a month using a VCR. And this was before the DVR and DVD recorders started making significant inroads. In addition, recent research by CEA reveals that 72 percent of consumers believe it is important to be able to record TV programs to watch at a later time.

Household penetration of VCRs is in decline. In 2000, 95 percent of U.S. households owned a VCR, but as of 2005, the figure has slipped to 88 percent. This decline will accelerate as current VCRs age and are replaced by DVD players. In fact, CEA predicts that by 2008, fewer than 1 million VCRs will be sold at retail compared to more than 14 million DVD players.

Interest in Recording HD Programming	
	Percentage of People
Onto a DVD	51%
On a DVR	47%

Source: CEA Market Research

At the same time as VCR households are declining, DVD recorders are finding their way into more households. In 2004, fewer than 900,000 units were sold, however, this year sales should reach 1.8 million and leap to 3 million in 2006. This upward trend will continue.

In addition, around 9 million U.S. households now have a DVR. And this number is growing. In 2004, 1.6 million units were sold, 2005 should see a 100 percent increase over that number, and 2006 will double again to 6.5 million units being sold, mostly to first-time buyers. These figures don't include the set-top boxes that will be rented by cable operators.

Bottom line: As consumers continue to record TV programs that are increasingly in high-definition, they will replace VCRs with DVD recorders and DVRs capable of recording in HD.

Barriers to HD Recording

Even though conditions are ripe for HD recording, there are three potential barriers. The first two are the most serious threats, while the last is not a significant cause for concern.

1. A Format War

HD DVD and Blu-ray are two competing formats, just as VHS and Beta were competing formats in the early 1980s. Some have argued the 1980s format war was responsible for the slow

however, disagreements ensued as to which format was better and talks broke down. By July, each side had released its own study concluding that it would be the winner among consumers, setting up the specter of renewed bickering. So, stay tuned.

2. Copy Protection

Probably the single largest worry among content owners and distributors of digital entertainment, especially high-definition entertainment, is the specter of copyright infringement. This also was the case when the VCR first hit the market. The difference now, however, is that a digital copy is just as good as the original, which was not the case with the VCR. Content creators and distributors will not put digital content in the mass market that is not protected from copyright infringement.

BOTTOM LINE: AS CONSUMERS CONTINUE TO RECORD PROGRAMS THAT ARE INCREASINGLY IN HIGH-DEFINITION, THEY WILL REPLACE VCRS WITH DVD RECORDERS AND DVRs CAPABLE OF RECORDING IN HD.

rise of home recording. Home recording of HD content could be slow to catch on if another format war ensues.

Of greatest concern if a format war breaks out is that studios will not release titles because of concern about which format consumers will adopt. Consumers will not adopt either format because of a lack of content. This spiral will create an impasse, and HD recording will stall. This would harm all industry parties involved and deny consumers a product they desire.

Whether a format war will occur is still up in the air. Early this year, each side was gathering backers and positioning itself as the ordained format. Now, each side has an impressive array of backers, quite literally splitting the industry in half.

During the spring and early summer of 2005, each side made overtures to the other and appeared headed for a *détente*. In fact, the presidents of Sony and Toshiba met to mend fences and agreed in principle on reaching interoperability. Once the talks began among the engineers and others on the front lines,

Consumers, on the other hand, must be satisfied they will retain their traditional home recording “fair use” rights.

In an attempt to satisfy both concerns, a copy protection mechanism was created: High-bandwidth Digital Content Protection (HDCP).

HDCP was designed by Intel Corp. to protect digital audio and video content as it passes through digital visual interface (DVI) or high-definition multimedia interface (HDMI) connections. The Federal Communications Commission (FCC) approved HDCP as a copy protection mechanism in August 2004. At that time it also required that as of July 1, 2005, any digital output for an HD signal have a copy protection mechanism.

Bottom line, HDCP (or something like it) now is required in all HDTVs. One thing that may strike the ire of consumers is that HDCP bans any analog outputs from compliant products. So consumers cannot make an analog copy of a digital pro-

gram. However, this also may be what spurs consumer demand for ways to make copies of HD content (meaning consumers will turn to HD DVRs and HD recordable discs).

In addition to the protection of signals, copy protected discs also are likely to emerge with both the HD DVD and Blu-ray disc formats. In fact, it already has been reported that HD DVD will integrate a secure system developed by Advanced Access Content System License Administrator (AACSLA).

As long as consumers can make recordings and copies for personal uses, these copy protection mechanisms should work in the marketplace. However, if too many restrictions are put upon consumers (e.g. they are unable to transfer recording to other devices), there will be a backlash which could delay successful adoption of HD recording. In addition, if consumers easily can hack this copy protection system (it already has been

With PPV, content distributors still have a lock on what consumers can see and when they can see it. Plus, unless you have a DVR, you cannot pause the movie or rewind it. Video on demand, however, is having an entire library of content from which to select and to watch when you want. Coupled with DVR technology, this definitely has the potential to replace any type of recordable disc. Being able to sit down at your TV, scrolling through a list of movies and television programs in HD, and selecting the one you want to watch will appeal to consumers.

However, recent research by CEA shows that VOD will not replace the shiny disc, despite the seemingly logical appeal. A plurality of consumers would prefer to own a movie on DVD rather than rent it or access it through VOD services. Even renting movies is preferred at nearly the same rate as VOD.

Apparently, consumers desire to have tangible evidence of ownership or usage rights, even if they only watch the movie once or twice. Being able to hold the disc in hand is a strong attraction. While this paradigm may one day change, it will take time as consumers' values are slow to evolve. Thus, VOD will remain a niche for some time.

Which is Most Appealing if the Yearly Cost is Equal	
	Percentage of People
Own Movies on DVD	43%
Pay a Monthly Fee for VOD	24%
Rent Movies on DVD	19%
Not Sure	13%

Source: CEA Market Research

demonstrated how HDCP can be hacked), then content distributors will be hesitant to roll out recordable HD programs.

Bottom line: Copy protection is a tricky issue that still has not been resolved fully.

3. Video on Demand

Video on demand (VOD) should not be confused with pay-per-view (PPV). PPV is what cable and satellite operators widely offer today. Consumers can select from a defined, and limited, set of movies or events to watch at certain start times.

The Perfect Storm

It is clear as more consumers buy HDTVs, and more HD content is available through broadcast, cable, and satellite providers, people will want to record HD programming. DVR and DVD recorder sales bears witness to consumer's willingness and desire to upgrade recording technologies as they become available. Combined unit sales of the two technologies will reach 4.4 million in 2005, equal to the existing installed base.

In addition to actual sales data, in a CEA survey, one-third (32 percent) of consumers said it was important that they be able to record HD programming once they adopt the technology. Consumer research data points to a bright future for HD recording, if potential barriers are overcome.

Robotics



Consumer electronics entertain, inform and connect us, but technology has not eliminated, or even made easier, most mundane household chores. Despite the technological advances of the last 20 years, most people still load and unload their dishwasher, washing machine, trashcans and lawnmower bag just as their parents did. Household appliances continue to improve, but they are not offloading any additional chores.

Some say the dark age of human domestic toil is nearing its end. Others believe that the robotic butler and android maid will live only in science fiction. The reality is somewhere between these two extremes. Where are we going and how much longer before we get there? The answers might surprise you.

History

In the late 1930s, Westinghouse introduced Elektro, a 300-pound humanoid walking, talking robot during the World's Fair in New York. By 1965, the first industrial robot from Unimation worked on a General Motors production line, and artificial intelligence labs at the Massachusetts Institute of Technology, Stanford University and the University of Edinburgh were in full swing. The 1970s saw the introduction of Cincinnati Milacron's T3, the first commercially available minicomputer-controlled industrial robot and the use of robotic arms on the Viking space probes.

During the 1980s, computer processor power began to catch up with the robotics industry which had broken into three distinct fields:

- Academic or exploratory robots serve as test subjects for labs. Some are flung into deep space while others sing and dance to entertain executives at tradeshows.
- Industrial robots work tirelessly to do the jobs deemed too dull, dirty or dangerous for humans. From building cars to busting bunkers, these robots perform a specific task with unflinching accuracy until the work, the required resources or the robot itself has been consumed.

- Embedded robots provide the mechanical brawn for a computerized brain. Often built into larger machines, these robots monitor and react to a number of variables exponentially faster than humans. From sorting mail to flying air and spacecraft, these robots turn knowledge into action at the speed of light.

By 2004, NASA/JPL's Voyager and Sojourner programs had produced robots that successfully had explored the Martian surface and the solar system. But for all their scientific, commercial and domestic achievements, it was one seemingly simple trick that reignited public interest in robot research. Ten years after Carnegie Mellon University created the six-legged Ambler walking robot, Honda Motors' Asimo android was created.

Honda first developed an autonomous bipedal android in 1986. Twelve years of research by 30 engineers produced the first walking prototype (P1) in 1993. A 6'2", 386-pound box on legs, P1 wasn't anyone's dream date, but it overcame the fundamental stumbling blocks to bipedal locomotion. P1 could balance itself, stand and walk.

Two hundred man-years and \$105 million later, P2 emerged two inches shorter and 74 pounds heavier than its predecessor. The additional weight and expense brought with it the ability to climb stairs, but it still looked like a walking toaster. However it could kneel and stand without losing its balance. Asimo is the refined version of the third prototype.

By 2003, Asimo could understand human gestures and spoken commands and was capable of rudimentary social interaction. When approached, it offered to shake hands. If told to follow someone, it quietly complied. If told to deliver a message, Asimo could use facial recognition to ensure the message was delivered to the intended recipient. By 2004, Honda had built 30 Asimo robots and was renting them for \$18,200 a day or \$175,500 a year.

Current Landscape

Robotics became mechanical during the industrial age, but they still relied on human manipulation for their instruction. These remotely manipulated devices became tools of telemedi-

cine, hazardous material handling, surveillance, exploration and movie animatronics. From the mechanical shark in the movie *Jaws* and the “battle bots” of TV’s *Robot Wars*, to the remotely operated vehicles (ROV) used to explore the wreckage of the *Titanic* and the Chernobyl nuclear power plant, remote control (RC) tools and toys lack the autonomy to be called robots.

Today, a robot is defined as a mechanical device that can detect its environment, make decisions based on sensory information and execute a physical operation as a result of its decision. In other words, robots are machines that logically and physically respond to environmental variables. An android robot resembles the human form and stands on two feet, but upright bipedal motion is not a requirement of modern robotics.

Robots already have infiltrated most aspects of our lives. Our homes’ thermostats control furnaces and air conditioners based on temperature and scheduling information. Cars constantly adjust their ignition and mixture settings based on driving and environmental conditions. Even the humble refrigerator can detect an empty ice bin and make more ice. From the Space Shuttle to the VCR, robots do their jobs for us every day.

Despite their sophistication and reliability, most household robots are about as exciting as the tasks they were designed to perform. Consumers don’t refer to even the smartest refrigerator as “him” nor are they entertained by the intelligence of their dishwasher. Advances in appliance sensory and control technologies have improved the products but have not changed the user’s experience fundamentally. It has been almost a generation since a product has emerged to relieve consumers of a household chore.

Honda’s Asimo proves that the android is a viable robotic platform, but at more than \$18,000 per day, it won’t be mopping floors. For a domestic robot to achieve mass-market appeal, it must be relatively inexpensive – on par with other labor saving consumer appliances – reliable and effective enough to be trusted with a household chore. Enter the iRobot Roomba that frees its owner from having to vacuum for only \$200. By 2004, this robotic vacuum was quietly hunting dust bunnies in half a million homes, only two years after its debut.

Survey Says

To determine the next household chore that might fall victim to the robot invasion, CEA surveyed consumers as to their least favorite domestic activities and the amount of time spent doing them. Surprisingly the most time consuming chores were not the most hated. For example, respondents reported spending an average of 2.31 hours cooking meals each week, but cooking ranked 9th on the list of their most hated chores. Conversely, consumers reported spending less than one hour per week cleaning the bathroom, but ranked it as their least favorite household task with 69 percent saying they hated the chore.

Multiplying consumers’ distain for a chore by the amount of time they spend doing it yields a score that is weighted toward tasks that are tedious and time-consuming. Doing laundry for example, ranked relatively low in terms of unpleasantness (7th) but was the second most time consuming, costing consumers nearly two (1.88) hours each week. Doing dishes, cleaning the kitchen, cleaning the bathroom and mowing the yard rounded out the top five most unpleasant and time-consuming chores.

The Top Ten Dreaded Chores
Cleaning the kitchen
Cleaning the bathroom
Washing dishes
Dusting
Doing laundry
Mowing the yard
Vacuuming
Taking out the trash
Cooking
Adjusting windows

Source: CEA Market Research

Dividing (rather than multiplying) consumers' distain for housework by the amount of time they spend doing it yields a score that is equalized over time. This shows how the chores would rank if they all required the same amount of time to complete. For example, if taking out the trash took as much time as doing laundry, trash would be consumers' most hated chore and laundry would fall to tenth place.

Averaging all of the rankings creates a murky but interesting

TODAY, A ROBOT IS DEFINED AS A MECHANICAL DEVICE THAN CAN DETECT ITS ENVIRONMENT, MAKE DECISIONS BASED ON SENSORY INFORMATION AND EXECUTE A PHYSICAL OPERATION AS A RESULT IF ITS DECISION.

picture of which chores consumers would most like to relegate to a domestic robot. The dirty and wet jobs like cleaning the kitchen (1) bathroom (2) and dishes (3) rank highest across the lists while choosing what to watch (11) turning lights on and off (12) adjusting the temperature (13) and selecting music (14) rank consistently low. Dusting (4) laundry (5) mowing (6) vacuuming (7) trash (8) cooking (9) and adjusting windows and window treatments (10) round out the top ten most disliked chores.

Survey respondents report spending an average of 15.37 hours per week on the 14 chores. Assuming that a domestic employee was being paid in accordance with the U.S. Federal Government minimum hourly wage of \$5.15, it would cost \$12,348.26 to have the chores done during a period of three years.

Performing household chores calls for a range of abilities found collectively only in humans. Today's technology simply cannot produce a robot that can match a human's flexibility, mobility and dexterity at any price. Even the most advanced of today's robots could not negotiate stairs holding a laundry basket or cook dinner. However, assigning groups of similar tasks to purpose-built or specialized robots may provide an intermediate step until the personal android becomes reality.

ScrubBot

A scrubbing robot might look like a scaled-down version of the robotic arms found assembling cars in automated factories. ScrubBot could plant itself in the center of the kitchen and use a liquid cleanser and rotating brush to gently scrub the countertops, sink and appliances before switching to the squeegee attachment to clean the glass surfaces. After selecting the mop head attachment and repositioning itself in the doorway,

ScrubBot could mop the kitchen floor and stand guard until it is dry. The same skills could be applied to cleaning the bathroom, dusting the house, washing the car and even window washing. It would cost \$2,345.92 to pay someone minimum wage to do these chores for three years. At that price a ScrubBot suddenly seems reasonable.

GoferBot

A smaller, more mobile robot might use a less dexterous robotic arm to collect the clutter of the day in a large onboard bin. GoferBot could begin its day by collecting clothes from around the house, sorting them by color and loading them into the washing machine. After transferring the final load into the dryer, (folding and ironing is probably too much for such a simple domestic appliance) GoferBot could collect dishes and load them into the dishwasher. GoferBot could patrol the house, collect trash and reposition anything that is out of place. Finally, GoferBot would report to ScrubBot to have its bin cleaned before returning to its charging station to await the family's return.

When the house is occupied, GoferBot would change from maid to butler mode and would make itself available to shuttle objects and messages around the house until after dinner when it would bus the dishes into the kitchen and place them in the

dishwasher. At minimum wage, the dishes, laundry and trash alone would cost \$3,028.81 over three years. But the value of sending your robot to fetch beers for you and your guests during a playoff game is immeasurable.

Embedded SoftBot

Manual labor is not the only work associated with running a household. Turning lights on and off, opening and closing

Internet agents lack the muscle required to manipulate objects in the physical world. All brain and no brawn, most software agents lack the physical capabilities that would otherwise qualify them as robots. However, employing personal agents to manage information, content and systems from inside of a home network effectively turns the entire dwelling into a robot. With their embedded computers making decisions and physically managing their complex operational systems, the space shuttle, the cruise missile and the modern jetliner, are shining examples of embedded, large scale robotics. Linking a home's

OR A DOMESTIC ROBOT TO ACHIEVE MASS-MARKET APPEAL, IT MUST BE RELATIVELY INEXPENSIVE - ON PAR WITH OTHER LABOR SAVING CONSUMER APPLIANCES - RELIABLE AND EFFECTIVE ENOUGH TO BE TRUSTED WITH A HOUSEHOLD CHORE.

windows and blinds, adjusting the temperature, selecting music and picking television programs accounts for \$3,414.15 worth of time over three years. While consumers do not mind spending their time on these chores, the proliferation of content streaming to and around networked homes easily could become unmanageable.

The overwhelming volume of video and audio content available to consumers necessitates smarter content management features across all products. Also, the increasing importance of home security and energy efficiency makes intelligent home system integration an important aspect of running a modern household. Coordination of, and human interaction with, a home's systems and content could be handled by another non-traditional form of software robot.

In Internet terminology, a robot generally refers to a self-running software "agent" that acts as a person's representative on a network. Commonly used to scout the best price for a given product among Internet retailers or to buy and sell stocks based on set of user-defined criteria, software agents can execute complex instructions in the virtual world on their owner's behalf.

security, HVAC, A/V, telephone and computer systems easily could bring the same functionality down to Earth for consumer use.

A benefit of personal software agents is that each family member can have a virtual robot follow them around the house and even to the car and the office. For example, my agent might be a caricature of Albert Einstein that pops up on my computer screen. "I found a source for the trim you needed to finish restoring the Chevelle," Albert might say from a small window on the screen. "Shall I order it for you?" "Later" I might say. "Did I get any messages?" "One voicemail from your sister. Shall I put you through to her? She is online at the moment." "No" I might respond. "Remind me to call her in an hour and show me the highlights of yesterday's race."

When I move to the living room couch, the race highlights leave the computer screen and reappear on the television. Albert could adjust the room temperature, lights and window shades to my preferred settings. "The fridge was left open last night so you might need to replace the milk. Shall I add it to this week's shopping list" Albert might ask from the TV screen. "Sure, now leave me alone for a while," I might respond.

Another agent in the form of popular kids cartoon star Jimmy Neutron might pop up on the screen next to Albert when my son entered the room. “Dad’s agent told me to tell you to do your homework before watching TV”, Jimmy might say to my son who reluctantly would head to his room. Jimmy would be waiting on his computer screen in his room and would have muted the phone and adjusted the lights already.

Case Studies

An infotainment robot requires access to a home’s systems, but it does not have to remain locked in a virtual world.

Companion or entertainment robots are among the most popular consumer robotics.

Sony AIBO

The ERS-7M2 is the latest AIBO® “robotic pet alternative” that has improved visual pattern recognition, organic touch-sensor technology, wireless LAN connectivity and sound quality, according to Sony.

In autonomous mode, the ERS-7M2 walks more fluidly, plays soccer with its Pink Ball, plays with its AIBOne (a plastic dog bone), sits, lies down, rights itself, self-charges and pays special attention to three different owners. Using a PC and wireless network (IEEE 802.11b) with AIBO Entertainment Player PC based software; consumers can control ERS-7M2 remotely while viewing the world through AIBO’s camera.

House-sitting mode allows consumers to record normal or time-elapsd video from AIBO while away from home. In Player mode, AIBO plays music (audio CD, MP3, WMA, WAV and Internet radio) as a dancing speaker.

AIBO’s visual pattern recognition technology lets it memorize and link any visual pattern to any music or actions. For example, if shown a CD cover, AIBO can play that music wirelessly. In scheduler, AIBO synchronizes with Microsoft Outlook to remind users of their appointments. The AIBO EYES function allows users to wirelessly view pictures AIBO takes and send e-mail commands to have AIBO play pre-recorded messages and songs to others at home. For an MSRP of \$1,999.99, AIBO

provides countless home entertainment, management and security benefits without the slobber and fur-shedding associated with biological dogs.

WowWee Robosapien

Based on the science of applied biomorphic robotics, WowWee bills Robosapien as the first affordable humanoid robot.

Robosapien boasts dynamic two-speed walking and turning, full-function arms with two types of grippers and 67 pre-programmed functions including pick-up, throw, kick, dance, kung-fu, fart, belch and rap.

Robosapien can perform up to 84 program steps including programmable “reflexes” to sound and touch stimuli. Robosapien’s impressive technology and \$99 MSRP won designer Mark Tilden and WowWee several awards and made it one of the most hard-to-find Christmas gifts of 2004.

WowWee Ltd., a privately-owned company based in Hong Kong, and Tilden are working on Robosapien V2. This taller model, rumored to debut in December for \$200, will feature the ability to pick up, drop and throw objects, bend over and twist from side to side, sit, lie down and stand up. It also comes equipped with an infra-red radar vision, and blue LED lights to detect obstacles, track movements and take objects that are handed to him. Mini Robosapien, Roboraptor and Robopet are in the works as well.

Trajectory and Impact

Robots remain a staple of science fiction, usually representing a dark and distant future when robots evolve to oppress human beings or vice-versa. This stems largely from the widely held perception that the emergence of the human-like android will signal the start of a robot invasion.

But the invasion is well underway and already has yielded great benefits to humanity. Robots fly planes, maintain spacecraft, explore the solar system and patrol oceans. They build cars, make computers and sequence DNA in factories and laboratories worldwide.

At home, robots wash our clothes, clean our dishes, heat our homes and protect our property. Many domestic robots are hidden inside large durable appliances on which we depend each day. These robots are as dull as their jobs and are taken completely for granted. But a number of developments have conspired to draw them out of their metallic shells.

1. Research and development into environmental sensing and interpretation technology has given machines the ability to recognize everything from people's moods and spoken commands to overheated in-wall wiring and dirty dishwasher.
2. Moore's Law on the exponential increase of computing capability has provided enough raw processor power to run complex recognition, navigation and artificial intelligence software quickly and efficiently.
3. Advanced servos, motors and mechanical actuators, coupled with strong, lightweight and precisely machined support components, can create synthetic musculoskeletal structures capable of fast, accurate and fluid motion.

Robotic technology has evolved so machines can sense, reason and physically react well enough to be of use around the house. The domestic robot likely will be sold as a household appliance or as an accessory to a suite of appliances.

Small robots that exist simply to load and unload the washer, dryer, dishwasher, refrigerator and trash compactor would provide significant and demonstrable value to consumers.

Homeowners who have invested between \$1,500 and \$7,500 or

tens of thousands invested in a home's fixtures and furnishings over three years.

Even a software agent robot would earn more than its cost in maximizing a family's investment in audio, video and computer hardware, software and services.

This year, when CEA asked consumers how long they thought it would be before they could buy or rent a mobile domestic robot to accomplish their most hated chore, 57 percent of consumers surveyed expected to own a domestic robot within the next ten years. Is the robot they expect in ten years already on its way? Will 2005 be the first year since the advent of the dishwasher that consumers can say, "I bought it so I didn't have to do that chore anymore?" Only the engineers inside the world's electronics companies know for sure, but the odds that robots will arrive sooner than expected look promising.

57 PERCENT OF CONSUMERS SURVEYED EXPECTED TO OWN A DOMESTIC ROBOT WITHIN THE NEXT TEN YEARS.

more in their household appliances are unlikely to balk at the cost of a domestic robot if it would perform \$1,000 worth of minimum wage manual labor each year.

A robot that carefully scrubs kitchens, bathrooms, cars, floors and windows could be sold as a power tool that performs more than \$3,000 worth of maintenance necessary to protect the

DIGITAL **Home Studio**

“**E**verything that is really great and inspiring is created by the individual who can labor in freedom”, wrote Albert Einstein in 1950. Applying Einstein’s wisdom to the 21st century suggests we are on the cusp of a new era of great and inspiring content resulting from expanding technological freedoms. The rise of consumer technologies, such as digital cameras, digital camcorders, powerful and inexpensive personal computers and software, broadband, and a host of other products and services have laid the foundation for aspiring amateur photographers, filmmakers, musicians and artists to flex their creative muscles.

Consumers have numerous options to purchase, use, interact with, move, store, manipulate and customize content (e.g., audio, video, games, communication and data and images). While those activities will certainly continue and grow, the next phase of the digital age will be the growth of individual content creation also known as do-it-yourself (DIY) content creation that already is becoming well established.

Terms like blogging and podcasting entered the collective lexicon with amazing speed. Low budget DIY films such as *Open Water*, shot with digital camcorders and edited using an off-the-shelf Apple Mac played in theaters nationwide and generated millions in ticket sales. Amateur comedians, calling themselves *Jib Jab*, with minimal technical knowledge released multiple Flash-based online spoofs of presidential candidates, generating millions of downloads and earning them interest from corporate powerhouses such as Anheuser-Busch. Individuals mix and remix songs that get played in clubs during iPod DJ nights. And, the list goes on and on.

While many of these examples exceed the aspirations of most individuals, they serve as an early indicator of things to come. Certainly, not everything created will be considered “great and inspiring” by the masses. However, beauty is in the eye of the beholder, and individuals may now turn to affordable cameras and camcorders, powerful multimedia computers, and fast Internet connections to create and share robust family videos, digital scrapbooks, multimedia presentations of vacation photos and online photo albums with music and narration, just to

name a few examples. Many signs point to an explosion in DIY content creation.

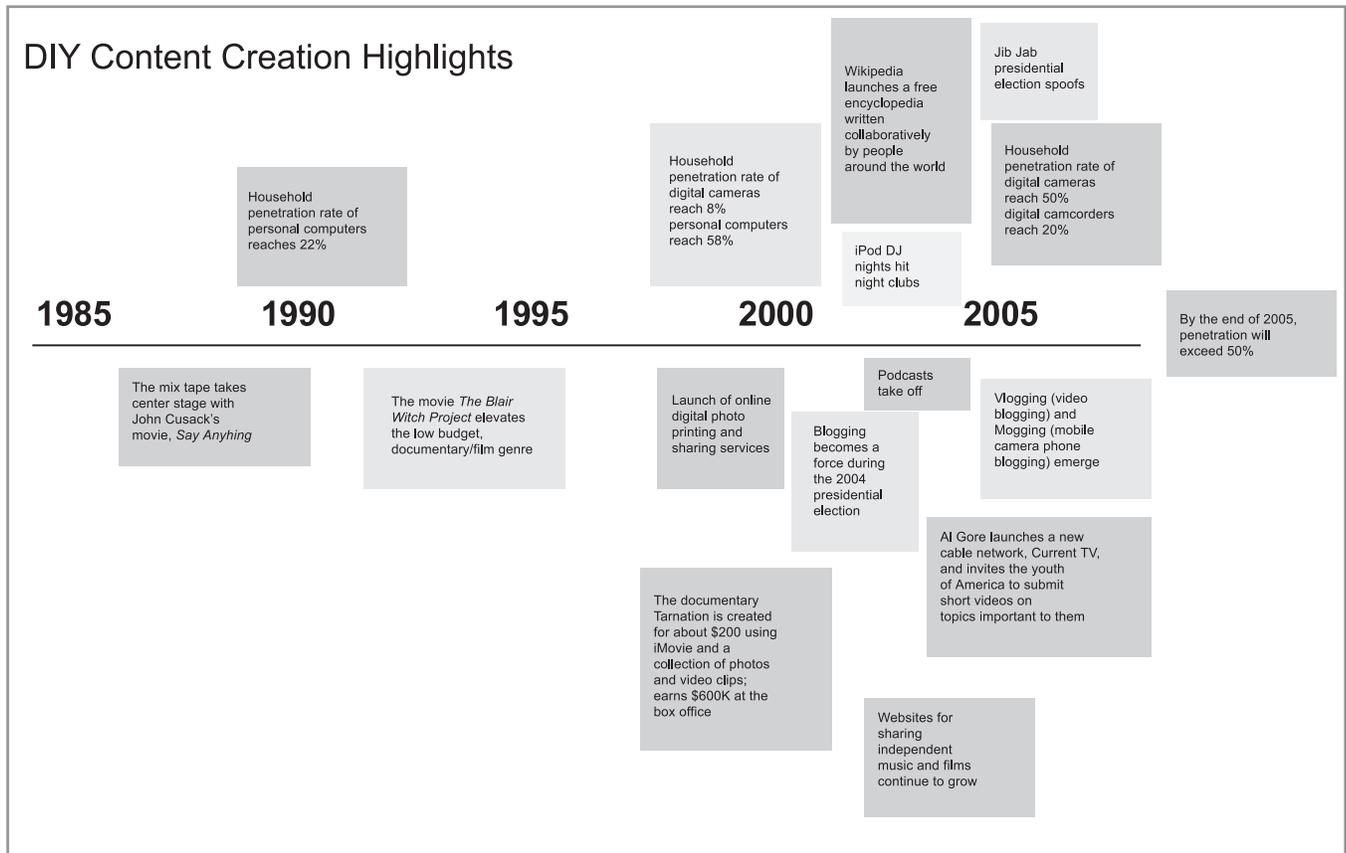
Defining the Market

This section of *Five Technologies to Watch* explores the many issues associated with DIY content, primarily on the consumer, meaning those creating content for their own use to share with friends and family members. In some cases, this means “prosumers,” the segment of individuals independently producing content with the hope of generating revenue, recognition or some other types of benefits. This segment still falls into the amateur category, but at a higher level than consumers.

What is DIY content? The concept doesn’t lend itself to a neat definition. Because it covers many areas, DIY content can be defined only in broad terms. For the purposes of this report, DIY content is defined as the amateur (consumer or prosumer) using various inputs such as digital photos, video, music and voice to produce a unique output. Simply snapping digital photos and printing them on a home color printer does not qualify as DIY content. Taking those same digital photos and editing, cropping and adding background music to a slideshow does qualify as DIY content creation.

Generally, DIY content requires building on a single input (e.g., digital photo) with additional edits or layers to create a new output. While this report concentrates primarily on digital audio and video, other forms of expression certainly qualify as DIY content. Activities such as podcasting, blogging and vlogging also fall under the umbrella of DIY content.

Serious market dollars are at stake. In 2005, consumers will spend about \$14 billion on digital cameras, digital camcorders, printers, PCs and software to engage in DIY content creation. This represents about one third of the total sales for these products. Add in auxiliary services such as online printing services and blank media (DVDs, miniDV tapes, etc.), and the current total DIY market is substantial.



Source: CEA Market Research

Consumer Perspectives

A July 2005 CEA Market Research survey confirms consumers engage in various DIY activities. Two-thirds of consumers transferred digital photos to a PC for storage, editing or printing in the past 12 months. The majority of these transfers involve photos taken with a digital camera, where 89 percent of owners moved photos to a PC for storage, editing or printing.

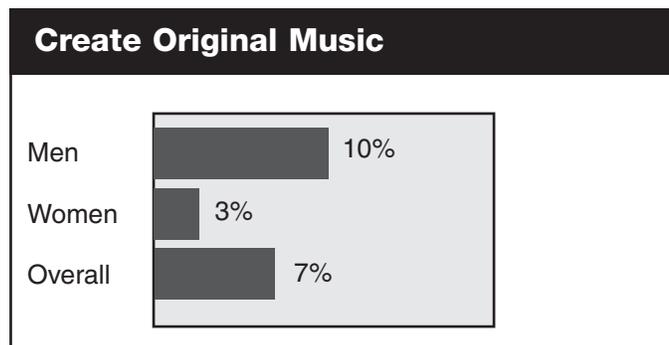
Sixteen percent of owners of a device with video capture capability, such as a camcorder, digital camera or wireless phone, transferred this file type to a PC for storage, editing or printing in the past 12 months. Digital camcorder owners were even more active with transfers increasing to 35 percent.

Consumers can choose from multiple software options when

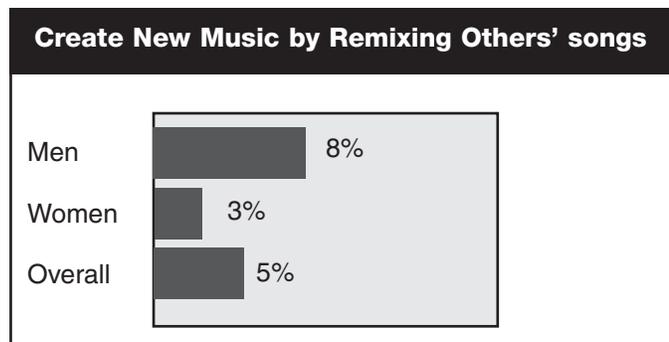
working with their media files, ranging from specialty applications designed for a specific purpose, to all-in-one applications designed for ease-of-use. For digital photos, a slight majority of consumers (57 percent) rely on software that came with the device, but the alternative also is important, with 36 percent of consumers using another application they purchased or downloaded or something that came with their computer. Software usage for manipulating and managing moving video follows a similar pattern. Forty-four percent of consumers transferring video files to their PC rely on the software package that came with their camcorder or other device used to capture video. The remaining consumers use a different application (32 percent) or are unsure (24 percent).

Software Used for DIY Content Creation	
Applications Used to Edit/Manage Digital Photos	Applications Used to Edit/Manage Digital Video
Other / unknown	Other / unknown
Kodak EasyShare	Apple iMovie
Adobe application	Sony application
Microsoft application	Kodak application
HP application	Adobe application
Olympus Camedia	Microsoft Moviemaker
Canon application	HP application
Apple iPhoto	Ulead
Dell Picture Studio	Pinnacle

Source: CEA Market Research
rank order by estimated market share



Source: CEA Market Research



Source: CEA Market Research

Several demographic factors provide additional insight into consumers' behavior. The data shows the arrival of children in a household often drives purchases of digital cameras, digital camcorders and other products to capture and share memories. Among online households, 70 percent with children under the age of 18 own a digital camera, compared to 58 percent of non-child households. For digital camcorders, the rates are 31 percent and 16 percent, respectively. When it comes to engaging in DIY content creation, the utilization rates among kid households and non-kid households converge. The fact that few differences exist suggests households with kids face time shortages, which limits the content creation process.

Gender and age are other telling variables. In terms of product ownership, females and males own digital cameras, digital camcorders, personal computers and many other technologies at near identical rates. Some differences emerge when analyzing product usage behaviors. CEA research confirms that females assume primary responsibility for recording the family's memories. Women are 82 percent more likely than men to strongly agree with the statement "I love taking pictures." And perhaps as a result, 33 percent of women strongly agree they are the primary photographer for the household, compared with only 25 percent of men.

Males and females engage in content creation at similar rates. The data suggests females are proportionally more interested in pictures while men are more interested in video. When editing digital photos or video, males are slightly more likely to use a third-party software application.

The product ownership profile of different ages follows a flattened bell shape curve. Those at the tails, ages 18-24 or 55+ have lower ownership rates of many products, likely stemming from financial constraints or lack of need (no kids or empty nesters). The middle age ranges, 25-34, 35-44, or 45-54 generally have similar ownership rates. Content creation seems to peak with the 25 to 44 age range.

Using a self-selecting method of determining product adoption status, the market segments into three major categories:

DIY Content Creation Activities Consumers Have Engaged in During Past 12 Months

Activity	Digital Camera Owners	Digital Camcorder Owners
Edited a digital photo (e.g., removed red eye, cropped, adjusted the brightness, etc.)	61%	60%
Created a slideshow of digital photos	42	50
Added special effects to photos or video	21	22
Digital scrapbook	20	22
Added background music to a slideshow of digital photos	14	21
Created a DVD of moving video to watch using a DVD player and a TV	12	24
Edited moving video (e.g., pulled highlight clips, etc.)	9	20
Added background music to moving video	8	16
Created any type of movie (e.g., documentary, film short, full length, etc.)	6	11
Created interactive family trees (using digital photos, video, etc.)	5	8
Created music videos	3	7
Added voice-over to a video	3	5

Source: CEA Market Research

- Early adopters comprising about 24 percent of the market,
- Mass adopters comprising about 40 percent, and
- Late adopters comprising about 35 percent.

As expected, the early adoption segment owns more products and engages in more advanced DIY content creation activities. For example, early adopters are twice as likely as late adopters to own a digital camcorder and four times more likely to edit video on a computer. For the activities below, it's worth noting early adopter behaviors are very similar to mass adopters, which indicates that while early adopters invest more in products, content creation is still an emerging market for all segments of consumers. Another explanation – owning product doesn't necessarily correspond to having the time or creativity to use them.

The magnitude of the difference between what consumers are doing currently and what they are interested in doing reveals

the activities most likely to experience a drastic increase in the future. For example, only 5 percent of digital camcorder owners have added voice-overs to their video, yet 39 percent express interest in this activity. This 34 percent difference indicates substantial pent-up demand for this activity.

As penetration rates of input devices (e.g., digital cameras) rise, so does the potential market for DIY content creation activities. Within three years, it's expected digital cameras will reach a household penetration rate exceeding 70 percent. For digital camcorders, the penetration rate likely will exceed 33 percent.

Many will engage in DIY content creation, but not at the same rates as current early adopters. Research also shows mid- to late-adopters are typically less tech savvy.

Activities Most Likely To Experience Strong Growth *(in rank order)*

Among Digital Camcorder Owners

1. Add voice-over to a video
2. Create interactive family trees
3. Add background music to moving video
4. Create a DVD of moving video to watch using a DVD player and a TV
5. Add special effects to photos or video

Among Digital Camera Owners

1. Create interactive family trees
2. Create a DVD of moving video to watch using a DVD player and a TV
3. Add background music to moving video
4. Add background music to a slideshow of digital photos

Source: CEA Market Research

Business, Strategic and Legislative Issues

The research indicates the majority of consumers purchase electronics products to satisfy a basic need first and foremost. For example, families purchase a digital camera or digital camcorder to record memories. Consequently, DIY content creation will not be a primary sales volume driver. However, eager DIYers, while a smaller market by the numbers, certainly spend higher dollars for better equipment (i.e., faster processors, more advanced software and higher quality resolutions). Bryon Acohidio of USA Today wrote in April 2005, “do-it-yourselfers have emerged as an economic force that big tech suppliers and giant media companies must reckon with. They help fuel demand for new computers, peripherals and multimedia production software, and typically are the first to try out the latest,

Sample of DIY Content Creation Activities Consumers Want To Do*

“Create a 2006 calendar with family pictures.”

“Create a family network/newsletter that shares family pics/videos.”

“Create complete genealogical history with narrative and photos where possible.”

“Create videos, with photos inserted, that I could edit (such as cutting people in, adding people, changing light, deleting red-eye) with music and/or voice-over, that could be e-mailed and viewed by anyone, without need for a special program.”

“Edit photos and print them with proper flesh tones and colors.”

“Have a simple process to burn to DVD. Most picture-to-DVD software programs are complex and do not perform correctly (i.e. video is choppy, will not play, etc.)”

“It would be nice to be able to write something about the photo in the very bottom edge so that it would print but not cover any of the photos.”

* *in consumers' own words*

Source: CEA Market Research

camcorders, audio recording gear and playback devices.”

In a July 2005 survey to the CEA CE Advisory Panel, a group of industry executives ranked the DIY content business opportunity as a “hold.” Panelists chose to allocate their hypothetical resources toward other technologies such as VoIP, new display technologies (e.g., OLED), and new channels of distribution for video/television content (e.g., cell phones). Can hardware and software manufacturers find significant new revenue opportunities in the DIY content creation market? Or, will the net increase for hardware and software companies be negligible? Will other industry players benefit, such as services to help in sharing, creating or printing?

Consumer Interest* in DIY Content Creation Activities		
Activity	Digital Camera Owners	Digital Camcorder Owners
Edit a digital photo (e.g., removed red eye, cropped, adjusted the brightness, etc.)	68%	71%
Create a slideshow of digital photos	51	55
Add special effects to photos or video	42	49
Create a scrapbook	35	40
Add background music to a slideshow of digital photos	37	46
Create a DVD of moving video to watch using a DVD player and a TV	37	52
Edit moving video (e.g., pulled highlight clips, etc.)	32	46
Add background music to moving video	33	45
Create any type of movie (e.g., documentary, film short, full length, etc.)	25	33
Create interactive family trees (using digital photos, video, etc.)	32	39
Create music videos	18	26
Add voice-over to a video	24	39

Source: CEA Market Research

*Interested + Very interested

Consumer Interest* in DIY Content Creation Activities by Product Adoption Status			
Activity	Early Adopter	Mass Adopter	Late Adopter
Edit a digital photo (e.g., removed red eye, cropped, adjusted the brightness, etc.)	66%	58%	59%
Create a slideshow of digital photos	44	45	32
Add special effects to photos or video	28	20	15
Create a scrapbook	21	21	13
Add background music to a slideshow of digital photos	19	13	9
Create a DVD of moving video to watch using a DVD player and a TV	20	14	6
Edit moving video (e.g., pulled highlight clips, etc.)	14	10	4
Add background music to moving video	20	14	6
Create any type of movie (e.g., documentary, film short, full length, etc.)	9	8	2
Create interactive family trees (using digital photos, video, etc.)	7	4	3
Create music videos	6	2	2
Add voice-over to a video	6	2	3

Source: CEA Market Research

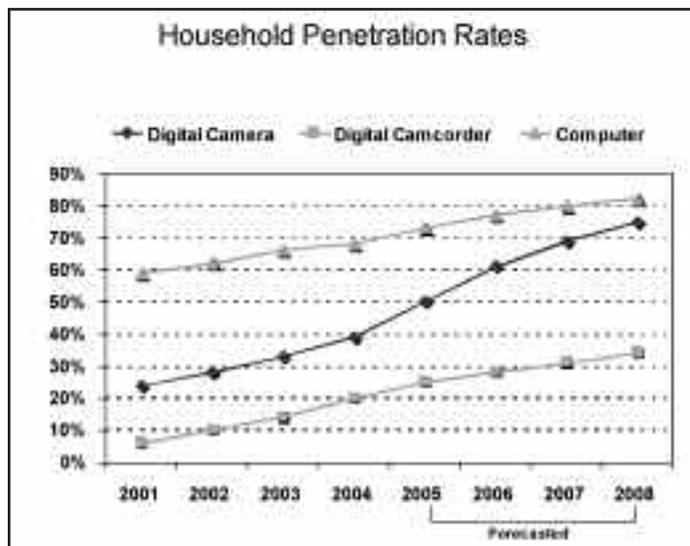
*Interested + Very interested

Potential Size of DIY Content Creation Activities		
Activity	Digital Camera Households Potentially Engaging in Activity /Millions of HH	Digital Camcorder Owners Households Potentially Engaging in Activity /Millions of HH
Edit a digital photo (e.g., removed red eye, cropped, adjusted the brightness, etc.)	37.7	19.7
Create a slideshow of digital photos	28.3	15.3
Add special effects to photos or video	23.3	13.6
Create a digital scrapbook	19.4	11.1
Add background music to a slideshow of digital photos	20.5	12.8
Create a DVD of moving video to watch using a DVD player and a TV	20.5	14.4
Edit moving video (e.g., pulled highlight clips, etc.)	17.8	12.8
Add background music to moving video	18.3	12.5
Create any type of movie (e.g., documentary, film short, full length, etc.)	13.9	9.2
Create interactive family trees (using digital photos, video, etc.)	17.8	10.8
Create music videos	10	7.2
Add voice-over to a video	13.3	10.8

Source: CEA Market Research

Forecasted Unit Sales of Digital Cameras and Digital Camcorders		
Year	Digital Cameras Millions of units	Digital Camcorders Millions of units
2005	23,125	3,665
2006	25,188	4,160
2007	26,420	4,692
2008	26,903	5,021

Source: CEA Market Research



Source: CEA Market Research

MOVIE MADNESS...

DIYERS COULD PRODUCE 9.2 MILLION MOVIES E.G., DOCUMENTARY, FILM SHORT, OR FEATURE LENGTH OVER THE NEXT FEW YEARS. TO PUT THAT ESTIMATE IN CONTEXT, THE FIGURE EXCEEDS THE EXPECTED TOTAL NUMBER OF COMMERCIAL FILMS PRODUCED IN THE U.S. OVER THE SAME PERIOD.

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Key Challenges that May Inhibit DIY Content Creation Growth

(Consumers response to “describe your greatest challenge”)

1. Limited Time

“It is very time intensive and I have to constantly undo to change settings.”

“Having to stop and read the book repeatedly to find instructions for what I am trying to accomplish.”

“I don’t have the time to study the book and learn how to do some of the specialized techniques like making a movie of camcorder pictures.”

2. Cost of Hardware, Software and Services

“I have very few needs that would only be met by purchasing an even more expensive A/V editor.”

“Lack of RAM in my desktop computer, I cannot work with as many images and such at the same time.”

“The software I use now isn’t robust; it’s just typical generic software, which adds more steps to editing and creating.”

3. Learning Curve

“Getting the time of the music to the time of the picture change.”

“Have a hard time removing the red eye out of photo and cropping photos.”

“I am still learning how to be creative. I want to add more to my CD photo album, but I don’t know how.”

“Transferring the digital photos so they can be watched on TV instead of the computer has been beyond my abilities”

4. Technical Challenges

“One, I would like to get some of the equipment (e.g., digital camera) necessary to do some of these things. Two, I would like an easier way to share these family memories through e-mail. Too many relatives can’t open or clearly see/hear files that

are too large or that were created with a competitor’s software, or sent from a rival e-mail provider.”

The prosumer segment faces the same three challenges, but in addition, they must contend with the difficulty of an uncertain return on investment (ROI) for their time. The prosumer engages in DIY content creation with some expectation of a return, which may or may not be monetary. Creating quality film shorts, vlogs or podcasts requires significant time and resources. Although more avenues are available to share created works with the world, competition is fierce.

Many prosumers attempt to take advantage of the Long Tail phenomenon. This concept was coined by Chris Anderson in an October 2004 *Wired* article to describe a business model where a percentage of sales are concentrated in a few titles (or products) and the remaining sales are distributed among many titles.

Alternatively, companies can make money from selling a limited supply of big hits and also from selling relatively few copies of many titles. This business model works when distribution and inventory costs are low, the case for many online retailers. This is good news for prosumers, because the model permits new entrants the opportunity to test the market, formerly impossible with traditional distribution channels.

Key Business Challenges That May Inhibit DIY Content Creation Growth

1. Proprietary, closed systems: Consumers expect to be able to mix and match products, services and file formats.

Consumers will tolerate a certain level of proprietary, closed system, but too much and the product/service may struggle.

2. Complex, difficult to use hardware and/or software: It is apparent consumers struggle with even the most basic tasks. Consumers tell of frustrations with hardware devices packed with features seldom used, computers that don’t recognize devices, and clumsy and confusing software. The answer is not to dumb down everything, but rather create products targeted for different levels of consumers and products that do a few things really well.

3. Debilitating and/or confusing copyright rules: Suppose an individual purchases a single song at iTunes or some other music site. The individual uses the song as background music for a slideshow of digital photos taken during his daughter's birthday party. The slideshow is posted on a website so out-of-town family members can view. Has a law been broken? Consumers and prosumers creating new content for personal or limited release must navigate these types of tricky copyright situations. Even without investing in a legal opinion and/or paying music licensing fees, simply trying to understand the relevant copyright issues can be prohibitively expensive for the amateur DIYer.

Consumers want to share their created content. Will the recent Grokster case dampen development of peer-to-peer networks that provide consumers a mechanism for sharing created content? It's too soon to tell.

4. Small Pipes Limit the Movement of Content: Consumers create content to share. While physical media is convenient for sharing content locally, it is less than optimal when seeking to share created content across large distances.

New Digital Opportunities

Digital cameras, digital camcorders, powerful PC's and software, broadband, and various other devices and services are opening a new world for aspiring amateur photographers, filmmakers, musicians and artists to flex their creative muscles. Digital content creation is a definite area to watch.

Distribution Channels for DIYers

For DIYers wanting to share the fruits of their labor, many websites provide a distribution channel.

Sample of Distribution Channels for DIYers

Music	Film	Digital Photos
CD Baby.com	BuyIndies.com	KodakEasyShare.com
PureVolume.com	NetMusic.com	Shutterbug.com
GarageBand.com	IndieFlix.com	Shutterfly.com
Live365.com		Snapfish.com
Amazon.com		

Source: CEA Market Research

GET YOUR **Game On**

5

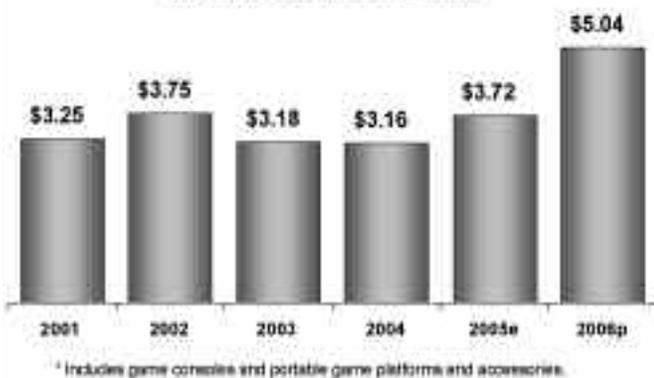
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Don't underestimate the importance of video games to the consumer electronics (CE) industry. During its 30-year history, the videogame business has developed into a rich and dynamic component of the greater CE world.

Where is the action in today's videogame arena? What are the future opportunities for fun and profit? The next generation of home gaming consoles promises to be an even more lucrative market.

Electronic Gaming Hardware *

Shipment Revenues in Billions



Source: CEA Market Research

Building Momentum

The genesis of the videogame business in the early 1970s was a collection of home game platforms (like the Atari 2600) complemented by an assortment of puzzle and sports handheld and tabletop game units (like Merlin and Microvision). The debut of the Apple I, TRS-80 and Commodore PET home computers in 1976-77 ushered in a new phase of PC-based gaming. In the 1980s, the PC platform hastily rose to prominence in the videogame industry. But in the past few years, in-home and portable game consoles have mounted a challenge to the PC's supremacy in the videogame arena.

The swift pace of technology innovation along with consumers' insatiable appetite for entertainment steadily grew the

videogame industry into the multi-billion dollar business it is today. And CEA foresees continued growth in the future.

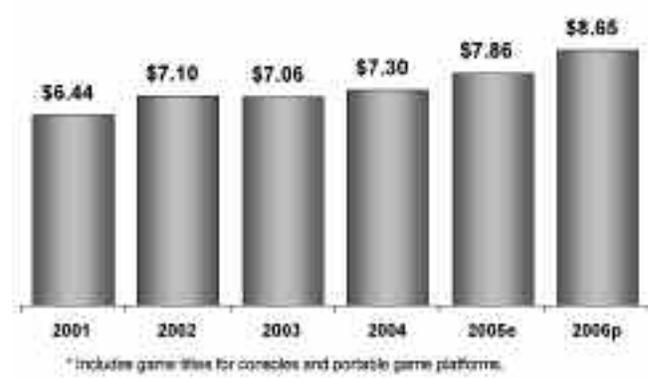
For example, shipment revenues of consoles and portable game platforms are expected to increase 18 percent to \$3.7 billion in 2005. But the highly anticipated availability of next-generation videogame consoles in 2006 should drive shipment dollars above the \$5 billion mark. But revenue growth is only part of the story.

The PC gaming platform has developed into a multi-billion dollar industry of its own, with companies like Alienware designing and building computer systems tailor-made for PC gaming. The gaming craze also has spawned new segments such as PDA gaming decks like the Tapwave Zodiac and cell phone gaming platforms like the Nokia NGage.

While development and growth of the videogame hardware business is impressive, the content (i.e. games) is the life blood of this industry, and the shipment revenues prove it. In the console and portable game deck arena alone, wholesale game revenues are expected to top \$7.8 billion this year, increasing 10 percent to more than \$8.6 billion in 2006. CEA estimates PC game shipment revenues will be close to \$1.2 billion in 2005.

Electronic Gaming Software *

Shipment Revenues in Billions



Source: CEA Market Research

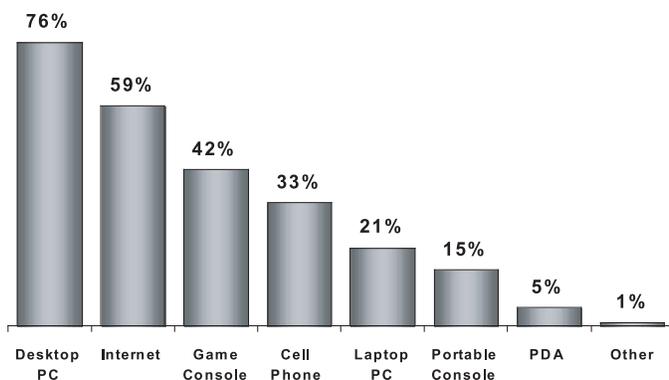
However, even as consumers spend billions on gaming hardware and software each year, the emergence of new game platforms, sales channels and services suggests the industry still has not fully tapped the spending limits of the game buyer. These are some of the opportunities that lie ahead, making the gaming category one to watch.

Playing Video Games Today

Recent CEA market research measuring gaming activities during the past three months shows most video gaming is done in the home, either on a PC, the Internet or a console system. The most popular platform for portable gaming is, not surprisingly, the cell phone. Apart from this almost ubiquitous mobile device, other portable gaming platforms are market niches.

This summer some 75 percent of online adults played a game on their PC and 59 percent played an Internet game. But while PC and Internet gaming seem the most popular platform for playing videogames, not all players are paying money to play. These gamers may play games bundled with an operating system or play free, downloaded or online-only games. So it is difficult to quantify the contribution of these platforms to total game spending.

Gaming Activity – Summer 2005



Source: CEA Market Research

Game consoles offer a more definitive picture of game spending since this platform requires purchasing a specific console and the games to play on it. Some 42 percent of online adults played a console game this past summer.

CEA's *2005 CE Ownership and Market Potential* study found 42 percent of U.S. households now own a videogame console, up from 35 percent in 2004. This growth is a clear sign of the popularity of game console platform systems like Microsoft's Xbox and Sony's Playstation 2. The study also shows households with a console gaming system presently own an average of 33 video games.

The study found about 12 percent of households plan to purchase a videogame console in 2005. Almost three out of four (71 percent) buyers will be repeat purchasers, but almost 4 million households will be buying a console gaming system for the first time. What is all this buying activity worth? CEA forecasts shipments of electronic gaming hardware will approach \$4 billion, with gaming software shipments at almost \$8 billion in 2005.

While this research suggests substantial opportunities exist today in the console market, the next-generation platforms on tap from Sony, Microsoft and Nintendo are the biggest opportunities to watch.

Opportunity – Next Gen Consoles

Arguably the next big opportunity in the video game business is the introduction of new console gaming platforms, including the Xbox 360, Playstation 3 and the Nintendo Revolution. The Xbox 360 will be the first out of the gate with a release date in Q4 in 2005. The Playstation 3 and Revolution platforms are expected to launch sometime in late 2006, according to media reports. But what do these new platforms do differently than their predecessors?

Details on the features and functions of the Revolution platform are still fuzzy, but the specs of the Xbox 360 and Playstation 3 are well known. In addition to sporting more pro-

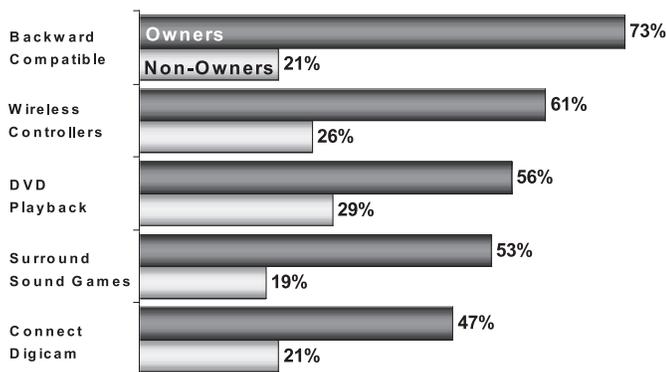
cessing horsepower and memory, the Xbox 360 and PS3 will support HD video, built-in wireless connectivity, wireless controllers and removable hard-disk storage.

The most important difference these new platforms present is not their system specs, but rather the strategy behind them.

THE MOST IMPORTANT DIFFERENCE THESE NEW PLATFORMS PRESENT IS NOT THEIR SYSTEM SPECS, BUT RATHER THE STRATEGY BEHIND THEM.

Strategy Analytics, a Massachusetts-based consulting firm, believes the Playstation 3 and the Xbox 360 will become the “cornerstones” of their respective company’s digital home

Purchase Drivers: Next-Gen Game Consoles Console Owners vs. Non-Owners



Source: CEA Market Research

strategy. The firm expects Sony to employ the PS3 as a means to help establish Blu-ray Disc, while the Xbox 360 could help position the home PC as a broadband digital media server.

Next Gen Consoles – Purchase Drivers

It is doubtful, however, consumers will buy these new consoles solely for the purpose of adding a digital media hub to their household. But recent CEA consumer research does identify key purchase drivers for next generation consoles and the dramatic differences between current console owners and non-

owners. Bear in mind these drivers were tested prior to pricing announcements and the general marketing hype surrounding the launch of the next-gen consoles.

Understandably, the survey results show backward-compatibility of games as the top purchase driver for next-generation

consoles among online adults who currently own a game console. Backward-compatibility is almost four times as important to console owners compared to non-owners. Close behind are wireless controllers as a purchase influencer to 61 percent of console owners, compared to only 26 percent of non-owners. This marked difference of opinion is rooted in user experience. Console owners clearly prefer to be free of tethered controllers.

Roughly half of console owners say DVD playback, surround sound games and being able to connect a digital camera or camcorder are influential factors in their purchase decision of a next-generation console. Meanwhile, about half as many non-console owners said the same. Once again, user experience is a key factor in formulating what features matter most when considering a next-generation console purchase.

The good news is both the Xbox and PS3 platforms support these features and specifications. But some of the more hyped features of these next-gen consoles including high-definition games, HD movie playback, online game play and accessing computer files stored on a PC were less influential to online adults. However, these features are twice as likely to impact a console owner’s purchase decision compared to a non-owner.

Although untested in this analysis, another important purchase driver is the library of available new games – the more the better. The Xbox 360 is expected to have 15 new titles available when the platform launches in Q4 2005, with as many as 40 new titles available by year’s end. Interestingly, the results show only 20 percent of online adults consider exclusive game con-

Purchase Intentions: Next-Generation Gaming Consoles			
<i>Console Owners</i>	Xbox 360 Platform	Playstation 3 Platform	Revolution Platform
With in 1 Year	18%	24%	11%
With in 2 Years	10	18	6
More than 2 Years	6	9	5
Not Sure	42	33	48
Never	24	16	30

<i>Non-Console Owners</i>	Xbox 360 Platform	Playstation 3 Platform	Revolution Platform
With in 1 Year	4%	5%	2%
With in 2 Years	2	3	2
More than 2 Years	3	4	3
Not Sure	26	25	26
Never	65	63	67

Source: CEA Market Research

tent during their purchase decision. This suggests the game library's breadth is more important than its exclusivity.

However, the data shows console owners are three times as likely to consider exclusive content as a purchase influencer than non-owners.

Purchase Intentions – Next-Generation Consoles

CEA consumer research measuring purchase intentions of next-generation consoles shows roughly 80 percent of first-year purchases will be made by current console owners. Note: demand level was measured prior to the release of street pricing for any of the next-generation platforms. Price generally

has a significant impact on demand for and adoption of CE products. In addition, CEA research has shown approximately one in four consumers follow through with purchase intentions as planned.

The fact that approximately 80 percent of first-year buyers for each of the three next-gen platforms are current console owners implies no one console will grow the aggregate installed base of these products more than the other. But what will sales volumes look like?

Starting with the measured demand level and making a few assumptions, it's possible to estimate first year U.S. sales volumes for each next-generation console platform. A CEA survey

of U.S. online adults found 46 percent owned a game console, yielding a population of 71.1 million U.S. online adult console owners. This ownership level produces a difference of 83.5 million U.S. non-console owners.

Keeping these populations in mind and assuming a \$399 street price for the Xbox 360, CEA estimates 4 million units of this platform could sell in the first year. This volume and street price would generate approximately \$1.6 billion in revenue.

HIGH CONSUMER EXPECTATIONS FOR IN-HOME GAMING MAY HOLD PROMISE FOR ON-DEMAND GAME SERVICES OFFERED THROUGH CABLE, SATELLITE OR IPTV.

Higher demand levels measured for the Playstation 3 suggest first-year unit sales for the Playstation 3 platform will be 5.2 million – slightly higher than the Xbox 360. Based on statements made by Sony executives that the street price of the Playstation 3 will be “expensive”, assuming a slightly higher street price of \$499 for this platform would yield first-year revenues of \$2.6 billion.

Demand levels for the Revolution platform were lowest, but this could be attributed to a number of factors including spotty details on hardware specifications and game title availability. Measured demand levels in the CEA survey, peg first year sales volumes for the Revolution at 2.3 million units – about 44 percent of the first year volume of the PS3. Media reports and statements made by Nintendo suggest the Revolution will be less robust in terms of hardware specs compared to the other next-gen platforms. So, assuming a lower street price of \$299, this would produce first-year revenues of \$0.71 billion – substantially lower than the other next-gen platforms.

Opportunities for the Future

While on-the-go gaming technologies have been hyped in recent years, research suggests the future of videogames is

where most gaming occurs today – in the home. Over half of the online adults surveyed by CEA expect to play videogames on their PC or the Internet. But keep in mind a portion of this gameplay may be freeware or bundled games with a PC or operating system. Adding another dimension to in-home gaming expectations, more than one third (36 percent) of online adults expect to game on consoles in the future. But what business opportunities do these expectations present?

In addition to signaling demand for gaming PCs and next-gen-

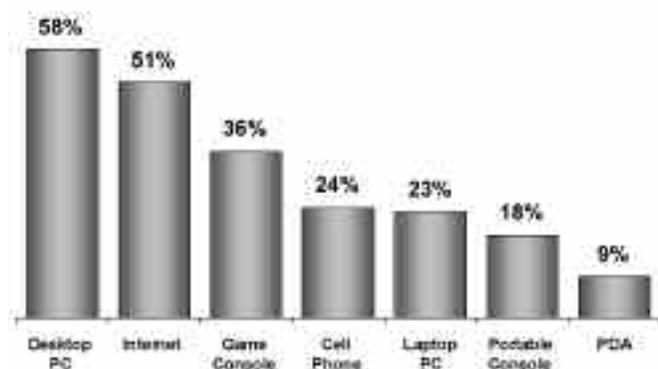
eration console platforms, high consumer expectations for in-home gaming may hold promise for on-demand game services offered through cable, satellite or IPTV. Already plans are in the works. Media reports say telecom giant SBC plans to introduce interactive-TV software from Microsoft that aims to give viewers new interactive features including a richer program guide and TV games. Cable TV provider Cox Communications reportedly is mulling over an interactive-TV games offering this year.

In the PC gaming environment, online gaming services such as GameSpy or Game Center that offer private game servers, tournaments and downloads could see increasing demand as consumers get their game on at home. But the opportunities in the in-home gaming arena extend beyond gaming hardware, software and online services.

Opportunity also may ripen for custom design and installation professionals to build personal gaming spaces for consumers. Industry trade publications like *CE Pro* have reported on the potential of “personal game room” design and installation as the next “big” thing in the installer world.

Turning to on-the-go gaming, CEA research shows about one quarter of online adults expect to play games on their wireless

Where Will Future Games Be Played?



Source: CEA Market Research

handsets. Today a multitude of wireless game platforms exist – each with its own collection of “mobile” games. Although most mobile games are restricted to the player’s handset, games that use the wireless connection now are available, including head-to-head and massive multiplayer titles.

CEA currently estimates wireless phones are present in 71 percent of U.S. households, with an average of 1.9 handsets per owner household. This penetration level assures significant exposure to mobile games among the American public through their handsets. As a result, the mobile gaming industry is expected to grow rapidly in the next few years. Market research firm IDC values the mobile gaming industry at around \$500 million in annual sales.

But IDC believes the combination of more game titles, lower game prices, increasing consumer awareness and improved distribution will help the mobile game market reach \$1.5 billion as early as 2008. Mainstream CE retailers are beginning to jump aboard the mobile game wagon. Radio Shack in August announced plans to sell JAMDAT mobile games for Sprint and Cingular Wireless customers at its 5,000 stores nationwide.

Another on-the-go gaming opportunity exists in portable game consoles, albeit a smaller segment than the wireless

handset game market. While only 18 percent of online adults expect to play games on a portable console, this market may be considered a niche. But this gaming market has perhaps the deepest reach into the teen and pre-teen market of any videogame segment. New competitors like the Playstation Portable platform (PSP) are beginning to challenge the incumbent GameBoy’s dominance through expanded functionality including movies and digital music playback. Early signs are promising as Sony reported its PSP platform sold more than 600,000 units in the first week after its March 24th release – demonstrating the GameBoy has not tapped consumer demand for portable consoles completely.

Other new competitors such as Gizmondo are vying for their slice of this market with their own unique features. The Gizmondo game deck – shown at the 2005 International CES – is expected to feature GPS navigation in addition to audio, video and gaming features. Other CE manufacturers may be able to hedge opportunity in this burgeoning market by adding game play to portable media playback devices. Content is important, however, so offering well-known, branded games will be crucial.

The bottom line is the video game business will provide constituents of the CE industry, including manufacturers, software developers, retailers and service providers, with ample opportunities for fun and profit in the years to come. From the home life to life on-the-go, future consumers will demand access to entertainment like never before and will be willing to spend their dollars to get it. So no matter what your business is in the CE industry – be ready to get your game on.

5

Displaying the Future

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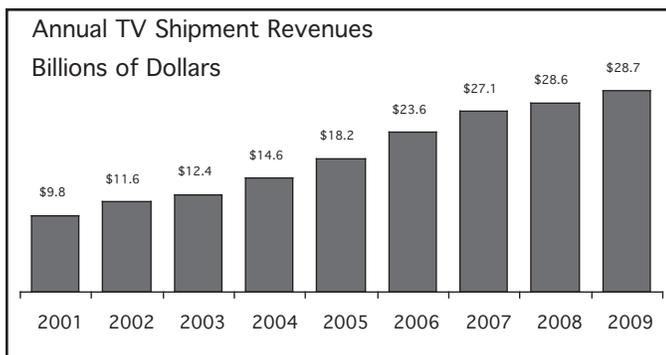
The TV market is in the midst of a major upgrade cycle. Replacing the mature cathode-ray-tube (CRT) technologies of the past are widescreen, flat-panel, higher resolution technologies. Take a quick stroll around your local electronics retailer, and you will see an array of TV options like never before. Consumers used to go to the store armed with cash and their room size, but now additional questions pepper the decision. Retailers boast TVs based on tubes, liquid crystal, plasma and light-reflecting chipsets in direct-view, rear projection or front projection formats. Follow that with questions about the TV's resolution, whether standard, enhanced, high-definition or some other fixed pixel designation. And finally, for further complexity, should you go with a digital cable ready set, one with an integrated digital tuner, just an analog tuner, or one with no tuners at all! There are certainly plenty of choices.

At the end of the day, all of this choice is a boon for both the consumer looking for a set to fill specific applications in the home and the retailer who can reap the benefits of consumers' renewed TV enthusiasm. The proof of the phenomenon is in the numbers. CEA expects shipment revenues for TVs to continue to grow over the next several years, rising from \$14.6 billion in 2004 to \$25.7 billion in 2009. This combines to make the TV market both the largest in history and the biggest single CE product category ever.

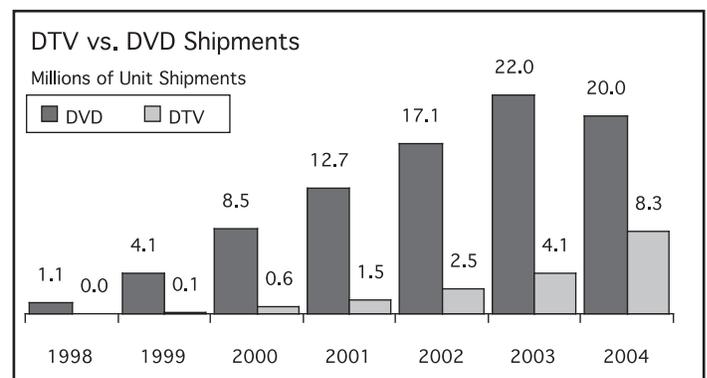
But, what is causing this growth and what are the prospects for the future? In short, what makes this market one to watch?

Bringing the Theater Experience Home

The root of the current enthusiasm for bigger, higher resolution displays can be traced back to the consumer's long-standing quest for a theater-like experience in the home. Beginning with VHS and more fully realized with DVD, consumers now have the ability to shun the crowds and enjoy popcorn and movies complete with great picture quality and surround sound from the safety of an armchair. DVD significantly raised the bar of realism by improving on many aspects of the video and sound quality and became the driver of home entertainment upgrades and, in particular, the television set. Ultimately, consumers want to realize the full potential of the new formats through better display technologies more congruent with the specifications of DVD. So the rapid adoption of large-screen, high-definition (HD), and widescreen displays coincide with DVD adoption. This came despite a real lack of HD content from TV broadcasters during the early years of the transition to digital TV. Of course this was only the beginning of the road to HD.



Source: CEA Market Research



Source: CEA Market Research

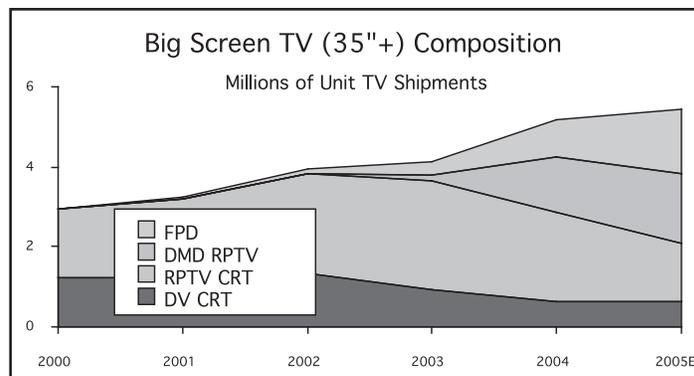
Now, with more broadcasters offering HD content, and cable and satellite carrying more content as well, the driver for new sets quickly is shifting toward more traditional TV content. Early CEA consumer research showed sports and movies were the key drivers for long-term adoption of high-definition displays. Companies like HBO, Showtime, ESPN, Discovery and HDNet were all pioneers helping to satiate consumers' demands for great new content and to carry HD proliferation to the next level. More content companies are joining this trail-blazing group, creating even more critical mass to nudge the sideline HD observer into the fray.

A Focus on Design

Interest in the home theater concept and improvements brought about by HD initially translated into greater shipments of big-screen, rear-projection sets based on traditional CRT technology. However, over the past few years newer digital technologies also have crept into the mix. Eventually, space constraints in homes led to an increased frustration with chunky sets, particularly since they often didn't fit the tastes of all household members.

These space constraints created demand for thinner technologies such as plasma (PDP) and liquid crystal (LCD) in the flat-panel space and the various digital micro-display technologies (DLP, LCD and LCOS) in the rear projection space. All promised great picture quality and a big screen without requiring greater allocation of valuable media room real estate. According to data captured by CEA, the more form-challenged CRT based displays are slowly but surely beginning to give way to the new technologies, most notably in the big screen space (sets with diagonal screen sizes 35-inches and above). While CRT rear projection sets were 58 percent of total big screen shipments to U.S. dealers in 2000, in 2005 this number has fallen to just 27 percent.

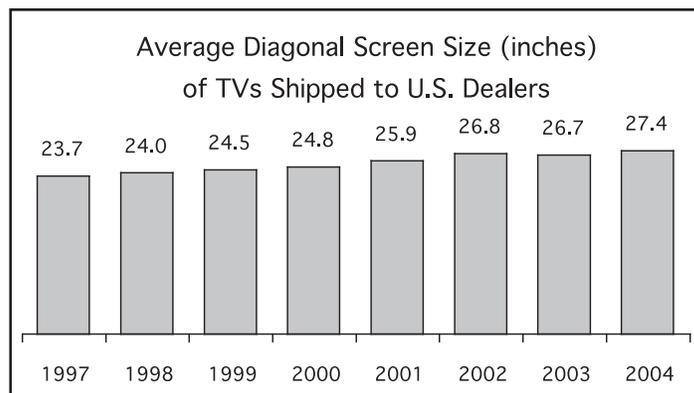
The net effect of this migration to newer technologies is multifaceted. For one, the average size of TVs purchased is on the rise. During the past five years, the average set size has



Source: CEA Market Research

increased by three inches. This should continue for several years as flat-panel display (FPD) technologies allow for even larger set sizes to move into and throughout the home. Analysts speculate FPD will raise the theoretical maximum size the average consumer might consider for a primary TV from 36-inches with older technology to around 45-inches with thin displays.

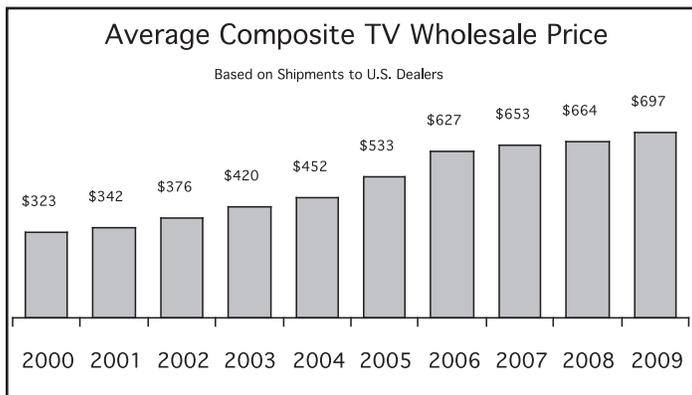
The other effect is consumers are paying more for a TV than they have in the past. This is counter-intuitive given the falling prices on any given TV type, but overall consumers are opting



Source: CEA Market Research

to upscale for newer technologies sporting a higher price tag. Thus, while the average wholesale TV price was \$323 in 2000, CEA forecasts it will be \$533 in 2005. This in turn is a key driver for the rapid growth the industry is experiencing. Whether this continues beyond the next five years in the face of rapid

deflation of many new technologies is yet to be seen. But for now it is a boon for manufacturers and retailers alike.



Source: CEA Market Research

Adding Visuals to Every Room

Looking at the underlying drivers gives hope the glory days may continue for quite some time, thanks in large part to FPDs offering both the wonders of high-definition and a smaller form factor. It is this same strength of size that opens up new doors for increased video applications in the home and new opportunities for the market. Specifically, FPD displays are showing up in living rooms, kitchens, bedrooms and even bathrooms. Some examples of this are the under-the-cabinet displays from companies like Audiovox or the mirrored surface LCDs from Philips. Other companies, such as Sharp or Sony,

WHILE THE AVERAGE WHOLESALE TV PRICE WAS \$323 IN 2000, CEA FORECASTS IT WILL BE \$533 IN 2005.

have specialized in aesthetically pleasing cases destined for a prominent position in the main living room or bedroom.

The net effect is an expected increase in the number of TVs owned per household. Already CEA has seen the average number of sets rise from around 2.5 sets in 2004 to 2.6 in 2005,

meaning the average U.S. home now has more than one TV per person. Looking forward, the increasing installed base will be a key driver for pushing annual shipment volumes on TVs well above the previous ceiling of 30 million units.

Beyond just adding sets to the average home, the focus on form factor created by flat panel also is having a ripple effect throughout the electronics market. For retailers, this trend translates into potential sales of other electronics products sporting an emphasis on design and unobtrusiveness. Examples are combination receiver/DVD players with brushed-metal cases and a thinner form factor for taking less room on a shelf. In-wall and in-ceiling speakers or thin wall-mount speakers also have evolved as options for the consumer wanting a more integrated look. Shipments of the later two categories have risen 10 percent over the past year alone.

For other channels of electronics, the design trend means installation service revenues as consumers seek out solutions more seamlessly integrated into the home décor. The first iteration of this is in the installation of large plasma displays, requiring someone more knowledgeable than the home owner. Witness the rise of Best Buy's Geek Squad for home installations as a solution to this growing need.

Content Distribution Evolving

By pushing the TV set into other areas of the home, flat panel is serving as the catalyst for other technology evolution as well. For now, the driver of set proliferation is primarily for access-

ing TV or movie content from multiple rooms. However, over time, these sets have much more utility to the consumer who possesses a variety of digital content to view. This includes the many digital photos, home videos, video games, recorded TV shows and streamed content from the Internet the average U.S. household is amassing with every passing day.

CONSUMERS ARE MORE WILLING TO OPEN THEIR WALLETS FOR ENTERTAINMENT CONTENT AS OPPOSED TO SAFETY FEATURES.

33

Right now, moving content between rooms in the home is a manual exercise employing, what industry insiders call sneak-erware, or content that must be physically moved from player to player. In a digitally rich content environment, connectivity to the various sets in the home provides a more efficient solution to the problem, thus creating the next opportunity for the display market. In short, home networking combined with content storage and distribution devices will provide consumers with an easier way to route video content from room to room to feed their hungry displays.

A simple example is the growing desire to view digital photos from any display in the home without having to move around the entire collection. This is where a TV connected to a central storage device could come in handy. For now, making the digital connection is still fairly hardware and sneakerware intensive, requiring a bridge technology such as Linksys Media Extender or physically moving the content. But in the future our displays may come with network ports for easy connection to a home entertainment network and a central content server. This creates opportunities for new services for retail and installer channels as consumers seek help in setting up and maintaining this network of products. On the hardware side, it is not too hard to imagine an International CES that showcases IP addressable or network compliant displays not too far in the future. A key piece of the puzzle is the interface used to access all this content in an intuitive way from any display – something the folks at Microsoft and others are keen to accomplish.

Increased Competition/Increased Affordability

All of the potential opportunity and the continued growth of the market are not without their costs. For one it has succeeded in attracting the attention of many companies who previously existed in very different segments of the technology industry. There are newcomers in the manufacturing space, lured by the prospects of selling more and larger displays to the home in the new model of usage. These include companies like Dell, HP, Akai, Syntax Group, Maxent and Moxell. At the same

time, existing manufacturers are ramping up production capacity in many of the new technology areas to meet the forecasted increase in demand. A similar story exists on the retailer side, in which Wal-Mart, Costco and a host of online retailers have joined the fray.

The effect of the increasing competition and production is rapid price deflation across the various product categories, even as consumers move up to the newer technology. Among the most competitive of the display battles are in the LCD and plasma segments. During the past year, LCD wholesale prices have fallen 12 percent, despite the emergence of larger screen size options in that space. Plasma has shown even higher price declines of 28 percent during the same time period. Much of



Source: CEA Market Research

the plasma decline is due to a market move toward the lower resolution ED options, in addition to overall competition. And of course, CRT, in the face of the next-generation of displays, continues to fall in price at a good clip as it moves closer to the end of the line.

Making them Thinner

On the horizon for the TV market is a host of further competition, once again from within the technology itself. Poised to hit the market during the next few years is the next-generation of the flat-panel family. Two technologies stand at the forefront of

this group as likely candidates for the successors to LCD and plasma – screens based on OLED and SED.

SED, or surface conduction electron emitter display, a technology created through a joint venture between Toshiba and Canon is slated to hit U.S. markets in 2006 beginning with a

with Cambridge Display Technology (CDT) now reporting lifetimes more than 100,000 hours.

The first iterations of OLED will continue to come in the form of cell phones and other small screen formats during the next two years, with the first TV applications coming to market in

ANOTHER BENEFIT OF THE OLED TECHNOLOGY IS ITS ABILITY TO BE MANUFACTURED AS A FLEXIBLE DISPLAY FOR USE IN CLOTHING OR OTHER CREATIVE APPLICATIONS.

50-inch model. Based on carbon nanotube technology, SED boasts extremely high contrast ratios, brightness, greater energy efficiency, low manufacturing costs (relative to LCD and CRT), and lifetimes exceeding 30,000 hours, in addition to the same slim form factor consumers have come to appreciate in plasma and LCD. This puts it securely in competition with plasma as a thin, large screen option. Challenges include similar ambient radiation issues faced by CRT technology, though testing is certainly underway to address this. Initial price points will put the TVs squarely in the early adopter category, but as with all emerging technology, these likely will fall quickly over the subsequent years, particularly given the technologies cost efficiencies.

Giving SED a run for its money are displays based on OLED, or organic light emitting diodes. As the name implies, OLED technology, as developed by Kodak, Dupont, LG Philips, Samsung and others, contains organic material that can be energized to produce its own light, making them emissive rather than backlit as in the transmissive technology LCD. This leads to greater energy efficiency, ultra-fast response times, great contrast, high brightness, superb color and sharp picture clarity at an even thinner form factor than LCD. Another benefit of the OLED technology is its ability to be manufactured as a flexible display for use in clothing or other creative applications. Early versions suffered from low life expectancies, but much of this now is being addressed in current R&D efforts,

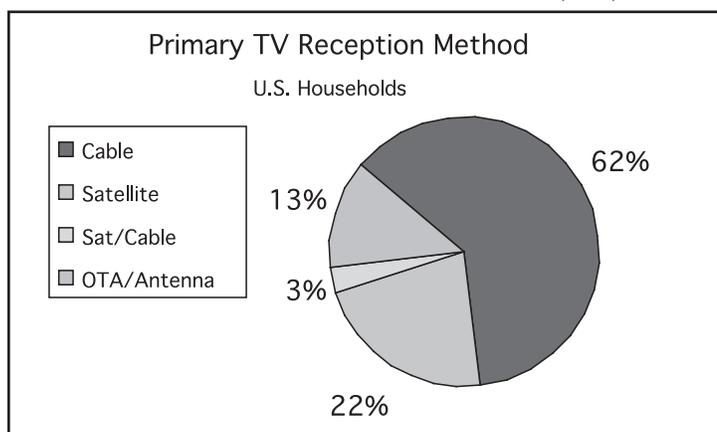
year three or four. Already, Kodak has a digital camera touting OLED, Sony uses it in its Clie line of PDAs, and several manufacturers have shown TV prototypes at the International CES. Exact market release dates of a TV built on the technology have not been announced.

Which technology will win in the marketplace is still anyone's guess, though SED does have a slight edge in the TV space given its early time-to-market. Product development also suggests a similar situation to the current market. OLED appears to be emerging first as a small-screen format targeted to the second and third sets in the home, similar to the current state of LCD. SED, on the other hand, will emerge first as a big screen option just as plasma has done. This equilibrium may not last, however, as scalability may put the two technologies in more head-to-head competition over the long run. Ultimately this bodes well for the consumers' ability to select from a set of options to find the best display at the best price.

Riding the Regulatory Currents

Other than technology evolution, another of the big issues to watch is the government's effort to accelerate the transition to digital broadcasts in order to free up the spectrum currently occupied by analog broadcasts. This spectrum is slated for a host of uses including more robust domestic security communications and advanced wireless services. For the most part this

is a sidebar for the consumer, particularly given the relatively low number of households who receive their TV signals via an antenna (12 percent according to CEA). However, mandates from the Federal Communications Commission (FCC) now



Source: CEA Market Research

are requiring new TVs to include tuners for receiving over-the-air digital broadcasts (ATSC tuners) in a phased in fashion. Already, sets larger than 36-inches must include a digital tuner and starting in March of 2006 any set over 24-inches must do the same. The final leg hits in July of 2006 when all TVs over 13-inches must be integrated with digital tuners. This means consumers now will see ATSC tuners as an additional feature specification when they go to buy a new TV. In the short term, this may mean the consumer will pay slightly more for a TV, but over time this will become a standard feature of the set, provided at no noticeable difference in cost.

Ultimately the goal of these mandates is to ensure enough households have tuners, so the last leg of the transition can be completed and analog TV broadcasts essentially can be shut off. Greater tuner penetration ensures fewer households will be left without reception capability for free over-the-air broadcasts. Currently the FCC and Congress are considering a date certain for when broadcasters must turn off their analog signals.

Regardless of the date, consumers will have many options for ensuring their sets don't go dark when analog broadcasts turn off. For one, TVs connected to cable and satellite will continue to receive programming, so non-subscribing households could choose to make the switch. Second, the consumer could replace any analog set in the house with a new integrated digital set as currently is happening in the market. And third, consumers could buy a converter box for receiving the digital broadcasts and displaying it on an analog set. It is likely the government will create a subsidy program for this last option to help smooth the transition.

A Market to Watch

In the end, the sheer volume of expected sales, the increased competition, the technology advancement and the government environment all combine to make the TV market a clear one to watch now and in the future. As a clear driver for electronics sales, TVs often are viewed as the bellwether for the industry. And certainly from where we sit today, retailers and manufacturers alike will be riding high on the wave of a sustained TV upgrade cycle. Stay tuned to those sets to see how it all plays out.

THE **Future** in Now

When people talk about the technology of the future, they often say things like, "Wouldn't you like it if..." or, "Imagine you could..." The truth is, though, that we don't need our imaginations to experience the technologies that will dominate our future, they are here already. In fact, several have been around for more than a century. Some of these technologies are waiting for that elusive breakthrough, one that finally will make the technology economically viable. Others just need that final commercial push to drive them into the mainstream, and many search for an innovative mind to reapply old knowledge in a new way.

Today's research already has begun shaping the world of the future. Expect the ways you think about some everyday items to change drastically, while in others you will only notice large progressions in reliability and convenience. You will be I.D.'d more often and more accurately, and you can expect personalization to spread to almost every aspect of your life.

Fuel cells are poised to make life easier and more environmentally friendly as our electronics begin to run longer on renewable energy. As biometrics spreads, it will make life less anonymous and keep our valuables more secure. Embedded RFID chips will do everything from order our groceries to shorten airport security lines. Finally, nanotechnology, quite possibly the most anticipated emerging technology, will usher in an industry-wide revolution, including the next step in the miniaturization of computer data and processors.

If the future came easily, though, it'd probably be here already. These technologies face numerous obstacles, and whether they are ethical or economic, we must strive to overcome them in order to realize the full potential of our technological progress.

Batteries Thrive on Hydrogen

Fuel cells are not just for cars of the distant future anymore, they will be arriving much sooner than you think, and will begin appearing not just in automobiles, but much closer to home. In the next few years, fuel cells will begin replacing the

rechargeable lithium-ion batteries in many high-energy portable devices you already use daily. As scientists develop smaller, more energetic cells, we may be on the verge of attaining cheap and effective fuel cell batteries, perhaps finally achieving and surpassing the much longed for eight-hour notebook battery.

Fuel cells aren't terribly new. A Swiss man named Christian Friedrich Schönbein discovered the principal of the fuel cell way back in 1838, and the first successful fuel cell device was constructed in 1932 by Francis Thomas Bacon in Britain. Fuel cells were integrated into the space shuttle in the 1960s and, more recently, have begun powering some buses and other public transportation. It is just recently, though, that fuel cells are beginning to make tremors in the consumer market.

Many fuel cells use pure hydrogen or extract hydrogen out of another substance, like methanol, to produce energy in a chemical reaction with oxygen. The reaction produces harnessable energy and the only byproduct is pure water, making it an extremely clean source of energy.

Lately, companies like Millennium Cell and Signa Chemistry have produced breakthroughs which will bypass and eliminate many of the problems which have been stunting fuel cell adoption.

Millennium Cell has produced "Hydrogen on Demand" which circumvents the dangers of storing pure hydrogen by keeping it in solution until it is to be used. Signa has increased the efficiency and reduced the heat production of the integral chemical reaction, allowing cells to produce more energy without losing as much of it through heat.

Fuel cells are poised to begin powering many consumer electronics in the next few years, with wide scale adoption rates expected within the next 20 years.

The North Carolina Fuel Cell Alliance reports that the fuel cell market, currently valued at \$1 billion, is primed to grow to more than \$13 billion in the next decade.

The batteries for your camera, digital audio player, cell phone, and even laptop may be powered by hydrogen fuel cells in the future, increasing battery life a potential two-to-ten fold, and will not lose charge capacity over time like today's batteries, eliminating the need for replacement.

As people begin to become accustomed to the new technology, it will begin competing with and even taking over the territory of its older cousins like alkaline and lithium-ion batteries.

While fuel cells may be the much-hyped next step in the evolution of the automobile, we can anticipate seeing them powering devices like laptops and digital cameras, perhaps even before the end of the year.

Measure for Measure

From kindergarten we remember our teachers reminding us that we are all beautiful and unique people with special talents and affinities. While our beauty may still be up for debate, our teachers' loving claims of our uniqueness will be justified constantly in the near future, as biometrics becomes more prevalent.

The use of biometrics – identification through the use of behavioral or physiological characteristics – is an increasingly quick and easy way to identify yourself or others securely.

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Biometrics uses a myriad of biological measurements that vary across all persons. Our fingerprints, iris shapes, voices, handprints, faces and even our vein patterns, all of which are as special as a snowflake, can be measured and catalogued, ready for whenever you need access to something. And the best part is, unlike a PIN or a keycard, the information cannot be easily lost, stolen or coerced from you.

Fingerprint scans already are appearing in laptops, computer mice and car doors, allowing the user to rapidly access secure information without having to remember a complex key combination. Biometrics also has begun appearing in some flagship programs at grocery stores and airports, shortening lines and streamlining previously tedious bottlenecks like checkout and security clearance.

But these new security measures are making some nervous. Many people do not feel comfortable submitting to a scan of a body part when they could just supply their password, for instance. Civil rights groups and privacy advocates are worried as well. They argue that biometrics may make identity theft even more lucrative and elusive. With your fingerprint connected to your bank account, social security number and front door, a criminal only needs one piece of information to access everything you own. And as personal information becomes more integrated and comprehensive, people fear increased surveillance by corporations and the government is possible, and harder to detect.

Solutions are on their way. With all the differing biometric identification strategies, companies now are trying to identify which is the best. An ideal biometric would be one which is the least intrusive and most accurate and which takes low cost and effort to deploy. Fingerprint scanning, the most popular biometric, is very distinctive, but also is seen as very intrusive.

Retina and iris scanning are even more accurate, but unfortunately also costly and intrusive. It seems, with biometrics, the more accurate the measure is, the more expensive and intrusive it is seen to be. Strategies like keystroke-scanning and voice-scanning are the least intrusive biometrics, but they also carry high false-positive and false-negative rates.

As the intrusiveness of biometrics decreases and the accuracy improves, we can expect scanners to appear in any place where secure identification is needed. ATMs, computer, and even television remote controls may have biometrics integrated to check your identity, or just to load your personal channel preferences. When people trust that the risk is small and become accustomed to the convenience of biometrics, we may begin to convert to a cashless society and witness the largest transformation in how money is spent since the introduction of the credit card.

Making Waves in Identification

They're already in your EZ-pass toll-paying devices and "Blink" credit-cards, but RFID, or Radio Frequency Identification, chips may begin appearing in more unexpected places, like passports and even the food you buy at the grocery store.

RFID chips hold a small amount of data, such as a security code or other identifying information, in a chip which, when

someone's identity. Privacy rights groups have criticized the proposal, pointing out that terrorists or other ill-intentioned persons easily could find the American in a large crowd by using an RFID transceiver and finding whose pocket responds to the signal.

Some religious organizations are also worried, equating prevalent RFID identification with the biblical Mark of the Beast, the use of which would signal the beginning of the end of the world.

RFID advocates dismiss these claims, revealing that the religious arguments also were posed when social security numbers were introduced, and that the technology exists to prevent just anyone with an RFID transceiver from recognizing the existence of a RFID chip.

The chips probably won't enter our homes as a means of identification, as many suspect, but through more mundane means, like in the food we bring home from the grocery store. Once RFID chips are integrated into the food packaging we buy, RFID-enabled refrigerators will be able to tell what food

WAL-MART AND OTHER COMPANIES WITH LARGE WAREHOUSES ARE WATCHING RFID TECHNOLOGY CLOSELY, WAITING FOR IT TO BECOME CHEAP ENOUGH TO POSSIBLY REPLACE THE UBIQUITOUS UPC BARCODE.

activated by an RFID reader, can transmit the data quickly to a system for analysis.

Many people and businesses are interested in the evolution of the chips. Wal-Mart and other companies with large warehouses are watching RFID technology closely, waiting for it to become cheap enough to possibly replace the ubiquitous UPC barcode.

In efforts to further control who enters and leaves the country, and make security even more thorough, the U.S. government has proposed using RFID chips in passports, dubbing them "contactless chips", providing an easy and secure way to verify

we have and will be able to suggest recipes based on what's available. When the fridge senses that there is no more milk in it, for instance, it can remind you to get some next time you are at the store or even order it for you online.

Other consumer applications of RFID technology include "Smart Key" systems for cars, already available in Toyota's Prius. With the RFID smart key in your pocket, you can walk up to the car and the doors will unlock automatically. When you sit down in the driver's seat, you don't even need to take the key out of your pocket to start the ignition.

If privacy issues are resolved, RFID chips are set to become

extremely popular, making consumers' lives, as well as many companies' and the government's jobs, much easier and more secure. The speed and confidence we have in our everyday purchases and transactions may never be the same, and we'll wonder how we ever did without them.

Micro-Machines

Not surprisingly, the largest technological changes to come in the next few decades will arrive in the smallest packages. So small, in fact, that hundreds of the next-big-thing may fit along

electronic items, like fabrics and clothing, notably showing up in the U.S. Army's new prototype body-armor. The technology will provide soldiers with extra strength via electric impulses to the muscles, creating a super hero-esque infantry. We civilians may have to settle for the Green Shield clothing developed by a Taiwanese company which utilizes nanotechnology to infuse the fabrics of underwear, undershirts and even bed sheets with odor-eliminating ions, although prices start at \$700 for a pair of socks.

Nanotechnology research has been booming, and for the past few years the United States has been leading in the field, reports

FOR YEARS THE UNITED STATES HAS BEEN LEADING IN THE FIELD, REPORTS LUX RESEARCH, ACCOUNTING FOR 1.6 OF THE \$4.6 BILLION SPENT BY WORLD GOVERNMENTS ON NANOTECHNOLOGY LAST YEAR.

the width of a single strand of hair. Nanotechnology will allow for the shrinking of many common computational objects, increasing storage capacity and speed, and will open up an entire new realm of possibility for future products.

Scientists have been manipulating materials on the atomic level for more than 15 years now, but the competitive applications of the technology have just begun to trickle into the consumer market. We probably will not feel the brunt of their influence for another decade at least. The ability to work with single atoms to create nanotechnology – objects less than 100 nanometers in size – will benefit all segments of the electronics world and, indeed, many outside it.

Increasingly smaller transistors will keep the speed of computer processors doubling for a long time to come, quickly approaching terahertz of processing speed. You also can expect your computer's hard disk space to swell dramatically, reaching multiple tera- and perhaps even petabytes (more than one million gigabytes), far more than enough space to store all the information in the Library of Congress.

Nanotechnology already has begun to find its way into non-

Lux Research, accounting for 1.6 of the \$4.6 billion spent by world governments on nanotechnology last year. U.S. corporations aren't being left out, spending \$1.7 billion on nanotechnology R&D in 2004.

If research like this continues, we can expect nanotechnology to leave the world of the rich and famous and become part of our everyday lives sooner than you may think. You'll see it popping up in nanotubed flat-screen televisions, stain-repellant khakis and ways we cannot dream of yet.

It's Always a Day Away

The consumer electronics of tomorrow will be more convenient, more personalized and far more powerful than those we are familiar with today. Countless technologies which promise to change our lives are on drawing boards, in development labs and in focus groups, waiting to burst into stores everywhere.

Televisions will continue on the same track they've forged the past few years, becoming more detailed, larger and cheaper, but they also will experience some more major changes.

IPTV takes the idea of cable internet and turns it on its head. Instead of getting Internet over a cable line, you can get TV signals over your broadband connection. The rise of IPTV will allow for personalized show recommendations, like TiVo, and will allow interactive functionality, like allowing you to play along with Jeopardy! or vote for your favorite “American Idol” with your remote control.

3D television technology is also on the horizon, with real three-dimensional projection without the geeky blue and red glasses.

Wearable computing is on the minds of many futurists, with products like electronic jackets already combining digital audio player storage, cell phone pockets and headphone jacks connected to solar panels on the back to charge all your accessories. Integrated buttons in the sleeve allow you to control your music and answer calls without reaching into your pockets.

Technology like this will expand to include shirts that monitor your heartbeat and blood pressure, or even change the permeability of the fabric based on your body temperature.

Further down the line, three-dimensional printing and personal fabrication may take off in the consumer market, as it is used already in many design firms and R&D departments.

With the help of the burgeoning fuel cell, biometric, RFID and nanotech fields, consumer technology is bound to get loads more exciting in the near future, changing our lives for the better and preparing us for what is sure to be an amazing new century.