Why Digital Entertainment Drives the Need for Speed

Michael Macedonia, US Army Stricom

Intel and AMD recently released yet another batch of supercharged CPUs. Their flags now planted firmly atop the 800-MHz summit, these companies are already eyeing the next mountaintop: 1,000-MHz 64-bit machines. Lost in the commotion to be the first with the fastest is the answer to one simple question: Why? We certainly don't need these speedsters to run Microsoft Office or file our taxes. So what are we going to do with all those gigaflops, which provide enough processing power to rival a supercomputer? The following quotes provide a clue.

> Intel's latest Pentium III processors are ideal for enthusiasts who want state-of-the-art performance and features for the Internet, as well as advanced applications such as video editing, digital imaging, and 3-D gaming. —http://www.intel.com/pressroom/archive/releases/dp122099.htm

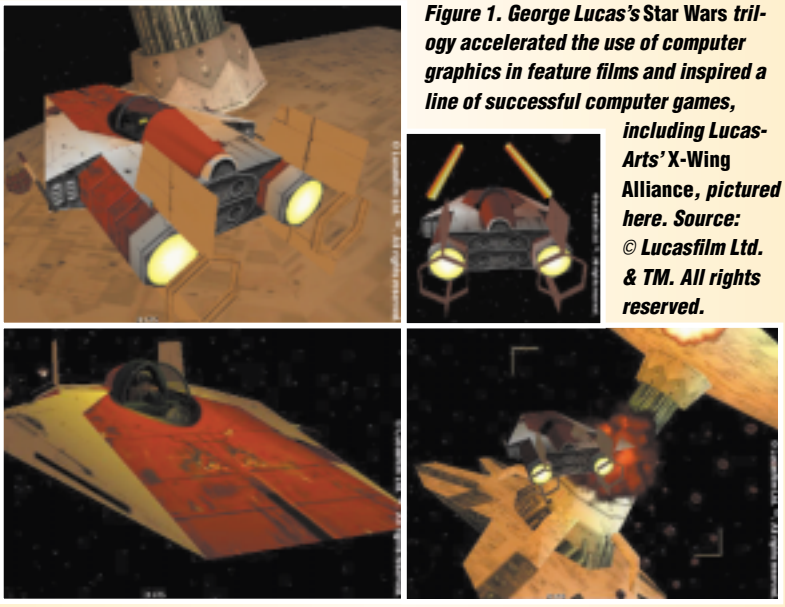

Figure 1. George Lucas's* Star Wars *trilogy accelerated the use of computer graphics in feature films and inspired a line of successful computer games, including LucasArts'* X-Wing Alliance*, pictured here. Source: © Lucasfilm Ltd. & TM. All rights reserved.

> These vector processing acceleration advantages give the G4 microprocessor a significant edge when it comes to fast visualization of large data sets, and intensive math for real-time simulations. Making the G4 perfect for everything from graphics and 3D games to astronomy, the biosciences and predictive modeling. —http://www.apple.com/powermac/processor.html

Intel, Apple, and AMD have entertainment computing on their minds—particularly computer games and Web-based digital video. Though plenty of astronomers may want a Mac G4, Apple knows that the entertainment market dwarfs any other high-end segment.

People aren't buying today's fastest CPUs to accelerate their office applications—they're using them to kick computer games into overdrive.

This is not a new phenomenon. As James Dunnigan points out in his book, *Dirty Little Secrets of the Twentieth Century* (William Morrow, New York, 1999, p. 120), radio went through a similar form of denial. "Radio's initial appearance was touted as an opportunity to provide more education and public-service programming, but what made radio work was entertainment. It should be no surprise that at the end of the century, most PC's were still bought to provide entertainment."

NUMBERS TELL THE TALE

By the end of 1998, more than 51 million homes had a PC, indicating a penetration rate of 49 percent (http://www.mpaa.org/useconomicreview/1998/sld040.htm). According to International Data Corp., home-PC unit sales in the US were expected to increase 37 percent in 1999, raising annual sales to 15.8 million

machines. IDC attributes this growth to falling prices and rebates tied to Internet service contracts—and to the boom in entertainment applications (Gary McWilliams, "New PCs Say, 'Let Me Entertain You,' and Sales Get Unexpected Lift," *The Wall Street Journal*, 28 Sept. 1999, Page B1).

In essence, for both economic and technological reasons, the entertainment market now drives computing.

Entertainment—defined as amusement, recreation, or diversion—cuts a swath through human experience wide enough to include computing. Yet the more recent phenomenon of mass entertainment derives its momentum from emerging prosperity and urbanization. For example, the modern circus arose in eighteenth century England as the Industrial Revolution began, while opera can trace its origins to the mercantile city-states of late-Renaissance Italy.

The bond between technology and entertainment is thus an old one. Archeology reveals, for example, that musical instruments can be found throughout human history. But like opera, musical instruments for private pleasure only became common in the 1600s, resulting in a 300-year technological evolution from violins to brass instruments to pianos and organs. Indeed, as the "From Pipe Dream to Flight Simulator" sidebar shows, computer games owe a debt to musical-instrument technology.

DIGITAL CONVERGENCE

Today, however, the different forms of entertainment—music, cinema, radio, television, games, gambling, and even the circus—are converging on digital media and digital platforms. The platforms themselves are also converging. PCs, digital televisions, and game consoles will soon have three things in common—broadband access, high-performance processors, and a variety of input-output devices. And they will all provide for a new entertainment venue that is simultaneously both a mass medium and an intimate one: the Web.

With the first release of *Star Wars* 23 years ago, and the release of *The Last Starfighter* seven years later, Hollywood began a digital revolution in filmmaking that continues to shape the industry today. Computer graphics and digital sound have become essential components of modern movie making. But within the next few years, film—the transport mechanism—will go the way of silent pictures as projection systems move to the digital realm, consumers adopt DVD, and broadband communications tie theaters to the Internet.

More significantly, the industry may soon forge a direct link to that other small screen, the home computer, which could bypass television networks altogether. Stephen Spielberg has already invested in a company that makes movie shorts for the Web, fostering cinema's first entrée onto the Internet (Bruce Orwall and Peter Gumbel, "The Big Battle in Hollywood Is Over the Tiny Screen—Film Giants and Little Upstarts Hope to Captivate Audiences With 'Webcast' Movie Shorts," *The Wall Street Journal*, 27 Oct. 1999, p. B1).

Television is in its third year of transitioning to high-definition television as increasing numbers of Americans and Europeans receive broadcasts via digital satellite and cable. Television networks such as Fox News, CNN, and CSPAN now simulcast on the Web. Even the relatively staid medium of television now takes advantage of gigabyte disks with playback devices such as Phillip's TIVO. Nikkei Online reports that Sony is cur-

From Pipe Dream to Flight Simulator

Computer games owe much to the pipe organ, which inspired the first pilot training simulator, developed in the 1930s. Edwin Link received his inspiration while working for his father's piano and organ company. The trainer used a pneumatic system to simulate the movement of the aircraft. Link initially sold the trainer to amusement parks while he awaited contracts with the Navy (J.I. Killgore, "The Planes that Never Leave the Ground," *American Heritage of Invention & Technology*, Fall 1989, pp. 56-63).

During World War II, the Link Trainer proved the training value of flight simulation and convinced the Navy to ask that MIT develop a computer that would power a general-purpose flight simulator. This endeavor became Project Whirlwind and "evolved into the first real-time, general-purpose digital computer...[which] made several important contributions to computing in areas as diverse as computer graphics, time-sharing, digital communications, and ferrite-core memories" (Thomas Hughes, *Funding a Revolution*, National Academy Press, 1999, http://www.nap.edu/readingroom/books/far/ch4_b1.html).

Figure 2. This Y-Wing fighter, which first took wing in the original* Star Wars *movie, now flies on home computer screens. Source: © Lucasfilm Ltd. & TM. All rights reserved.

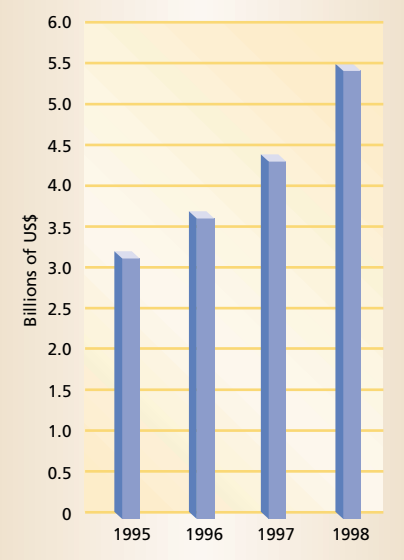

Figure 3. Between 1995 and 1998 revenues from recreational and educational software rose from $3.2 billion to $5.5 billion. Source: IDSA 1999 State of the Industry report.

rently developing a new line of network-capable audiovisual components, to include the PlayStation 2, that can be controlled through a television set (http://headline.gamespot.com/news/99_12/28_vg_sonynet/index.html).

The music industry has been shaken by the MP3 audio compression format—but the genie is out of the bottle thanks to enhanced CDs, rippers, and Lycos. On the video front, the DVD player—available now in both PCs and home entertainment systems—became the fastest growing new format of all time, reaching one million systems in 23 months—nine months less than it took to sell the first million CD players.

Meanwhile, the modern-day circus can be found at Walt Disney World, where the live performance of Fantasmic provides a digital tour de force and the old-fashioned penny arcade has morphed into the virtual reality of DisneyQuest. The expertise gained from these projects helps explain why Disney Imagineering has a world-class computer science laboratory.

THE HOME FRONT

As Siggraph—the computer-graphics community's showcase—has demonstrated over the last several years, the demands of digital film development are making way for computer games' even more demanding real-time simulation requirements. As a mass market, games now drive the development of graphics and processor hardware. Intel and AMD have added specialized multimedia and graphics instructions to their line of processors in their battle to counter companies such as Nvidia, whose computer graphics chips continue breaking new performance boundaries.

According to the Interactive Digital Software Association (IDSA), the sale of game and edutainment software for computers, video consoles, and the Internet generated revenues of $5.5 billion in 1998, as shown in Figure 3. Video game rentals accounted for a further $800 million in 1998 (http://www.idsa.com/pressroom.html). The interactive entertainment software industry that created these products did so with only about 70,000 employees. Compare these figures with the motion picture business, which generated $6.9 billion, but employed over 240,000 people to do so (http://www.mpaa.org/useconomicreview).

Games will likely be the battlefield over which the war for control of home computing will be fought, with the Sony PlayStation 2 and PC platforms the top contenders (Mike Macedonia and Ted Lewis, "Sony Versus Wintel: Mortal Combat," *Computer*, June 1999, pp. 110-112). There are several strategies at play. Sony's interest lies primarily with the end device, such as the console and set-top, while creating high-end content for the broadband world. Meanwhile, Intel is making a play for both the desktop PC and high-end server platforms that will supply the content for multiplayer games, video, and music. Apple, on the other hand, has made a bid to capture the game market by accepting the OpenGL standard, but it's also going after a traditional Macintosh niche: digital content creation.

By aggressively maneuvering to seize and expand their market share, the entertainment industry's biggest players are shaping a 21st century in which consumer demand for entertainment—not grand science projects or military research—will drive computing innovation. Private-sector research-and-development spending, which now accounts for 75 percent of total US R&D, will increase to about $187.2 billion in 2000, up from an estimated $169.3 billion in 1999, according to Battelle Memorial Institute's annual R&D forecast.

Figure 4. Lucas's latest film,* The Phantom Menace*, has already inspired several computer and console games, such as the pod racing game pictured here. Source: © Lucasfilm Ltd. & TM. All rights reserved.

Entertainment Computing Resources

Over the next year, I will introduce and survey some of entertainment computing's many innovations. Meanwhile, those of you interested in this topic can draw upon the following resources for more information.

IEEE Computer Graphics and Applications and *IEEE Multimedia*. These publications cover a wide variety of topics related to entertainment computing. CG&A in particular has consistently covered the emergence of graphics for games and real-time simulation. (http://computer.org/cga/ and http://computer.org/multimedia/)

Game Developer Magazine. This publication provides a good source of information about the state of the practice in game development. (http://www.gdmag.com)

ACM Computer Graphics. Sponsored by Siggraph, this publication has been concentrating more on game technology in recent years. In particular, Richard Rouse III has a superb column on gaming and graphics that is also available online at http://www.siggraph.org/publications/newsletter/.

Microsoft alone expects to increase R&D spending by 23 percent, to $3.8 billion (James P. Miller, "U.S. Companies to Boost Spending On Research by 10.6 percent Next Year," *The Wall Street Journal*, 29 Dec. 1999, p. A1). The IDSA estimates that in 1998, interactive entertainment businesses invested approximately $2 billion in new technology R&D, with an increase of more than 20 percent expected in 1999.

The significant and expanding role entertainment technologies play in the development of computer hardware and software implies that this sector can provide insights into the directions our industry will take in the coming years. In the months to come, this column will track the major trends in entertainment computing and provide technical analyses of its emerging technologies. ✷

Michael Macedonia *is chief scientist and technical director of the US Army Simulation, Training, and Instrumentation Command, Orlando, Fla., (http://www.stricom.army.mil/stricom/aboutus/macedonia.html).*

Michael Macedonia, Stricom, 12350 Research Parkway, Orlando, FL 32826-3276; macedonia@computer.org.