Edward A. Fox
Guest Editor

The Next Generation of Interactive Technologies

From home entertainment to cultural exhibits to educational methodologies to personal computing, interactive technologies could change observers into participants.

Karen A. Frenkel

For centuries, stories have been told linearly. Tales would vary slightly with each retelling, but the storyteller alone determined what listeners heard. Now, audiences of all kinds are beginning to have a say in the matter. The distinctions between playwright and theatergoer, and more recently between producer and television audience are blurring a little. At a Los Angeles improvisational comedy club, performers in *Funny You Should Ask* are asked to freeze so that patrons can shout out the actors' next emotion or action. In *Tamara*, a play performed in mansions in both New York and Los Angeles, the audience chooses what character to follow from room to room, while concurrently other actors perform elsewhere. But that is nonlinear interactivity without high technology.

This year, television viewers nationwide will join in the first interactive mystery movie, *Can You Solve It?* Based on a successful interactive video game played at home, it was developed by Scott Jacobs, president of Laser Arts Interactive, in Los Angeles. He is bringing it to television with the conviction that people no longer want to watch passively. Jacobs is devising a method for viewers to create the story live, in real-time and compete to solve the mystery and win prizes via a special 1-800 interactive telephone system. The program you will see will feature the consequences of your direction and it is up to you to solve the crime and deliver your solution through the television for scoring. Says Jacobs, "We're creating a hybrid media that is essentially turning passive couch potatoes into active, motivated thinkers."

Interactive developers are as multifaceted as is multimedia, but they have in common the desire to increase and enhance participation, to democratize access to information in one way or another. Interactive multimedia is also seen as a way to broaden already saturated markets and to recapture straying ones. NBC's Alan Gerson, VP of Program Marketing and Administration, has asked interactive developers to come forward with their ideas because "interactivity is a way to entice additional audiences." Leaders in the toy, video game, education, publishing, and computing worlds agree and these divisions are blurring; David Shefrin, Chairman of the Interactive Video Industry Association and an interactive videodisc pioneer formerly with IBM, says broadcasters are recognizing that they can be publishers, too. And the day when computer chips appear in TVs and TV tuner chips appear in personal computers is not far off. Some see IBM's announcement last spring that it would support multimedia as an enhancement to its PS/2 personal computer line as an indication that the computer giant is using interactive technology to find new markets for personal computers.

Since multimedia merges so many kinds and quantities of data, optical storage media, the costs of players, and the need for authoring systems are becoming increasingly important. According to Bob Moran of Business Communications Company, Inc., in Norwalk, CT, worldwide shipments of optical disks will reach $10 billion by 1993, up from $3.9 billion in 1988.

"INTERTAINMENT"

Nolan Bushnell, famous for his pioneering video games like Atari's Pong, wants to link storytelling and game playing by moving away from strict linearity to the "never-never land of branching, full bandwidth video." He hopes to arrive there with an interactive game system, called ISIXs, that he is developing in conjunction with Hasbro, Inc., in Pawtucket, RI. Although loathe to give details, clues to ISIXs and his overall vision were to be found in his keynote address at Intertainment '88, a conference held by Alexander Associates, Inc. in New York. "As surely as storytelling started around the campfire, so did game playing, because with prehistoric

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man, you found knuckle bones of animals used for various games," he said. The two have followed parallel tracks, he said, and many of us feel that the media distinctions are consistently merging and blurring. "Our dream is: How can we take some of the interactivity and fun of the game world and some of the fantasy in storytelling and merge them together so that we can have a little bit of each?"

Bushnell described two convergent paths that "interactivists" are taking to achieve the same goal of interactive multimedia. One group, the "CD crowd," uses low bandwidth computers and very fast random access to information. The other group, "linear synthetic interactivists," with which he allies himself, has only linear access to their data. These two approaches differ fundamentally in that the software for the linear method allows access to a frame only when needed. The software is harder to create, but the benefit is that upon relinquishing random access in the hardware, you gain distribution flexibility. That is, such programs could reach viewers by cable TV, direct satellite television, or any other kind of a mass environment, because these require linear formats, he said. No CD or videodisc laser player can do those sorts of things, Bushnell said. Videodiscs pose limitations for branching seamlessly, depending on whether they are adjacent or nonadjacent track, for example. On the other hand, even though these technologies require expensive hardware, they do have a fixed frame in the encyclopedia function, which Bushnell said is very important.

Ultimately, "what we really want is to have a whole world linked by 400 megahertz fiberoptic cable with about a trilobyte of memory in the basement of every home," he said. Looking at the cost of memory and the cost of bandwidth over the last 20 years, he postulates that 80 to 90 percent of American homes can have not a trilobyte, but a couple of random access gigabytes within the next 20 years. If that happens, software will provide the solutions, he said.

But how can true interactivity get into the marketplace now? "Right now the best interactive environment that we have is the personal computer," Bushnell said, "It has the data that we want, and most floppy disks can hold enough information on relatively low bandwidth computers, but you give up realistic images. The level of graphics that we have is probably not acceptable for true realism," he said, "We're still dealing with cartoons. You also give up high bandwidth speech. You can get some compression with the more expensive systems, but the basic old PC, Apple II, or the Commodore environments allow very limited speech.

"The road is still difficult, and I think that the road is going to be long, but the discipline gained in the marketplace by understanding the difficulty of programming and creating branching for interactivity will be rewarded independent of which systems prevail," he said. "In order to tell a story, to create the interactivity, creating branches is key. And those who really have that understanding will be able to dominate this marketplace. No matter what you say, it is clear to me, that the interactive entertainment market will swamp the movie and TV businesses as we know them." Turning his attention to video games, he noted that the size of that market exceeds $2 billion annually. It is heavily skewed toward the male 8- to 18-year-old marketplace. But to bring the rest of the world in, "all we have to do is show interactivity using soft edge graphics, good audio, some adult type of programming" so that it is "dressed down and non-techy," and the market could reach $20 billion annually, he said.

Speaking with an eye more on education than on storytelling and video games, Ted Nelson has also expressed the desire to break out of a morass of passivity. He objects to boundaries imposed by failing to fully use the capabilities of computers. Known for his book *Literary Machines*, and for coining the word *hypertext*, Nelson told the press attending Microsoft's Fourth International CD-ROM Conference, "We are used in the Western world to hierarchy and sequence. The educational system is based on hierarchy and sequence; there's a beginning, a middle, and an end to everything that's published. Why? In pedagogy we have hierarchy and sequence because it's a convenient way to teach and it's a way to judge you." Objecting to formal curricula, which in Latin means "little race track," he added, "What we need is a way that everybody can explore the subjects they want to learn, because it is those subjects you have chosen for yourself that you learn best." Some people might enjoy compulsively following a sequence that someone else created, he said, but others might want to *explore* material, creating their own interconnections and perhaps publishing them.

"The combination (of educational electronics and the tube) may yet save the minds of all those millions of preadolescent couch potatoes. Perhaps technology can finally turn passive to interactive—and lumps into learners."
—New York Times *editorial*
February 19, 1989

ANALOG VIDEODISCS

Interactive laser videodiscs, which were first released in the late seventies, are now used for educational and training applications in schools and industry, for cultural applications at museums and theme parks, and for marketing and retailing. They offer varying degrees of interactivity and incorporate text, audio, video and graphics, depending on the application. Some enable people to choose what to watch next by touching the relevant outlined section of the monitor, just as some automatic bank tellers do. Others are controlled by an external computer and allow users to access full motion video and even edit it into a documentary.

In Museums . . .
For the Getty Museum in Los Angeles, display via videodisc was the only medium by which the museum could bring its precious illuminated manuscripts to the public, according to curator Thomas Kren. Ordinarily, only one two-page spread of these priceless medieval books of countless miniature paintings and accompanying text would sit in a glass case. That has limited curators and tantalized viewers. "You could only get a taste of what it is, as a work of art," says Kren. "Manuscripts are particularly suited to the [videodisc] medium," he says, "because it allows us to do something with technology for the public that we can't actually do in our galleries very effectively. Unlike most works of art, which can be seen entirely in a gallery, an illuminated manuscript is a collection of decorated components. Rarely is there one opening miniature; often there are 80 or 200 throughout a volume. We just bought a manuscript with 350 miniatures," Kren explains. Since many manuscripts tell stories, seeing the sequence of miniatures all at once is part of the "aesthetic impact of that object as a work of art," Kren explains. In addition, the videodisc enables people to appreciate how dramatically and even how cinematically a story is told. While it will never replace looking at the work of art itself, it is the only way for the public to do the equivalent of paging through the books. To do so, museum goers will touch the screen of Sony's View System computer, which controls a Lasermax videodisc player.

"Believe it or not, the rest of the world is significantly bigger than the 8- to 18-year-old marketplace. If, God forbid, we should have some interactive entertainment that a 50-year-old would enjoy, we will have tremendous opportunities."
—Nolan Bushnell, Axlon, Inc.

Facsimile books of illuminated manuscripts are very expensive and not very faithful to the original, so getting the most color-accurate and high-resolution results was a priority. The Getty hired Interactive Production Associates (IPA) in Los Angeles, to do the job. IPA's Peter Bloch, David Schwartz, and Michael Yampolsky trailblazed image capturing and graphic overlay techniques for the Sony View System. They decided to compare a film transfer method with Truvision, Inc.'s TARGA® board. Film transfer involved sending 4 × 5 transparencies supplied by the Getty to a camera transfer service that put it on fine grain 35-mm motion picture stock, which was then transferred onto the videodisc. In the other method, they used a Sony DXC3000H camera to send the image from the same transparencies onto a TARGA board. Those files were dumped off onto betacam and onto one-inch videotape and finally onto the videodisc. "Without a doubt, there are qualitative and quantitative differences. The highest resolution image comes directly off TARGA," says Bloch. Rather than use an off-the-shelf videodisc authoring system, for extra flexibility, Yampolsky decided to have it hardcoded for the disk in C. Eventually the museum might sell such videodiscs in its store.

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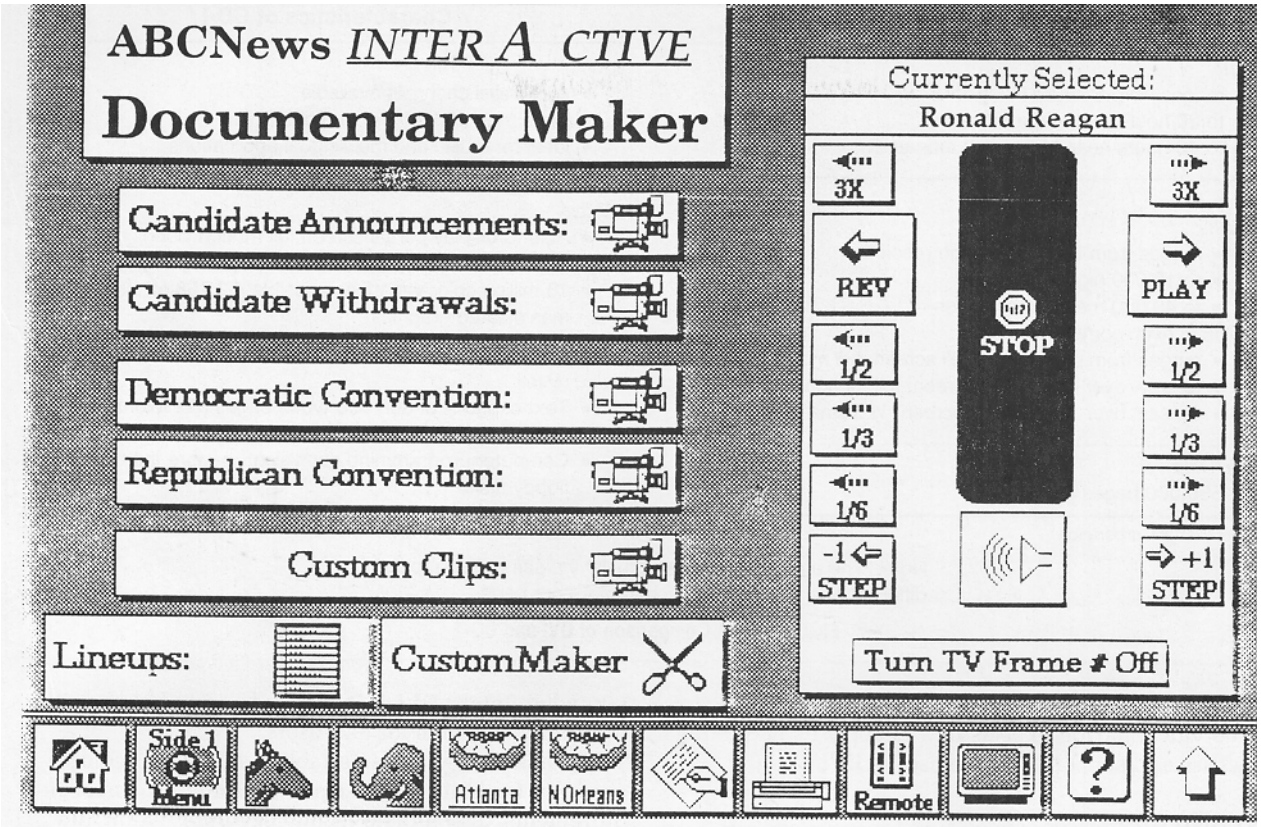
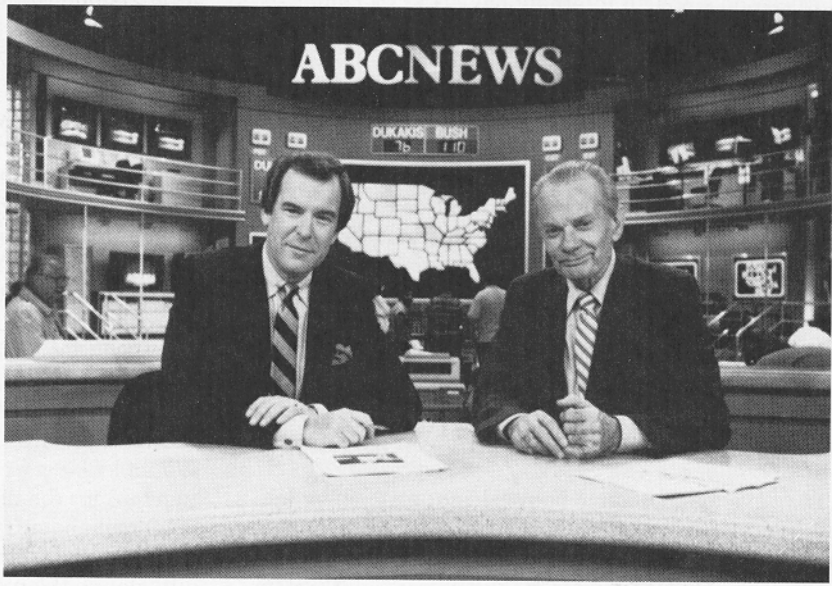
From Broadcasting to Schools . . .
While the Getty videodisc shows stills, many videodiscs show full motion video. Last spring, ABC News Interactive, in New York, a new division of ABC/Capital Cities, and Optical Data Corporation, in Warren, NJ, released a videodisc, "The '88 Vote: Campaign for the White House." One side contains announcement and withdrawal statements of all thirteen candidates, biographical information, excerpts of key speeches at both conventions, and delegate and electoral vote information. The other side contains Bush's and Dukakis' statements on issues, campaign commercials, election day coverage and voting results. Transcripts of all the speeches are also available. The videodisc can be controlled with either a remote control or a Macintosh via a HyperCard stack, so you can navigate through the clips, information, and graphics.

According to David Bohrman, ABC News Interactive Executive Producer, the inspiration for "The '88 Vote" came from the 10,000 electronic cueing cards that had been computerized for the first time using HyperCard for anchor Peter Jennings as he covered the election. Previously they used about 200 5 × 7 paper index cards that were easy to lose and hard to read. The prototype videodisc took two to three months to develop and is intended as an interactive tool for teachers. "The teacher is the glue that holds this together," he says, "It's not something that the teacher can put on and go away to smoke a cigarette for 20 minutes," says Bohrman. ABC News Interactive also created Documentary Maker, which lets the user become a director; he or she can create a custom video on the spot. For example, the teacher can preselect a series of clips and show them to the class, and he or she can also break the class into groups and tell them to come up with their own documentary on the campaign.

From Analog to Digital . . .
Asked why he chose to go with analog videodisc instead of digital video stored on a hard disk or CD-ROM, Bohrman said that CD-ROM is still too expensive and digital video is not broadcast quality. "It will be, and at that point we'll move to that." In the meantime, since ABC News has a massive library of 350,000 videotapes and some film that can be transferred to tape, it plans to offer more videodiscs, such as "In the Holy Land" on the PLO and Israel, and one on the life of Martin Luther King.

But videodisc players are also expensive ($1000) and, according to *The Videodisc Monitor* editor and publisher Rockly Miller, in 10 years about 560,000 players have been installed nationwide. IBM has created Marketing





The '88 Vote: Campaign for the White House

The *'88 Vote* videodisc is accompanied by a HyperCard stack which is similar to the one used by Peter Jennings during his news coverage of the Presidential race. It allows direct control of the videodisc player for review of clips or browsing. A function called Documentary Maker lets a student or teacher be the "director" and arrange random clips in any order for analysis or presentation. Copyright 1988 ABC News/Capital Cities.

Assistance Program (MAP) for its touchscreen Info-Windows Presentation System, which was initially developed in 1985 as an in-house educational system. And now there are over 15 authoring systems and 60 MAP participants, according to Gary Barron, Senior Program Administrator, Advanced Education Systems. But Barron sees videodiscs competing with digital video for the next six years and then expects DVI on CD-ROM to supplant laser videodiscs. And Miller says six years is quite a long time in the computer world. Digital Video Interactive (DVI) will encroach upon videodiscs, but he says "we will have a long way to go before digital formats are anywhere near as cost effective or data dense for full motion video and large databases. In the meantime, combinations of the technologies are evolving; an IBM/Duke University project on teaching anatomy uses a PS/2 hooked up to a videodisc, which supplies the video, and a CD-ROM, which

Characteristics of DVI	Characteristics of CD-I
Audio • ranges from 5 hours FM stereo • to 20 hours mid-range monaural • to 40 hours near-AM quality monaural	*Audio* • 16 parallel channels available • More than 19 hours of audio possible • Ideal for music and multilingual applications
Video *Stills* • ranges from 5,000 very high resolution • to 10,000 high resolution • to 40,000 medium resolution *Motion* (with companion audio) • ranges from over 1 hour full screen, full motion • to, say, over 4 hours ¼ screen, full motion • to, say, over 16 hours ⅛ screen, ½ frame rate	*Video* • Able to display partial-screen full-motion video • Capacity of 7,000 natural (photographic-quality) pictures • 16 million color variations possible, 32,768 for user-manipulated graphics
Text/Data • 650,000 pages	*Text/Data* • Text capacity of 300,000 typed pages (20-volume encyclopedia) • Computer programming equivalent to more than 1,000 floppy disks
Source: Intel Corporation.	Source: American Interactive Media, Inc.

Note: The amount of text is actually the same, but appears different due to the allotted characters per page.

FIGURE 1. A Comparison of DVI and CD-1

shows graphics. During the transition from videodisc to digital video, Barron expects IBM to apply its marketing expertise and support in videodiscs to DVI.

DVI AND CD-I

At Microsoft's Fourth International CD-ROM conference, IBM and Intel announced that they will further develop and market DVI for IBM's PS/2 line of personal computers. The agreement not only enables the computer giant to enter the digital interactive multimedia market, it lends support to a new technology that has struggled to emerge. "We're poised at the beginning of an era that will reshape the way people use personal computers," said James Cannavino, President of IBM's Entry System Division. "With multimedia we're on the verge of something almost magical," that enables people to watch videos and hear sound and music instead of just reading text on a computer screen, Cannavino claimed. "It will appeal to a much broader audience, including those who are intimidated by interacting with computers. With multimedia we will win them over," he said.

The development agreement calls for an open system approach to integrating interactive multimedia and will "provide a stable common environment for applications software vendors, computer manufacturers, and system integrators," said Intel's David House, Senior VP and General Manager of the Microcomputer Components Group. Together IBM and Intel will define new DVI technology products including boards, software, and integrated circuits. They will also develop IBM PS/2 micro channel architecture (MCA) board products. MCA supports the very high data rates DVI requires, according to Cannavino. Intel will publish the specifications for DVI-based systems and expects the agreement to expedite applications development through the early 90s, when Intel's DVI chip sets and add-in boards will be readily available for end-users.

IBM and Intel will also establish a joint technology center to facilitate DVI acceptance, solicit customer requirements, disseminate technology information and support application development. The center will open this year at Intel's facility in Princeton, NJ. Intel also introduced its Pro750 application development platform for DVI, which both companies will market. End-user delivery systems will be available later this year.

Many at the conference interpreted the partnership as a boon to digital video multimedia, although some raised questions about DVI's transmissability. Said Toshi Doi, Sony Corporation's Senior General Manager Super Micro Systems Strategic Business Group, "DVI involves asymmetrical coding and it takes some time for preparation. Theoretically it could give better picture quality, on the other hand, the chip from Intel could not be used for transmission or for storing motion pictures on hard disk. Today, CCIT is defining transmission standards for motion pictures, and at least we should look very carefully at that before defining the standard for the media." Since for computers, "we cannot forget about transmission," he cautioned attendees to wait, think over asymmetrical coding and then carefully define the industry standard. But Microsoft's Rick Hargrove, Group Program Manager for Multimedia Systems, disagreed. He said DVI is media independent because you can play back off a hard disk and CD disk. "I see technologies like DVI, that can compress and play back information, as being very important in the future, regardless of whether we are at ISDN levels with optical fibers or multiple Gigabyte CDs."

As one of the major corporations that invented Compact Disk-Interactive (CD-I) with Philips and Microware Corporations, it is not surprising that Sony might wish

to cast doubt on DVI, which can be considered competing technology. (See Figure 1 for a comparison of these technologies.) DVI uses a general purpose signal processor for audio and custom processors for decoding video and will run on top of personal computer computers' operating systems. CD-I is a packaged system, with its own player and a UNIX-like operating system called CD-RTOS (Compact Disk Real-Time Operating System), and the system will be hooked up to TV monitors and stereos. As such, CD-I is aimed more for the consumer market than is the current delivery form of DVI. To produce authoring tools for CD-I, five companies formed a new consortium last spring, called OptImage, with operations based in Des Moines and Chicago. The companies are N.V. Philips, the Netherlands; Sun Microsystems, Cupertino, CA; Microware Systems Corporation, Des Moines, IA; Datalink Corporation, Minneapolis, MN; and National Computer Systems, also in Minneapolis. Their charter is to consolidate available hardware and software development platforms using a set of new, high performance authoring tools that facilitate efficient creation of new titles. Philips and Sony have issued three sets of specifications to developers: the Red Book for CD audio, the Yellow Book, for CD-ROM, and the Green Book, for CD-I. CD-IV, a Philips format to integrate CD-I and interactive videodisc, is expected soon.

One major difference between DVI and CD-I is that CD-I does not accommodate full-screen full motion video for more than a few seconds. It can show partial screen full-motion video, but is better suited for full-screen full-motion animation, says former OptImage VP, Technical, Richard Bruno. That is one reason why CD-I is said to be especially suited for children. (See Tell Me Why on p. 878.)

Bruno has been heading the development of an authoring system, The Information Factory, which will enable audio/video designers, script writers, producers, and directors to design on a computer and automate such processes as digitizing that information, manipulating and interleaving it, and so forth. The Information Factory is modeled on the methods used to make a motion picture. "The information factory concept first starts with specifying," says Bruno, "You can't make a film unless you have a specification—a screenplay. Next, you add details like individual camera shots and settings. After these have been shot, they must be edited. And once you've done all the editing, then you have to splice it together and add audio and then see what it plays like in its final cut. You may have to re-edit again and there are iterative steps until you're satisfied with the total work," Bruno explains.

"In the ideal Information Factory you also start with a screenplay, but instead of pencils and paper, you use a computer to design the logical structure of the screenplay, and then from that you then go deeper and deeper in the details of the application until you reach the level where you have actual pictures and actual sounds and actual application software that runs it. And you specify that. You have cameras that can automatically grab slides and pictures from videotape and digitize them. It has audio grabbers that grab audio that you've put on normal tape facilities, and it can edit it. It can do all the things that you have to do in order to make a full title."

Parts of the fully automated Information Factory, are now being beta tested, says OptImage VP Sal Locascio. OptDesigner helps specify and produce the equivalent of a screenplay. It then delivers its data to OptImager, which digitizes, cuts and pastes, and manipulates images resulting in a compressed image, that could be put on a disk. OptTuner collects, digitizes, and edits sound and then puts it in a compressed form that then can be put on the disk. Two other tools are yet to come: OptOrganizer, which is a database that will track all the data that goes through the system and will provide status indicators, and OptAssembler, which will assist the developer in producing the application program and will assemble and test it.

HIGHLIGHTS OF THE MICROSOFT CD-ROM CONFERENCE

While researchers wrestle with the technical issues of interactive multimedia, developers are grappling with creating applications for many formats without complete, usable development tools and authoring systems. What would be an optimal tool for the myriad of individuals involved in creating a multimedia production? Products will be built not solely by engineers, but by graphic artists, erstwhile movie and documentary makers, former sound studio technicians, or combinations of all of these, along with software engineers. Their areas of expertise therefore range from writing and linking subroutines and thinking about compiling code, to creating graphic overlays, to film and video post production to sound editing. Each is accustomed to his or her own technical aids. And since CD-ROM is a medium for storing and retrieving the textual, graphical, video, and audio data comprising multimedia, much rests on the direction of that infant industry. But figures vary due to methodologies and the many different kinds of optical disks. According to the Business Communications Company study, the average annual

A Compressed Cat. Using Digital Video Interactive, this image can be stored on CD-ROM. Courtesy of Intel Corporation, Princeton, N.J.

Tell Me Why

Designed to answer questions children most often ask, the CD-I title, *Tell Me Why*, encourages kids aged 7 to 13 to explore five broad topics: our world, how things began, the human body, how things work, and the zoo. Based on a newspaper series from the 1960s with the same title, the CD-I version was developed by Interactive Production Associates for American Interactive Media. Both a Macintosh II and an IBM PC were used during development.

The image on the top is the menu for the exhibit called "First Pictures," which poses the questions, Who made the first photograph? How did movies start? and Who made the first paintings? The image on the bottom shows part of the answer to the last question, while the audio explains cave art in Lascaux, France.

Created with Pixel Paint, a CLUT-based (Color Look Up Table) paint program that runs on the Mac II, the graphics contain up to 128 colors. These were chosen from the 256 colors available on the Mac, but the CD-I environment actually has a palette of 16.8 million colors. With CD-I these colors can be changed automatically, so in one exhibit about the difference between how light mixes and how colored paints mix, children watch red, green, and blue combine to form white, and then red, yellow, and blue combine to make black. "It's not like video, where we would have to have a different frame for every different thing you saw," says Director Michael Yampolsky, "CD-I can actually change the colors." In addition, CD-I dissolves between two planes, so some animatics that normally require editing can be done in run time. For example, in one exhibit not shown here, a heart appears to be beating as the animations alternate between two frames on different planes.

IPA/AIM often had to create production methodologies from scratch. The CLUT animations on the Mac had to be adjusted for differences in the pixel aspect ratio from the Mac to the CD-I environment, for example. When images were created with TARGA® and Vista® boards, IPA/AIM wrote routines in C to take files from the Mac to the CD-I system.

Some of the history of authoring tools for videodiscs seems to be repeating itself here. "Just as we had to create methodologies, we had to participate in creating development tools. The development budget for *Tell Me Why* is incredible because we have had to invent everything," says Yampolsky, "It's like when we made videodiscs, seven or eight years ago. We would create methodologies that would let us do things relatively expensively. The second time around we would do something in three days that took three weeks the first time." In addition, a final CD-I product can be very disk intensive, taking up as much as 650 megabytes.

Courtesy of Interactive Production Associates, Copyright American Interactive Media. Director, Michael Yampolsky; Producer, Peter Bloch; Art Director, Jim Kealy; Graphic Artists, Emily Dorfman, Mark Chavez, Jeff Rosenkrans.

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growth rate between 1988 and 1993 for analog and digital videodisc players (which had a worldwide commulative total, or installed base, of 3,726,500 in 1988) will be 17.1 percent. CD-ROM (1988 installed base, 69,700 plus or minus 10,000) will grow 40.1 percent for the same period, and CD-video, which includes DVI and CD-I, will grow 33.5 percent. Looking just at the CD-ROM installed base, there were 171,000 drives worldwide in 1988, according to Julie B. Schwerin, President of Infotech, who conducted a study for the Optical Publishing Association. She reports total revenues for 1986, 1987, and 1988, of $31 million, $81 million and $406 million, respectively, and expects revenues to quadruple in '89. Looking at CD-ROM sales,

Linda Helgerson, Editor and Publisher of *CD-ROM End-User*, reports that in 1987, 30 to 35,000 drives were sold worldwide, 70 to 100,000 were sold in 1988, and this year sales could reach 150,000. Drives cost from $500 to $1,000, depending on features and interfaces. Some call CD-ROM drives "professional" to distinguish them from home CD-DA (Digital Audio) players for stereos.

Whether multimedia industry participants think of CD-ROM as a storage or distribution medium, they face the now classic problem that plagues the rest of the computer industry; how to decide what to develop and for what platform. A clear, lucrative opportunity exists when building a business application for a targeted market and a motivated buyer, but developing for a horizontal community, that uses an entire spectrum of personal computers and video equipment presents difficult choices.

Nowhere was this high-tech version of the chicken-before-the-egg problem more evident than at Microsoft's Fourth Annual CD-ROM Conference last spring. In the final general session, Stewart Alsop, Editor and Publisher of *P.C. Letter*, probed CD-ROM publishers, micro computer marketers and VARs, and video game and business software developers for their thoughts on the industry agenda. They discussed the implications of Microsoft's commitment to multimedia and the growth path envisioned by Microsoft Chairman, Bill Gates, as outlined the day before.

CD-ROM Extended Architecture

Announced in August 1988 by Microsoft, Philips, and Sony, the CD-ROM XA (for Extended Architecture) format incorporates audio from the CD-I format. It is consistent with ISO 9660, (the volume and file structure of CD-ROM), is an application extension of the Yellow Book, and draws on the Green Book. Two thousand copies of specifications were distributed at this year's conference. Using products available today for Level 1, the first phase of Gates' growth path, developers can begin working on multimedia applications with interleaved audio and data. Level 1 includes DOS or Windows, 640K, VGA graphics board (640 × 480 × 4), and CD-ROM XA. Level 2, which should be available in 1990 or 1991, will be based on Windows, a megabyte of memory, CD-ROM XA, advanced audio with a digital signal processor, and enhanced VGA (640 × 480 × 8). Level 3, with expected deliveries in 1991 or 1992, will run OS/2 Presentation Manager and will be able to play CD-ROM XA and DVI applications.

Commenting on the primary issue confronting multimedia developers today, Microsoft's Hargrove distinguished between encoding data for CD-ROM, integrating it, and then presenting it as multimedia. "Multimedia doesn't occur until you present that data," he said, "then you need a presentation platform." Once all the different elements are integrated with the distribution data, the most important and difficult task must still be perfected—integrating time. "When you start dealing with time and the real nature of multimedia, something that comes close to what consumers expect, . . . you can't do it," he said. "You run into bottlenecks very quickly—synchronization problems [and] contention problems. You have to be a very good engineer [just] to do a demo." Synchronization of operations and parallel data transfers are a difficult problem given today's personal computers and operating systems, he said. Microsoft is addressing this with IBM by creating a natural user environment, Hargrove said. In addition, multimedia applications are not practical now because of the variations in the installed base of video adapters, processors, RAM speeds, hard disk speeds, whether there is a CD-ROM or not, Hargrove said.

Professional and Consumer Drives

This complex picture makes Microsoft reluctant to rush to deliver a less than fully integrated system. Further, it could not be offered at the right price, Hargrove said. At $2,500 to $4,000, such systems could fail to meet expectations, but disappointment due to price is not the only fear; misunderstanding CD-ROM in the entertainment/electronic games industry could threaten the reputation of the CD-ROM industry as a whole. CD-ROM systems for consumers could prove disappointing if people expect professional CD-ROM capabilities, according to Sony's Doi. "I don't believe people understand the difference between the consumer CD drive and the CD-ROM drive we are now selling. The major difference is that the consumer drive's average seek time is 3 seconds. On the other hand, the professional drive's seek time is 300 milliseconds. Also, wear is quite different. Therefore, if you use the consumer drive for heavy professional use, you will be very disappointed," he said. The consumer CD-ROM might also affect the ability of personal computers to penetrate the consumer market, said Jim Mackonochie, chairman and founder of the British company Pergamon Compact Solution, a division of Maxwell Communications Corporation. This suggested that attempts to find new markets for the IBM PC and PS/2, which many interpret to be the purpose of the IBM/Intel DVI alliance, could fall flat. Pointing to the 70,000 CD-ROMs packaged within NEC's new video game project PC Engine that were shipped in the preceding four months, Mackonochie stated that including the other 170,000 professional drives, that meant a 70 percent increase in the installed base at a mass market price point. "The entertainment

"With multimedia we're on the verge of something almost magical. . . . It will appeal to a much broader audience, including those who are intimidated by interacting with computers. With multimedia we will win them over."
—Jim Cannavino, IBM

industry is going to be driven by CD-ROM peripherals to video game machines," he said, "and within the year we're going to have the second generation of Segas and Nintendos based on the 16-bit architecture. The growth of this may have an effect on the MS-DOS platform trying to move down into the mass market." Hargrove retorted, "Potentially, [but] I don't know if the threat is any more real than CD-I." Doi then invited manufacturers of all computer architectures to join in on CD-ROM XA to create a "common space" between IBM PCs, Macintoshes and CD-I systems. In response, Apple's Jim Davis, Director of System Software Product Marketing, stated that Apple sees CD-ROMs permeating its product line, and that the CD-ROM XA levels schedule was not a threat to the Mac. "We want to get the ball rolling . . . We're always glad to have IBM's participation in the marketplace," he said wryly. But Apple had declined to quote its CD-ROM sales, or sales of its products bundled with CD-ROM, at a press conference the day before.

Alsop picked up on CD-I, asking Doi how Sony regards CD-I's future. Sony's enthusiasm for and commitment to CD-I had been doubted earlier, since Sony was conspicuously absent from an OptImage press conference, but Doi stated that Sony has not made any decision about CD-I. "There might seem to be a contradiction between CD-I and CD-ROM XA, but its not a contradiction," Doi insisted, "XA makes it easier to then go to CD-I. CD-I could be a consumer implementation of CD-ROM XA."

CD-ROM XA and Authoring Tools

What might be the end product if a publication or production evolves through the three XA growth paths outlined by Gates? Pergamon's Boeing 757 Maintenance Manual serves as an example in the computer industry. At XA Level 1, Pergamon envisions spoken instructions when an engineer calls up text, for example. The audio could say, "Don't put more than 24 ft/lbs of torque on this nut." At Level 2, the screen could show a color picture of a component, and at Level 3, a digital video of a maintenance man could show how he installs that component. While this might be good for vertical markets where revenue per product shipped is high, Alsop commented that it is hard to imagine revising a product every nine months for markets in which products command lower prices. But Doi observed that although prepared on a PC, Sony found that the Boeing manual could be played back on a UNIX workstation using the KRS retrieval system. That means greater possibilities within vertical markets, Doi said, and the same strategy can be used for horizontal markets—another reason why he would like Apple to support XA.

Experimenting with the value added by audio at Level 1 in the entertainment/mass market realm, Pergamon recently incorporated full stereo audio into the game Defender of the Crown. "We'll have to see how consumers pay with their dollars and pounds for this added dimension," Mackonochie said.

Audio help files mentioned by Mackonochie are widely foreseen. He said, "Every publisher in this room has this vision. We will be able to publish multimedia products in ten years' time." And David Roux, VP of Information Services Group at Lotus Corp. said, "If we're honest with ourselves, we [will admit that we] haven't come anywhere near scratching the surface of the capabilities at Level 1. There are years of work to be done." He also added that the expectations for "quality of production values are an order of magnitude greater than anything available today." Roux expressed the sentiment that the industry should not preoccupy itself with Level 2 and 3 time frames. He urged serious developers to find a business application, start building a product, and figure out what price they can sell it for given the amount of time it takes to build. New capabilities could be added later. At a later point in the panel he went so far as to say that lack of tools does not stand in the way. "If you have a great idea, you can do it," he said, "It costs a little more money, takes longer, but that's no reason not to do it. What stands in the way is lack of will." The audience applauded.

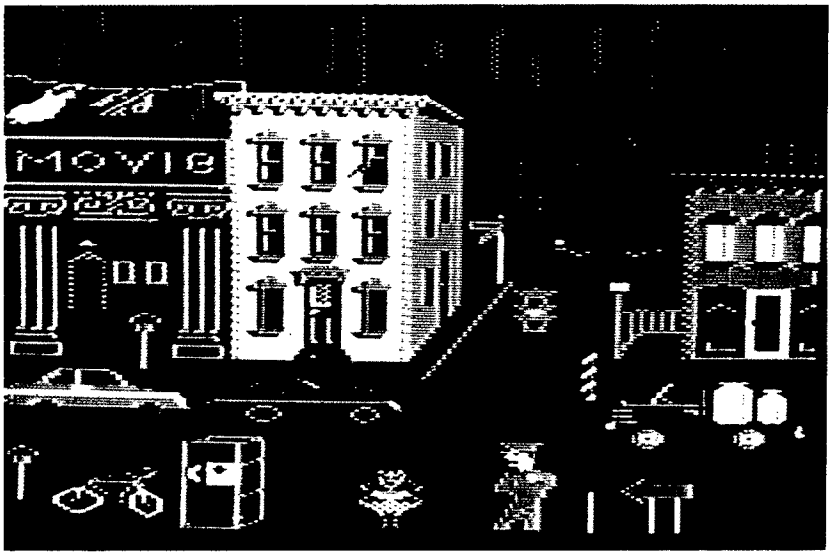
"The issue of multimedia user interfaces is moving more toward the paradigm of the Mac, which is to recognize and point, and away from remember and type."
—Jim Davis, Apple Computer

But John Scull, President of Macromind, Inc., reiterated the need for tools and urgent need for developers to choose platforms. His company makes a desktop video editor and storyboarding tool for the Macintosh. "Many of us are in a position where we *have* to sell products *today* and must look at platforms that have consistency, [on which] people can actually do things today. That's why our hopes are on the Mac."

But Hypercard, which requires no programming, is already widely used even though it isn't a professional authoring tool, Alsop commented. When Mackonochie indicated that better development tools were needed, Apple's Davis countered that creating the right tools is an "issue of iteration." Hypercard "might not be the right end tool, but it is *an* end tool," he said. "We have to produce tools so people can iterate toward the mass market. In this business it is rare that you start with a blockbuster product. People have to be willing to try and willing to iterate. We're trying to provide fundamentals. . . .We don't quite know what the blockbuster product is, but we do want to make sure that it's possible to do it on the Mac," Davis added.

Although he believes that choosing a platform is a key issue, Scull said the main objective should be to get tools to people so that they can use their imaginations and get direct feedback. That will lead to better content. Macromind is focusing on all dimensions—time,

Grandma's House
An electronic playground for children being introduced to computers, Grandma's House was designed and developed by Interactive Picture Systems. IPS animation tools, Movie Maker®, were used to create compressed graphics required for storage on a hard disk. Distributed by Spinnaker Software, the program runs on the Commodore 64, Apple II family, and Atari 800 series. Graphics courtesy of Interactive Picture Systems, New York.



sound, motion, synchronization, and high quality graphics, he said. "Otherwise all we're doing is taking a book and throwing it on a screen," he said. "It's like when the movie business started. All they did was shoot a play until Griffith came along and said 'Let's use our technology, let's use our imaginations.' And the industry took off. That's what needs to happen here."

Some complain that CD-ROM is progressing too slowly. Others point out that after three years the business, at $300 or $400 million in sales, is larger than the PC business was after the same number of years and is therefore moving very rapidly. And CD- ROM has its detractors. Guy Nouri, President of Interactive Picture Systems, Inc. in New York, has been producing interactive videodiscs for almost ten years and now advocates interactive programs stored on hard disks. He emphasizes the effectiveness of video stills. Says Nouri, "I'm not embarrassed. I think 90 percent of the content of the message can be conveyed with intelligently presented and produced stills, with sound. It's a hell of a lot cheaper to maintain." Content with compressing video stills and storing them on hard disks, which are mainstream, he notes that information can be updated more easily. "Interactive technology is valuable for getting people to react with the information. But if that information is old, that experience is old," he says. He has invented a video fax system that transmits stills and updates interactive installations over telephone lines. "There's still no real reason to get into CDV (Compact Digital Video) right now," Nouri says, "That technology really hasn't settled out yet, and around the bend, from Radio Shack, we're going to have a read-write disk (Thor), which will blow CDV out of the water—and be a hell of a lot cheaper."

Speaking at Microsoft's CD-ROM Conference about "the crime of WYSIWYG [What You See Is What You Get]," which is to use the computer as a paper simulator, Ted Nelson was also not enthusiastic about the opportunities presented by CD-ROM. It could perpetuate the tendency to simulate paper, he said, and defeat the possibilities of multimedia. "Here we have this extraordinary instrument and yet we use it to imitate a piece of paper and the way something is going to look when it's put on a paper." WYSIWYG means that what you get out on paper is all you can have, he said. "In other words, we're limiting output to this picture of something that's going on paper. It's like driving a 747 on the highway. Similarly with CD-ROM . . . I think CD-ROM is a shuck 'n' jive. It's just another system of disks. The whole point is to make these nonsensical boundaries of storage media go away, not to errect walls of the boundary of the disk." Creating such closed packages is "no way to build a world," he said. "I want to make the world a better place, not a re-Balkanized, hard-up system of little fiefdoms." Pointing to the *Oxford English Dictionary* on a CD-ROM, he objected, "You've got to use *their* interactive structure on the screen, use *their* key commands. The only way you can use it is their particular way, unless you write your own screen drivers and so on." Although not criticizing that work in particular, he explained, he said there is something wrong with the whole idea of dividing the world into independent, incompatible kingdoms.

Looking to the future, Bushnell says that as Americans have more leisure time, they will tire "of being passive to death. We want our active minds. . . . The next industrial revolution isn't going to be, like many people think, a change in man's mind. It's not going to be thought of on the level of implementation. It's going to be thought of on the level of creation." As products allow people to pursue creative solutions, he says, we will see "an erosion of the barriers to creativity."

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