MULTIMEDIA
TECHNOLOGY
FROM A TO Z

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FOREWORD

An Emerging Vocabulary for an

Emerging Technology

For those who envision even a fraction of its long-term possibilities, the future of

multimedia technology has impor tant implications for several industries. The coming of

multi media technologyÐthe merger between the software, film and TV, publishing, and

telephone industriesÐoffers much promise. But, like a gigantic, transglobal,

multi-organizational corporate merger, it threat ens to bring with it professional

tension and possible confusion.   In the first place, this merger calls for the

integration of occupa tions that have previously remained proud and separate nations on

the map of professions. For example, in the upcoming age of e multi media technology,

film producers must learn to work smoothly with software developers; which means, of

course, that both parties, ego centric by nature and with a history to prove it, will

need to learn to be sensitive to the intense production demands placed on the other. One

highly collaborative medium will become part-in-parcel of another highly collaborative

medium. And, in about half the time it takes this synthesis of development processes to

take shape, the whole emerging enterprise of multimedia technology may have to take stock

of other sets of entrenched and demanding development and produc tion methods from other

industries, ad infinitum.   Therefore, delivering on the enormous promise of multimedia

technology may result in a transitional period in which applications are created somewhat

turbulently and not without conflict. As with any

human endeavor that demands large doses of confluence and com promise, one of the first

battlefields may certainly be the language itself. Sophisticated technical vocabularies

may collide, perhaps as never before. Struggles for lexical hegemony are likely. This

conflict may no doubt parallel the inevitable struggles for power and author ity that

arise as each professional faction jockeys for position in terms of deciding who produces

what for whom.   Take the word "frame," for example, innocently useful to so many of

the tributary professions that flow into multimedia technology. To the animator, it means

a single visual element, one picture in a series of pictures run together to create the

illusion of motion. To the film maker, the word "frame" means nearly the same thing,

though the methods for producing a frame of video are quite different than they are for

producing a frame of animation, leading perhaps to misunder standing Îs, even between

these two closely related professions. To the software developer, the word is at least as

purposeful, but it means something entirely differentÐa packet of encoded information

punc tuated at either or both ends with specific digital patterns that demar cate and

identify the contents. Audio producers have, in their own right, a specific use for the

word "frame," and it only roughly corre sponds to these other uses. We could go on, but

the point is a simple one. Terms like "frame," which do such a good job of evoking struc

tural images for the entities they name, abound in all of these profes sions, and in many cases occupy pivotal positions in the nomencla tures surrounding them. One senses that they may not be abandoned easily for the other profession's meaning of the word.   All of which brings us to the purpose of this book. As the vo cabulary of multimedia technology emerges from the fray of con vergingÐsome would say collidingÐprofessions, there i Ús an abun dant need for professionals to cross-pollinate one another with their most meaningful terms. Clear communicationÐalways at a premium in collaborative venturesÐmay escalate to a new level of significance as filmmakers try to direct the activities of computer programmers, and software designers labor to explain themselves to TV program mers. We intend for this book to infor m as well as to build bridges of communication between these conflicting professions.   In pursuit of this ambassadorial goal, we have selected key prin ciples and terms from each of the converging industries that we be lieve representÐat least during this formative eraÐ the cornerstones of the multimedia industry. Thus, from the film industry we have in cluded the term EDL (edit decision list), an everyday item in video production, but an utter unknown to professionals in software devel opment or print publishing. From the world of computing, we have included such commonplace terms as CPU (central processing   ¾unit), which are probably familiar to most professionals, but, as the ma chinery of multimedia technology invades virtually every corner of our homes and of fices, may certainly become as central to our every day household language as, say, terms like baseboard to bevel. In selecting these core terms, we have tried to be judicious, delving only as deeply into the semantic interiors of these tributary professions as we feel may be truly useful to multimedia technology initiates.   In addition to providing this cross-pollination of

vocabularies, we have attempted to capture, in as comprehensive a fashion as pos sible,

the body of terms coming into existence as a direct result of the emergence of multimedia

technology. This new language is spurred primarily by two forces: the host of enabling

technologies ushered into place to bring multimedia content and applications into the

home, schools, and the workplace, and the significant design activity sur rounding the

production of that content.   In   8 the area of enabling technologies, for example,

there is now a flurry of activity associated with the digitization and compression of

video. Video, which has traditionally been an analog medium, is cur rently being co-opted

into the all-digital computer realm. This pro cess is creating an explosion of new

technologies and a correspond ing volume of new terminology to describe these

technologies. In the fledgling realm of multimedia content creation, the discipline of in

terface design is expanding to occupy a good part of the academic niche serving this

embryonic art form. Like all academic niches, it too is creating a steady stream of new

terrns.   Finally, because the industry is still young, we felt it is of some value to

identify key places and events. Like most of our society, the universities are still a

Þ bit stunned by the meteoric rise of multimedia technology and have not yet had the

requisite half-decade or so to approve new courses, let alone realign their departmental

structures to accommodate this new medium. Of course, that may all come in due course.

Presently, however, there are a number academic pio neers who have surfaced, some of them

privately funded and outside of the university structure. Since these few institutions

are now hav ing a relatively large impact on the conceptualization of multimedia, we felt

it was worthwhile to include them in the book, so that some of the early doers may know

where to find some of the early thinkers.   We are firm believers in the power and

importance of language. To the extent that a   Eny human enterprise is governed by vague,

am biguous, or even misguided language, it is likely that the enterprise itself may be

similarly indisposed. We are also true believers in the future of multimedia technology.

We are convinced it stands in the same transformational relationship to the twenty-first

century that the sum of its tributary media of film, television, computing, and tele

phony have with regard to the twentieth century. We are thus moti vated to make whatever

small contribution we can to setting the lan guage of multimedia on a well-defined

initial course. And we wel come your involvement in the activity as the language of

multimedia and its corresponding technologies unfold.

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PREFACE

his book defines for you over 1,000 terms related to multi
 Ñ media. Generally sp   - eaking, these terms were selected around   sets of

professional functions that relate to multimedia in one of two ways. They either belong

to one of the major contributory disciplines that provide the bases for this new

industry, or they be long to a set of competencies that owe their origins to the birth of

multimedia.   For example, as video becomes "just another data type," the con siderable

language surrounding the century-old industry of film and video production has become a

justifiable concern for those who would talk the language of multimedia. Thus, we have

included a large num ber of film and video terms, though we have not tried to duplicate

that industry's entire nomenclature.   Instead, w   We have made an effort to include

those terms that would be of greatest use to developers who are working to incorporate

video in their multimedia content, and particularly for those who are pro ducing CD-ROM

titles, which is now the most intense locus of video activity in this young industry.

Since most of these developers are not blessed with Hollywood-sized budgets, but instead

rely heavily on stock footage and other forms of predeveloped video, our most con

centrated effort in the video realm is in the area of post-production, where the general

move toward all-digital, computer-based tools pro vides us with a reinforcing motive to

include these terms. Thus, you will find a cluster of terms around such areas of video

post-produc tion as digitalvideo effects, which has earned itself the status of an

acronym, DVE.   We also selected terms c   fentered around areas of professional com

petency that owe their very origins to the birth of multimedia. For example, certain

software tools that owe their newborn existence to this industry are called "authoring

systems." These software toolsets have many dimensions and subclasses, and we have made

an effort to be as inclusive as possible with regard to the rapidly growing lan guage

that describes their emergent richness and diversity.   Hence, as with any professional

nomenclature, the semantic net work that is the language of multimedia is centered around

an over lapping system of conceptual nodes, many of which owe their origins to earlier

sources and centers of meaning, and many others of which owe their genesis to the birth

and growth of the profession. Because there are so many clusters of interrelated terms,

the reader will find a large number of c   éross-references contained within the entries

to this dictionary. We have used italics wherever we have included a word within a

definition that we have also defined in its own right else where in the dictionary.

In many instances, we introduce a new, and often esoteric, term as part of another term's

definition, but have elected not to define it in its own right, typically because that

esoteric term lies below what we have determined to be a sort of threshold of interest.

Based on our judgment, any terms lying below that threshold do not carry enough weight in the industry, or perhaps lie so far to its fringe that they do not merit their own entry. In such cases, we have enclosed those terms in quotation marks, and made an attempt to define them insofar as they contribute to the definition of the entry in which they appear.   If you were to pursue the cross-references, and all of ° our embed ded definitions, as if riding the associative trails of a hypertext docu ment, you would eventually start to see the multinodal pattern of mean ings by which this young and vibrant industry is erecting its own language. It is our hope that you will enjoy and be instructed by our efforts to define the industry.

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INTRODUCTION
The Multimedia Indu   stry

A fter two decades in the great technology incubator, banished
 to such threadbare regions as corporate training departments,
 and to such deprived platforms as the first generation of per
 sonal computers, the phenomenon we are now calling multimedia has
 exploded onto the technological landscape with a force that even its
 most vocal advocates had not imagined possible. But what is it? Most
 of the authors of the considerable volume of what is being written
 about the subject are downright bewildered when pr essed on this blunt
 question. It would appear that, in spite of abrupt and blaring pronounce
 ments in the media, the identity of this new medium is very poorly
 understood.   Could it be that the future of multimedia is now happening so fast that

we have totally lost our place in the procession of technological history? Probably. But

there are a number of reasonably cogent things that can be said about multimedia and

about   Êwhere this emergent medium is heading. Based upon the reflections of a handful

of indus try leaders and early conceptual pioneers, it is possible to round up at least a

thimbleful of useful ideas. We offer them here as a provisional explanation of what's

happening.

Three Industry Segments

The early market for mult imedia applications appears to have divided itself into three

fairly distinct segments:
1. The Home Market: which owes its origins to the likes of Sega,
   Nintendo, and the other adolescent video games, is now on the
   verge of blossoming into a much, much more robust enterprise.
   The games themselves are becoming more sophisticated and in
   telligent and are now offering some of the first genres capable of
   attracting and holding an adult audience. Just around the corner

looms the promise of interactive television, which threatens to
turn the standard American couch potato into the newly rejuve
nated couch commando.

2. The School Ma ørket: which owes its origins to the small-scale,
   curriculum-based programs that ran on Apple IIe's, has recently
   played host to the large-scale integrated learning systems that rank
   among the most sophisticated forms of instructional software yet
   created. These systems integrate the electronic delivery of course
   content across broad, multigrade spans of content, and deliver
   that content via network-based client server systems that monitor
   learner performance in specific, objectives-level detail. With all
   of the great debate over the declining quality of the American
   education system, the pressure to explore various forms of in
   structional technology will keep this market growing at a rapid
   pace into at least the near future. 3. The Business Market: which is, ironically, the

most backward
   segment of the interactive market, has great growth potential. The
   tremendous pressur   Áe to reengineer business practices and pro
   cesses in almost every sector of our economy will likely elevate
   the attractiveness of interactive training solutions. Corporate
   America will be seeking ways to quickly and efficiently train large
   and geographically dispersed workforces as never before, and now
   that the corporate desktop is coming to be occupied by MPCs
   (multimedia personal computers), rather than just plain old va
   nilla PCs, the inclination to use interactive multimedia should
   grow dramatically.
    In sum, every segment of the multimedia market will be growing during this last

decade of the century. The business market will be driven by the need to constantly train

and re-train a diverse workforce. The school market will be fueled by mounting pressures

to modifyÐ if not overhaulÐ an antiquated instructional delivery system. And the home

market will likely be the liveliest of all, as the twitch-and-sho   - ot design model of

first-generation electronic games matures into sev eral successor genres, including the

first interactive forms of fiction and cinema, and various other forms of increasingly

immersive media. The hype is not foundless. The wave of mergers and acquisitions we are

now witnessing between previously segregated portions of the information economy are

nothing if not early harbingers of an explo sively innovative future. The massive and cash-rich telecommunica tions firms are buying entertainment and computing companies. Print publishing firms are seeking alliances with software companies. In fact, virtually every permutation of linkage between these various stew ards of information is being pursued with almost frantic vigor.

   All of these enterprises must be positioning themselves for some thing. But for what?

Multimedia Is about Converging Industries and Technologies

In 1978 Nicholas Negroponte, one of the true savants of multimedia, used   a Venn diagram and his intellectual track record as an MIT pro fessor to raise $70 million to launch the Media Lab, an organization dedicated to contemplating the far-flung technological horizons of communications. In the Venn diagram, Negroponte showed that three industries were converging to form a single technological powerhouse, one that would dominate the future of human communications. Those three industries were the printing and publishing industry, the com puter industry, and the broadcast and motion picture industry.   He projected that the overlap between these three industries would approach a near union by the end of the century. And while many futurists would just as soon have us forget their projections once the time of their foretold future has arrived, Negroponte's premo   Ònitions seem more and more worthy of acknowledgement the closer we get to the year 2000. Clearly, these industries are converging.   If anything, that convergence is ahead of schedule. And the mul tifarious outcomes of that convergence are a large part of what we are calling multimedia. They involve new products, new services, and new genres of art and entertainment. In fact, the impact that can be attributed to the interindustrial convergence that is multimedia seems to broaden with each passing year and certainly with each new jour nalistic interpretation.   The span of topics

covered in the trade and academic presses by articles that have the term "multimedia" in their titles is truly stagger ing. Much of what is written f oocuses on the enabling technologies, such as networking, transmission, and new forms of mass storage, on to the playback environments and the ever-expanding array of authoring tools. Many of the articles claim that in the final analysis content is king, and then proceed to spray the journalistic canvas with widely diverging interpretations of just what exactly constitutes mul timedia content.   Many writers think of multimedia as videoconferencing and its various derivatives, suc h as document conferencing, distance learn ing, and video mail. Others see multimedia technology as a new form of publishing, and thus see these media as those that are quickly re placing all major forms of paper documents with superior, interactive versions: electronic catalogs and brochures replace their passive anu inferior ancestors of the same name (sans the "interactive"); likewise, e   ~lectronic encyclopedias and computer based training programs re place the static encyclopedia and textbook, respectively; and, not to forget the arts, interactive fiction and fantasy games replace the most venerated form of document in our cultural history, the novel.   Still others see multimedia technology as a natural step in the direction of increasingly sophisticated and immersive media. These writers and thinkers are prone to let their thoughts drift among such topics as 3-D audio and video, motion platforms and force feedback, even on to the exotica associated with cyberspace and virtual reality. Regardless of how one chooses to judge these various attempts to describe and classify the things associated with multimedia, one thing is absolutely clear: multimedia is a serious phenomenon.   It connects to our most salient historical arcs. The merging of computers and media   ónow permits the authorÐor, as in film, the authoring teamÐto

enlist and engage the audience as never before. Rather than watching the performance of a

protagonist from a de tached and safe-harbor seat in the theater, the

listener-reader-viewer must now become something new and unprecedented in the history of

the narrative arts. The audience member must now become an ac tive participant, must now

become the very protagonist whose per formance is the thing that is judged.   The

convergence of publishing with computers and media means that shoppers and learners and

explorers will be able to take control of their media in ways that enable them to find

just the right adver tisement relative to their immediate needs; to individualize their

train ing experiences to match instructional content to personal skill and knowledge

deficiencies; and to select entry points on the ladder of challenge that are most likely

to lead to   the optimal gaming experi ences.   As we contemplate the consequences of

the converging technolo gies that are now being called multimedia, it is prudent to take

stock of a lesser known, but highly appropriate, quote from Marshall McLuhan:
The hybrid or meeting of two media is a moment of truth and revelation of which new form

is born .... The cross ings of media release great force.
                    Understanding Media, 1964.

    And, as we further devote our thoughts to the proposition of re sponding to a steady

flow of new, hybrid forms of media, it is also prudent to ask . . .

Why Bother?

ImaginingÐ for just a momentÐ that it might be possible for us to seize control of the fuel

line that feeds our capitalist engine with the flow of innovations upon which it now so

obviously depends, what type and amount of pressure would we want to place on the nozzle

that regulates the pace of new media? ImaginingÐ for just a wildly speculative   ÊsecondÐ

that ours might become the invisible hand of Adam Smith's economy, how would we adjust

our grip when it came time to determine the rate at which we permit our traditional media to transform themselves via the synthesizing force of digitization?   To inform the grip in our thusly deified hand, it would be appro priate to ask the larger question: what is the value of these new forms of media? In other words, what are the advantages of multimedia? By way of framing the answer to this question, we must first conjure at least a working definition of the proper scope of the term. In other words, we must first answer the question: Over what span of human interests will this upstart and wildly hybrid medium have a signifi cant impact?   Even at this relatively early juncture, the answer to this question seems obvious: the impact of multimedia will be global, both in a literal and a figurative sense. Like all major forms of communication that have gone before, m øultimedia willÐ in the fullness of timeÐ have a significant impact on every industry and population segment.   Using this perspective to frame the question "why bother?" and, thereby, to inform our decision making with regard to our imagined control over the rate of appearance for new media, it would seem appropriate to respond by looking at two very broad divisions of our economy: the arts and entertainment industries, on the one hand, and the remainder of the business world, on the other. What beneficial impacts will multimedia have on the arts and entertainment industries? More to the point, what benefits will multi media bestow on the creators of artistic and entertainment productÐ or, if you will, on what is being broadly referred to today as "con tent"? Stated with just one more minor twist: why would our most gifted creators of content take leave of the venerable media of our ancestors and contempo +raries (novels, film, painting, etc.) to risk their highly valued time and effort on producing the emerging artifacts of multimedia?   To provide at least a provisional answer to

these critical ques tions, we would like to turn to the insights of an individual whose

career predated multimedia, but who is of great contemporary mo ment because he is the

man who many would consider to be perhaps the most credible practitioner of the avant

garde in the twentieth cen tury. That person is Alain Robbe-Grillet (the last name

pronounced "Robe Gree-ay"), the French novelist who visited more experimenta tion on the

narrativ e form than any other writer in this century with works such as The Voyeur and

Last Year at Marienbad.   During his career, Robbe-Grillet penned several essays on the

transformation of the narrative form, a subject on whichÐas we have statedÐhe had

unparalleled expertise. Robbe-Grillet understood the restless nature of art, parti   i

cularly in this, our most restless of centu ries. Several of these essays were gathered

together into the little known 1965 volume For a New Novel. In analyzing the motivating

forces that are currently driving us in the direction of new, interactive forms of art,

it is appropriate that we exhume some the thoughts con tained in this mid-sixties

collection.   More than anything else, Robbe-GrilletÐboth in his novels and in his

philosophical reflectionsÐbelieved that the great historical arc of our storytelling

tradition is the trend toward increasing levels of realism.
It has always been the same: out of a concern for realism each new literary school has

sought to destroy the one which preceded it; this was the watchword of the roman tics

against the classicists, then of the naturalists against the romantics, the surrealists

themselves declared in their turn that they were concerned only with the real world.
   Central to this trend toward greater realism, in R obb   Õe-Grillet's mind, is the

ability for the author to gain increasingly direct access to the audience. In a comment

that clearly anticipates the dawn of inter active art formsÐthough it is fairly clear

that he was not specifically thinking of anything like interactive multimedia or virtual

reality at the timeÐR obbe-Grillet states: . . . "farfrom neglecting him, the author today proclaims his absolute need of the reader's coopera tion, an active, conscious, creative assistance."   Reading a Robbe-Grillet novel, even today, two to three decades later, is still a strange experience. Many people find his works impos sible to penetrate. This is not the time or place to explore the specific attributes that make them seem so out-of-the-ordinary; but what is appropriate to mention here is their most stunning attribute. Once one sees what Robbe-Grillet is trying to doÐonce one breaks his code, so to speakÐit is clear that the effect he is most trying to create is the elimination of the usual   /gulf that separates the reader's psyche from that of the main character; one sees that he is laboring to place the reader as far into the action of the novel as is possible via a literary instrument. In a sense, Robbe-Grillet is trying to make the presence of the author disappear, and thus bring the reader into direct and na ked contact with the protagonist's experience.   Robbe-Grillet speaks so directly to the issues surrounding the emergence of new media precisely because he did not foresee those media in any specific detail, but rather saw the larger forces and trends of which they are a part, of which they are the natural, late-twentieth century extension. Like its immediate predecessor, film, an interac tive multimedia program provides the author with a leap forward in terms of the power to recre   ate the scenes and dramas of man, and thereby extends our storytelling tradition's venerable drive towards greater realism. More vividly, though, interactive forms of stor ytelling and enter tainment force the audience into the work of art by making them ac tive participants in their creation. When an audience member plays the role of a protagonist and makes decisions that influence outcome, something fundamental and powerful has happened. As if in a Robbe Grillet novel,

the consumer of an interactive fiction experiences di rect contact with the narrative circumstances of the story.   The forces motivating the emergence of interactive and increas ingly immersive forms of art and entertainment are powerful. They are deeply rooted in much larger historical trajectories, and t   êherefore must seem inevitable to us, no matter what fits and starts and skepti cism may greet them during their initial stages. But what of more practical applications? What of the role of multimedia in the world of commerce and industry?   Here, again, we see powerful trends, but they issue from a differ ent set of motivating forces. Multimedia will play large in the busi ness world, but the forces that write the history of interactive media in this market segment will not be the same as in the arts and enter tainment world. Here, the key motivating factor appears to be some thing that we might refer to as the velocity of information.

 If we follow the major themes that have appeared in the business literature over the past few decades, we see that there is fairly wide agreement on what the key trends are: the globalization of the world economy, leading to increased levels of competiti   on in almost every industry segment; the need to compress every aspect of the product life cycle, from R&D to manufacturing and especially into sales and marketing; the penetration of microprocessor -based forms of machine intelligence into almost every type of product and service, leading to an amplification of the forces behind technology-driven change; and, most critical of all, the need for organizations to employ a dynamic and flexible workforce, thus enabling them to change course quickly in response to sudden opportunities and/or competitive threats.   All of these themes relate directly to the need for organizations to change quickly; which, of course, is as much as saying they need to increase the rate at w hich they are able to learn and absorb new pro cesses and

technologies. As never before, the pressure to increase the velocity of information beats down on us, both from an individual and an organizational standpoint.   Thus, any techn ⁻ology that can make this acceleration more bear able, that can speed our rates of learning without breaking the bank, will hold great appeal. And while the first generation of interactive training programs has had its fair share of disappointments, there is no doubting that the long-term potential of interactive media in the business world is great.   In fact, a number of studies have appeared over the past few de cades that document the power of well-designed interactive training programs. It has been validated that a well-conceived interactive prod uct can be more effective than any other form of instruction, save perhaps the one -on-one mentoring that occurs between learner and expert. But, of course, experts are almost always scarce, and there fore very expensive, resources. They can be leveraged somewhat by using a seminar format, but then this form of instruction abandons the intense levels of interaction that confer so much value on mentoring.   The features of inter - active multimedia that make for an effective instructional delivery platform are abundant and are by now fairly well known. They include the ability to offer learners an appropriate level of control over the learning experience; to ask questions of learn ers, thereby forcing their direct involvement; to track the performance of learners over a range of questions and other interactive challenges, thereby building up profiles of learner knowledge and skill; to pre scribe entire learning sequences on the basis of objectively determined levels of knowledge skill; to use multiple and appropriate forms of media to meet the unique needs of particular instructional challenges and student populations; to track learning preferences, as well as per formances, thereby enabling programs to match delivery

formats to learning styles; and to link a diverse database of training resources to the even more diverse learning needs of large audiences, thus provid ing the long-aw aited power and promise of individualized instruction.   The benefits of an effective piece of interactive multimedia to a business organization are both numerous and potentially profound. It enables an organization to leverage the knowledge and skills of its strongest performers by encoding their expertise in the pedagogical logic of the program. It makes it possible for large and geographi cally dispersed companies to significantly reduceÐif not eliminateÐ the high travel and lodging costs associated with offering seminars. It offers learners the ability to take the training wherever and whenever they need it, the so-called just-in-time learning phenomenon. It en ables organizations to discern knowledge levels in their workforce, and thus be able to address specific streng Ûths and weaknesses. And it offers managers the ability to track the effectiveness of their invest ments in training, and therewith better allocate their future training expenditures.   Though the business world has been slow to adopt interactive solutions, the mounting evidence that these programs can deliver some powerful benefits will no doubt work to reduce the resistance. More important, though, the pressure on organizations to increase the ve locity with which information travels through their ranks will make interactive forms of instruction a near-necessity in the very near future.

But Will It Be Easy?

Increasingly, interactive forms of media appear destined to stand in the same relationship to the twenty-first century as fil tm and TV have to our own. The current floodtide of journalistic interest is almost willing the transition from linear to

interactive. But there are many factors which will make that transition difficult, expensive, and pain ful. In fact, at least two of the most significant problems have already made themselves quite apparent.   In the first place, the most obvious aspect of the interactive revo lution is also its most problematic, at least here in the early going. The most fundamental aspect of interactive is the digitization of au diovisual forms of information. This relatively straightforward pro cess holds the potential of unleashing some of the most powerful change agents in the history of the capitalist world. Unfortunately,
there is no question about its having unleashed a tremendous set of technological problems.   If we consider the past three decades to be   @the formative years of computer technologyÐ as most experts doÐ then it can be said that the formative period in the history of computing was all about the processing of symbolic forms of information, i.e., of text and num bers. As it turns out, digitally encoded forms of symbolic information are very compact, though this was certainly not the prevailing senti ment even just a decade ago, when personal computers were only capable of storing and manipulating a few million characters, or about the equivalent of a few healthy books. With the subsequent advent of hundred-plus megabyte hard drives, and then the 600+ megabyte CD ROM, we now comfortably hold the view that computers have risen up to swallow our books and accounting records. The lone problem remaining seems to lie in getting this information better organized.   But when we move on to the task of digitally encoding audio, and especially video, sources of information, we re-enter th Èe domain of the humbleÐ the very humble. One second of uncompressed, tele vision-quality video requires over 27 megabytes of storage. Pursuing this equation to some of its more painful conclusions, we find that the mighty CD-ROM player is capable of handling just about 30

seconds of uncompressed video, and that a full-length motion picture would require close to 200 gigabytes, or approximately the amount of stor age that one would expect to find handling the entire data processing needs of a medium-sized corporation. Cough.   The digitization of mediaÐ of audio, image, and videoÐhas cre ated a crisis in the computer and the communications industries. Though a multitude of compression/decompression schemes have entered the marketplace in the past half-decade, the problems associ ated with displaying and storing and transmitting the volumes of data needed to encode media are still immense. Computers are not fast enough. Storage devices do not have enough capacity. And õ the net works do not have nearly enough bandwidth. If you look at a multi media title and wonder at the relatively poor quality of its media as sets, consider it a manifestation of this larger problem. Barring some unforeseeable innovation, the challenge of mastering this undercapacitation will be at the center of the multimedia industry for at least the next decade.   But this technical problem is not the only one that threatens our transition into the age of multimedia. Nor is it perhaps even the most difficult. As one contemplates the convergence of mediaÐ of print and publishing with computers, and of both of these with film and televisionÐthe most tumultuous proposition would appear to be the imminent collision of the cultures that preside over these various media with decisively different styles, values, and knowledge -sets.   Take, for example, the separate cultures that preside over the com puter industry, on the one hand, and the film and TV industry, on the other. Both   are global leaders. Both require extremely large numbers of finely specialized and highly talented individuals. Both are proud to a fault, even ethnocentric. Neither tribe will take too kindly to the inevitable turf intrusions of the other. And lest we agree to fool

our selves, it is impossible to imagine that there will be many safe pas sages on the corporate battlefield that will serve to adjudicate the struggle for multimedia booty.

It Will Be All of These Things

The coming decades will see the rise of multimedia, replete with op portunities and pitfalls. The convergence of multiple industries of the most powerful sort will further accelerate the forces of technology associated change. New forms of mediaÐ electronic brochures, in teractive fictions, system emulation program ¡ s, even virtual realityÐ will appear with clockwork regularity. Some of them quickly ascend to the role of major social change agent, much as telephony and tele vision, for example, have done in our century.   There is no reason not to feel the same sort of excitement about the prospects of multimedia that one indulges in over such phenom ena as major space exploration programs. This enthusiasm, however, should be balanced by some equally legitimate anxieties. As indi viduals with careers that will be impacted by these new media tech nologies, how should we govern our career path decisions? As orga nizations, which of these risky and expensive technologies should we commit t   "o, and when?And, as a society, how should we manage (regu late) these new industries so as to minimize some of their potentially destructive influences?   We have written this present and humble volume in an effort to make our contribution to easing the anxiety and conflict that will no doubt accompany the coming of multimedia. As we stated in the Fore word, one of the most substantial conflicts will appear earlyÐ has, in fact, already appeared. It is the clash of professional vocabularies, of nomenclatures. If we can help some of these contributory industries understand and appreciate the language and concepts and potential of the others, then we will have hit our mark.

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A/B roll editing:
 This process of splicing and combining two or more videotapes, t èhe most common of

editing functions, is now be ing made far more flexible and easy to do by the advent of

digital video production tools.
Accele rator board:
This term refers to a class of expansion board used in personal computers to speed up

their performance, usu ally in relation to processing the display of visual information.

Ma chines built to process alphanumeric forms of information now need to process mixed

media data types (e.g., audio, image, video). These accelerator boards, directly

connected to the computer's monitor, pro cess the movement of pixels, taking the burden

off of the computer's CPU (central processing unit). High-end, high-performance boards

use a special type of memory known as VRAM (pronounced vee-ram, and stands for video

random access memory), which allows the com puter to write new information to a memory

location while the old information is being read.
Access + key:
 With the advent of the massive storage capabilities made possible by CD-ROM, and optical

storage in general, an in creasing number of application developers are making use of

this tech nology, which is a software-encoded key allowing access to a group of files

protected by a file protection code. With large clip media li braries, for example, the

developer can enable users to pay for only those portions of a particular library that

they need.
Access time:
 Refers to the location and recovery time of infor mation requested by a user on the

computer.
Accuracy aids:
With reference to computer graphics, this term refers to various pre-programmed

techniques, such as snap-to grids, that enable a designer to achieve positioning accuracy

on an interac tive display.

Acoustic coupler:
 A nearly obsolete piece of data communica tions hardware, an acoustic coupler functions

as a modem by con
verting a computer's digital signals into chirps to Ñ be sent over the telephone line,

and, conversely, by converting the chirps received back into digital signals intelligible

to the computer.

Active display: With reference to handling digital video in memory, this term refers to

that portion of the video memory cur rently being displayed, as opposed to screen

contents being held in memory for later display (if needed).

Active window: With graphical user interfaces (GUls) based on the desktop metaphor (such

as the Apple Macintosh or the Microsoft Windows interface), it is always possible to have

several windows open on the desktop at any one time. However, for the sake of main

taining order, it is only possible to have one of those windows active at any one time.

Thus, the window where the user's actions are di rected at a giv en moment is referred to

as the active window.

ADC: Stands for analog to digital conversion of data.

A/D converter: A device that samples an an Álog signal at regular intervals and

quantizes each sample. An A/D converter stands as the primary translator between the real

world of analog phenomena and the computer world of digital phenomena. The most important

aspect of the A/D conversion process is the sampling rate, which measures the frequency

with which the analog phenomena are converted in to digitally encoded numbers, and,

therefore, expresses the resolution, or quality, of the A/D conversion. The higher the

sampling rate, the more accurately the digitally encoded data represent the analog phe

nomena being measured or captured. Any type of probe or sensor that interfaces to the

computer (e.g., a digital thermometer) is an example of an A/D converter. As the world

becomes increasingly computer ized, the presence of A/D converters will be widespread.
Address: With regard to computing, this term refers to a character, a group of

characters, or other bit pattern that occupies ⁞ and can be accessed through a

particular storage location in computer memory.
ADF: Stands for automatic document feeder, a mechanism that at taches to a scanner and

allows unattended scanning of multiple im ages. This relatively simple device is a great

labor-saver for the emerg ing document imaging industry.
ADPCM: Adaptive delta pulse code modulation is a technique for translating analog audio

into digital audio. As the term "delta" im plies, this technique belongs to a large

family of digitization tech niques that rely on correlating patterns of amplitude over

time. It is a direct descendent of pulse code modulation (PCM).
ADSL: Otherwise known as the asymmetrical digital subscriber line, this technology was

developed by Bellcore (the research arm of Bell Labs dedicated to the interests of the

so-called baby bells, e.g., Bell Atlantic) to enable the providers of telephone services

to supply video services for the residential market over the copper wire   transmission

lines that have been traditionally used for providing POTS (plain old telephone service).

This is a strategic technology for the telephone companies. At present, the telephone

companies may be at a competi tive disadvantage to the cable operators with regard to

providing multimedia services like videophone to the home market. Cable op erators own

the coaxial cable delivering cable TV service to homes, which provide s them with a

sizable bandwidth advantage over the copper lines that telephone companies own for

delivering their sig nals. ADSL may neutralize this comparative disadvantage. It uses

specially designed transmitters and receivers that reduce the interfer ence and noise

normally experienced on a copper line. The technol ogy makes it possible to transmit ⁞

television-quality, compressed video over ordinary copper wire. Up until the appearance

of ADSL, it was thought that the goal of merging the switching capabilities of thepublic

switched telephone network (PSTN) with the ability to carry a video signal would require

the telephone companies to provide curbside fiber lines to every home, which is an

enormously expensive under taking. This technology may eliminate that need.
Advanced Interactive VideoTM: Also referred to by its ac ronym, AIV, this term refers to

a laserdisc format developed in 1986 by Philips UK and a number of other media and

computer interests. The format accommodates analog video, digital audio, and digital data

o Qn the same laserdisc surface. Also referred to as LV ROM, this format is suffering

from the same fate that has befallen the other laserdisc formats: namely, a diminishing

popularity in comparison to the all-digital formats associated with CD-ROM.
Advisory Committee on Advanced Television Ser vice: This ad hoc committee was established

to recommend from among competing technologies a single set of functional specifica tions

to the FCC for an HDTV (high definition television) standard.
Aftertouch: Also referred to as "pressure-sensitive," this is an attribute of more

sophisticated MIDI (musical instrument digital in terface) keyboards with which the

amount of pressure placed on a key is encoded as part of the MIDI data stream. In other

words, when a player presses a key on the MIDI keyboard, not only is the code for that

particular key g qenerated, but so too is an additional code that describes how much

pressure was employed in pressing the key. Ob viously, this attribute enables the MIDI

standard to encode a finer set of distinctions in its digital representation of music.
Agents: This is a relatively new type of software module that imple ments technologies to

understand the user's spoken or written requests and then complies with them. This term

is roughly synonymous with interface agents, varying from that term only in the sense

that it rep resents the more general and abstract machine intelligence which lies behind,

and makes possible, the functioning of an interface agent.
Age of Interactivity: This term is slowly emerging from the trade journals and carries

with it some probability that it will replace the currently popular phrase "Information Age" as the label du jour for describing the techn ½ology-intensive era in which we live. The term "Age of Interactivity" bears many important connotations: that we will soon see the mass media of broadcast TV and film turn to inter active forms of presentation and enterta inment; that ye olde technol ogy of telephony will soon be revitalized by the video dial tone; that the classroom model of educationÐ dominant for the entire history of public educationÐ will begin to give way to interactive forms of in structional delivery, such as we are now calling educational software (a.k.a. CAI, CBT, IVD, etc.); and that interactive cinema and a num ber of the other cyberarts will gradually replace linear, one-way forms of narrative, such as fiction and film, as the dominant modes of storytelling and mass entertainment.

Alerts: From the world of graphical user interface (GUI) design, these interface elements, also referred to as alert boxes, notify the user when an unusual, or possibly d +amaging, condition has occurred.

Algorithm: This term refers to a series of instructions or proce dural steps for solving a specific problem.

Aliasing: These are unwanted visual óffects in raster images, es pecially jagged lines and edges (jaggies) caused by improper or low quality sampling techniques.

ALU: Arithmetic logic unit refers to that specialized part of the CPU that performs arithmetic and logic operations.

Ames Research Center: Located along Route 101 in Silicon Valley, this NASA research center is responsible for pioneering manl/
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of the foundational technologies of virtllal reality (VR) and simula tion systems. Home to noted VR inventor Scott Fisher, this center is responsible for developing, among other creations, the Convolvotron directional audio system, the Virtual Planetary Exploration (VPE) system, and the Virtual Interactive Environmental Workstation (VIEWS) .

Amplitude: W ³ith regard to audio and/or video signals, amplitude refers to the

strength of a given signal. Amplitude is measured in various units depending on the

application. For example, with audio signals, the measurement is in decibels, which is a

logarithmic scale based on human hearing sensitivities. For audio, amplitude is a mea

sure of volume; for video, it is a measure of image contrast.
Analog: In electronics, analog is a continuously variable signal. Analog signals are

often depicted as waveforms, and in the computer world are always held in contrast to

discretely variable digital sig nals, representing separate datapoints in space and time.

Analog phe nomena in nature include waves, time, temperature, and voltage.
Animated blobs: Created by Carnegie -Mel ølon IJniversity's Jo seph Bates, these

creations represent the first attempt at automated storytelling using the principles of

object-orientedprogramming. The blobs are self-contained, intelligent objects, programmed

according to the rules of behavioral theory. The way blobs encounter each other sparks

emotional responses that in chain-reaction form cause addi tional reactions so that they

appear to be creating their own spontane ous drama.
Animated map: A series of maps presenting a moving image, typically used to show

spatio-temporal patterns such as the distribu tion of population in the United States

over the course of several de cades.
Animation: Is th *e process of displaying artwork over time to simu late motion. Most

animation belongs to one of two types: graphic or character. "Graphic animation" is

generally composed of a single piece of art whose position changes over time (e.g., a

moving logo). To create movement, one piece of art has intermediate positions rather than

intermediate drawings. Graphic animation is relatively easy to master, does not require

drawing skills, and, in a computer environ ment, requires only modest storage and

processing power. "Charac ter animation," in contrast, entails generating a different

piece of art for each frame, as is done for TV cartoons. In traditional character
animation, an artist works at a light table, creating each frame by transferring a
drawing from paper to acetate (called a ceT) and hand colorin Zg it with paint. Two key
drawingsÐ which are the principal points of movement for each frameÐ punctuate several
"inbetweens" which, as the name implies, are the intermediate drawings between key
frames. With desktop animation tools, many of the more arduous tasks of traditional
animation, such as inbetweening, are automated, leaving open the potential for an
enormous growth in the use of char acter animation for many purposes, such as edutainment
products.

ANSI: Stands for theAmerican National Standards Institute, a stan dards-making body for
the computer industry, most famous for its ASCII standard format for encoding characters
in the PC environ ment.

Answer analysis: From the realm of educational software, this term refers to the
simplest, lowest level form of performance track ing, where the programmer writes code to
analyze a learner's respo ®nse to a single question. The most common form is the
multiple choice question, where the program simply branches on the basis of whether or
not the learner answered the question correctly.

Anti-aliasing: Aliasing is perhaps the most commonly cited vi sual artifact of computer
graphics, whereby boundaries take on a stair step pattern, often referred to as the
jaggies. Anti-aliasing refers to techniques designed to sharpen the image by switching
pixels to in termediate intensities along either side of otherwise jagged diagonal lines.
Anti-aliasing techniques are particularly important with displays that feature relatively
low resolution.

Architectural walkthrough: A sub-type of the surrogate travel genre, walkthroughs are
also a form of virtual reality, wherein the user can control a simulated passage through

an architectural struc ture such as a hallway in a building. The underlying or enabling

tech nology of architectur «al walkthroughs is CAD (computer aided design) programs. In

the coming age of interactive artforms, the capabilities and techniques made possible by

walkthroughs will become a tool within the larger toolkit for those making highly

immersive forms of electronic games, interactivefictions, and training simulations.
ARM: Otherwise known as the Argonne Remote Manipulator, this is a prototypical

telerobotic device developed at theArgonne National Laboratories. The ARM is a long,

multijoint arm suspended from the ceiling. The device provides basic control and force

feedback to the user s hand, wrist, elbow, and shoulder along three axes and three

torques. It is designed to give the user control of a remote robotic arm and was

developed initially for handling radioactive materials. Many of the techniques and

devices used in the construction of the ARM are now finding their way into the design of

virtual reallh, systems.
Art director: A key figure throughout much of the history of the collaborative

fictional enterprises, such as theater, film, video, and feature animation, the art

director is one role that, if anything, will be enlarged by the advent of interactive

multimedia. The primary re sponsibility of the art director is to create the total visual

look of the product, which requires a highly creative and artistic sensibility. Many art

directors from the film and video sector have made exccllent con tributions to the

discipline of interface design. Their skills at manipu lating color and lighting,

translating functions into metaphors and metaphors into button designs, and specifying

spatial relationships have made their presence welcome on many interactive projects. Art

directors are of Îten assumed to be good illustrators, which is not nec essarily the

case, though they are certainly dependent on good illus trators to implement their

vision. In the interactive world, art directors design the visual aspects of the

interface, while illustrators execute their designs; i.e., they create the artwork for

the buttons, graphics, ammatlons, etc.

Artifact: This term is widely used to describe flaws that can be detected in all forms of

media, both analog and digital. More pre cisely, though, it is used to describe a flawÐa

random sound or vi sual effectÐthat was not present in the original source signal, but

that has been introduced by one of the components in the recording or reproduction chain.

For example,   /J7icker is a common artifact in the analog video world, while

pixellation is one of the most common artifacts found in digital video.

Artificial intelligence: This term refers to the part of com puter science concerned with

designing machines that exhibit human characteristics and do things in a way that would

require intelligence if done by people. The classic measure of AI, more relevant today

than even perhaps when it was conceived, is called the Turing Test. Named after its

author, Alan Turing, this test is passed by a machine if its ability to carry on a

conversation is indistinguishable from that of a human, as exemplified by "HAL," the

fictional computer in Stanley Kubrick's (director) 2001: A Space Odyssey.

ASCAP: Stands for American Society of Composers, Authors and Publishers, an organization

 c that has become best known for working out a detailed set of licensing specifications

for recording artists that helps ensure that royalties and other usage fees get paid to

the copy right holders and artists. Many people feel that this set of specifica tionsÐor

something very much like itÐwill be in great need in the Age of Interactivit, where, for

example, the widespread use of clip media will make it diff1cult to track and manage the

payment of roy alties to all of the contributing artists.

ASCII: Stands for American Standard Code for Information Inter change and represents one

of the most important and enduring stan dards of the personal computer market. ASCII is a

standard table of 8-bit digital representations of uppercase and lowercase Roman let

ters, numbers, special control characters, and various graphic charac ters. This widely

adhered to sta »ndard makes it possible for the vast majority of PC software programs

to exchange information at a basic text-and-number level.
Aspect ratio: In the most general sense, the aspect ratio is the width-to-height ratio of

a rectangular object. With respect to com puter displays, this can refer to either the

screen shape or the pixel shape. Video has a screen aspect ratio of 4:3, and film an

image as pect ratio of 3:2. Converting from one presentational medium to an otherÐ the

classic example being from motion picture to televisionÐ can be problematic, often

forcing some form of distortion.
Asymmetrical codec: Refers, for the most part, to interframe forms of

compression-decompression, where the encoding (compress ing) side of the process is much

more time-consuming and expensive than the decoding (decompressing) side. Both DV7

(Digital Video Interactive) and MPEG (Motion Picture Experts Group) are asym metrical,

interframe codecs. T Èhe primary reason for the asymmetry rests on the arduous

computational task associated with finding the patterns of temporal change and stability

in video sequences. Once these patterns have been found and subjected to the delta

encoding techniques, it is not nearly so difficult to decompress (reconstruct) the

original image.
ATM: Stands for asynchronous transfer mode, a term which every one interested in the

networking of mixed media data types should commit to memory. This technology possesses

several traits that make it the favored networking protocol for the future of

high-bandwidth, multimedia, data communications. It works by splitting data into small

chunks, giving it the key attributes of a packet switching protocol. But instead of

routing each packet individually, as is characteristic of most packet switching systems,

ATM establishes a virtual circuit be tween origin and destination so that it can

accommodate the time sensitive streaming data associated wi)th digital video. Thus,

ATM also possesses the essential characteristic of a circuit switching sys tem. Because

of this combination of attributes, ATM is noted for its ability to allocate bandwidth on

demand, a trait often referred to by the popular computer term scalability. Because it is

scalable, and be cause it can handle ultra-high capacities, ATM is favorably viewed by

media futurists for its ability to scale way up in response to a re quest for

transmitting image or video, thus being responsive to the needs of networked multimedia;

but also for its ability to scale back down after the multimedia transmission is

complete, thus saving the user from having to pay for such high bandwidth when it is not

needed.

Audiographics: This term refers to an early form of picturephone that features two-wa
y audio on a voice-grade telephone circuit with computer and/or video still images sent

over the same line or a sec ond line. Synchronization of the audio and visual components

is not sought with audiographics, since the time required to send the visual components

(an image, for example) is often delayed in the range of several seconds to several

minutes, whereas the audio is transmitted in typical, real-time fashion.

Authoring system: This term is given to systems that contain software tools designed to

empower individual developers and de velopment teams to produce various types of

multimedia applica tions. Though there is obviously considerable variation from one sys

tem to the next, the categories of tools provided in most of these ap plications include

media integ jration tools, i.e., tools for digitizing mixed media data types and for

interfacing to media peripherals such as CD-ROM players; media production tools, such as

paint systems and other routines for building and managing screen objects; answer

analysis and performance tracking routines; a high-level program ming interface designed

for ease of use, such as the time-line inter faces featured in such programs as

Macromedia's Director; and, some form of programming or scripting language, such as

HyperCard's HyperTalk. Though virtually every authoring system sells the idea that it can

be used by computer-neophyte authors, this is only true in a limited way. Most authoring

systems can be used in a restricted fashion by uninitiated authors. In general, though,

the development of sophisticated multimedia products is a highly collaborative under

taking that requires numer   Æous specialists, utilizing several tools all working under

expert direction.
Auto assembly: In the world of video production, this term re fers to the penultimate

portion of the editing process whereby a mas ter tape is constructed from the EDL (edit

decision list) under the control of a computerized editing system.
Autochanger: This term refers to the critical component of an optical juke box (or any

other form of juke box), which is responsible for fetching and loading optical discs

using some form of robotic device.
Auto iris: From the world of film and TV production, this device is useful when filming a

scene during dawn or dusk. It is a camera lens function that automatically adjusts to

compensate for changes in light levels.
AVITM: Stands for Audio Video Interleaved, Microsoft's movie file format. The

interleaving refers to the fact that under this file format, video and audio files that

re   °late to the same captured media event are interleaved with one another so that

synchronizing them (lipsynching, for example) can be more readily accomplished.
Backchannel: In the emerging world of interactive television, this term refers to the

channel over which users (home consumers of interactive programming) will communicate

back to the entity from which the programming initiates. Because TV has historically been

a strictly one-way medium, with programming that originates with the broadcaster and is

sent to the home user, there has never been any infrastructure put in place to handle

backflows of data from the user to the broadcaster, other than informal channels that lie

outside of the cable system (e.g., cable users can pick up the phones and μcall their

local cable operators, but this communication channel is not part of the cable system per

se). With the perceived need for interactivity at an all-time high, cable operators are

now experimenting with various ways of supplying their users with backchannels so that

these users can potentially interact with the programming. At present, these backchannels

possess relatively low bandwidths, but this should change in the near future.
Backdrop: From the realm of digital video, this term refers to the background image plane

displayed when all other picture planes are made transparent.
Backfile conversion: When an organization contemplates the conversion of its various

documentation (e.g., paper documents, mi crofiche, slides, Metc.) to a digital format,

and then to long-term stor age on one or more of the many emerging optical mass storage

tech nologies, it must confront the (often massive) chore of converting all of its

historical records. With paper document sources of informa tionÐby far the most common

caseÐthe process usually involves sc.nning, touch-up, indexing, and then, finally,

transfer to disk. This whole process is called backfile conversion, and it represents one

of the meat and potatoes applications of the age of multimedia. The pri mary advantage to

organizations that undertake this process is that it brings all of their historical

sources of information under the control of some form of information storage and

retrieval system. The "converted" sources of information can then be searched and

retrieved in an automated fashion, as well as subj Æected to various statistical

analyses. In contrast, with traditional sources of archival storage, such as microfiche,

the user must first read an indexÐwhich may be computerizedÐand then must manually fetch

target information from the archival vaults, a procedure that backfile conversions seek

to eliminate.

Background task: This is a task that a computer performs while the primary or foreground

program is not using the CPU (central pro cessing unit). In a true multitasking

environment, the user is typically unaware that a background task is being processed.
Back-of-the-book index: In the world of traditional book pub lishing, this term refers to

the index that appears at the back of the book, with which we all have great familiarity.

It is of importance to the dawning era of multimedia because it is now viewed as part-in

parcel of a thing called document design, which in turn is attached to such eme   rging

media as electronic reference documents (ERD). With many desktop publishing systems, the

construction of back-of-the book indexes can now be automated by simply tagging the terms

in the body of the text that one wants to appear in the index. The pro gram then tracks

the location of these terms as the document changes in size, and automatically writes

their respective page numbers to the index upon command. Going one step further, with

many ERD authoring systems, these indexes can be made "live," meaning that by clicking on

one of the entries in an electronic back-of-the-book index, one is immediately

transported to the indexed location (page number) in the body of the text.
Back plane: From the world of DVE (digital video effects), this term refers to the lower

of two visual planes used in two-plane eects to create transitions from one screen to the

next.
Bandwidth: This term is of such applicability to our emerging era of multimedia that i

út now rolls off the tongues of technological babes, "wannabe" business tycoons, and

hardcore telecommunication wiz ards. In its widely used contemporary sense, bandwidth

refers to the information-carrying capacity of a transmission link between any two

devices. In its more traditional sense, it means the range of frequen cies, usually

measured in cycles per second, that a piece of audio or video equipment can encode and

decode. Video uses higher frequen cies than does audio, and so is said to possess a

higher bandwidth. In the field of information processing, the stream of digitally encoded alphanumeric characters that dominated computer usage before the era of multimedia represents one of the smallest forms of bandwidth. Thus, from a technical standpoint, one of the great struggles of the era has to do with transforming the computer so that it can gracefully handle the higher bandwidth sources of informationÐnamely, =audio, image, and video.

Bandwidth reduction: In the television industry this term is commonly heard, especially among those who are wrestling with the transmission demands and constraints of HDTV (high definition tele vision). It is roughly equivalent to the term compression, in that it refers to the host of techniques that can be employed to reduce the overall bandwidth requirements of a television broadcast. RLE (run length encoding), DCT (discrete cosine transform), and motion com pensation are just some of the compression techniques enlisted in the overall effort to reduce bandwidth.

Banff Center for the Arts: This Canadian institution is con sidered by many to be the leading organization in the world for ex ploring how virtual reality can be used within the arts.

Bar sheet: Used extensively in animation productions, this dia grammatic form is used by the director to make a blueprint of the action, music, dialogue, and sound effects for the entire picture. It illustrates how all of these elements are to be timed, and unfold in parallel, as each scene progresses. Perhaps most importantly, though, the bar sheet deserves a bright historical footnote, as it has served as the basis for the time-line metaphor that has informed so many of today's multimedia presentation and authoring systems.

Batch processing: From the world of traditional mainframe data processing, this term refers to a form of information processing that is typically B held in contrast to

real-time processing. With a batch process, information is gathered and stored in advance of being pro cessed, or analyzed. Thus, when a bank stores up all of its transac tions for the day and then updates all of its customer records at night, this is said to be batch processing. The data is stored up into a "batch" before anything meaningful is done to it. In contrast, with real-time processing the data is analyzed or processed immediately upon re ceipt. In the era of multimedia, most applications demand real-time, as opposed to batch, processing, because when users are interacting with mediaÐ as when they are playing video gamesÐthey want their processed data now, not later.

Bed: This term emanates from the world of film and TV, where it is used to describe the instrumental portion of music which ser £ves as an underscore to the visual proceedings.

Benchmark: This is a task used for measuring some aspect of a computer's pcrformance.

Beta Test: It has long been the practice of software developers to send pre-release versions of their programs to expert users who get some form of consideration (like discounts or free licenses) for test ing out those products bcfore they are released to the gcneral public. Given the extremely complcx nature of most software programs it is to be expected that the developers will be unable to catch all of thc bugs (technical llaws in the code). The process of heta-testing helps to clean up the code. As entertainment developers begin to produce interactive productsÐwhich, after all, possess a strong software com ponentÐthey will need to avail themselves of the culturally accept able habit of beta-testing.

Binaural fusion: From the world of perception, this is the pro cess by wh ©ich the brain compares information received from each ear and then translates the difterences into a unified perception of a single sound issuing from a specific region of space. Any manufacturer of 3-D sound equipment must take this phenomenon into account.

Bit: The smallest unit of data, a bit refers to the on-off signals stored in computer

memory.

BITC: Stands for burned in time codes and is pronounced "bit-see." This term refers to a

characteristic of video required in video editing and other post-production activities

whereby the timc codes for each video frame have been burned into a set location, or

field, on the frame. Time codes are very important in editing, because they repre sent

the logical equivalent of a memory address, enabling users to move quickly to the

locations in the video stream they wish to be working with at a particular moment. In the

analog world of video tape, these time codes are actually "burned" into the s urface

of the tape. In the digital world of nonlinear video, the time codes are also digital and

are embedded in the video datastream. Though fundamen tally different, the digital time

codes appear to the end user much as their burned-in forebears of the analog era.

Bit map: This refers to a software object that represents visual data in a form where

each pixel location corresponds to a unique memory location accessible by the computer

CPU.

Bit mapped displays: Are made up of tiny dots. called pixels, and stand in contrast to

the older-generation character displays, which are only capable of representing

information out of the ASCII charac ter set. Bit-mapped displays are capable of much

higher resolution than character displays and represent the primary instruments of

graphical user interface (GUI) design. Bit-mapped displays have manipulation capabilities

for both vector and raster graphics, which allow pr esentation of information appea

ring in the final paper form.

Bit resolution: With digital forms of media, bit resolution is a measure of the quality

of the digitized audio, image, or video. Bit resolution represents the number of bits

used to represent each sample taken in the ADC (analog-to-digital) process to form a data

stream of digitized media. Thus, with reference to digital audio, the industry standards

are 8-bit, 1 2-bit, and 1 6-bit audio, with the higher bit lengths representing a higher

quality form of digitized media.

Blind: From the realm of digital video effects (DVE), this term re fers to a two-plane

effect in which the image on the front plane be comes like a Venetian blind that opens to

reveal the image on the back plane.

BLOB: Stands for binary large object, a term that belongs to the language of relational

databases and is often referred to as a memo field. The best way to understand what a

BLOB is, is to compare it to standard relational database fields. The standard database

fields, be cause they must fit into a ta bular model, have a fixed length. Thus, a

relational database always has some intrinsic limit on the amount of information that a

single text item, or field, can store. In contrast, a memo field uses the fixe d-length

part of a table only as a pointer to a large body of information with a virtually

unlimited size. Thus, a memo field can be used to store a paragraph, a page, a book, ad

infinitum, all using, in the database proper, only the amount of space required to hold

the pointer (memory address). This data structure is ideal for hypermedia forms where an

orderly, navigable structure must be main tained (which corresponds to the database), but

where numerous large information objects (digitized images, animations, film clips) of

widely varying size must be made available.

Block: This is an amount of data moved or addressed as a single unit within the compter's

memory.

BMP: Stands for bit -mapped file, and refers to the internal picture file format used by

Microsoft Windows, versions 3.0 and higher. This rasterfile format is also supported by

OS/2, the IBM operating sys tem.

Board: This term is synonymous with "circuit board" or "card." The primary function of a

computer board is to hold the chips and wiring that control either some essential

function of the computer's CPU or a peripheral device such as a CD-ROM player. Throughout

the volatile history of computing, boards have been used as a vehicle for scaling up the capabilities of computers, adding, for example, au dio capabilities to a computer that was manufactured before such ca pabilities were a standard part of the computer's (built-in) motherboard. Thus, boards should be thought of as a major source of scalability and extensibility in the computer world.

Bookmark: Also referred to as an electronic bookmark, this graphi cal user interface (GUI) design/navigational feature is employed to facilitate multisession uses of electronic documents, interactive mul timedi þa applications for training, and hypermedia applications for reference. Bookmauks simply record or save the point at which one decides to exit a program, making it possible to re-enter at that exact point when one stans the next session. As the size and use of elec tronic forms of publishing continue to grow, bookmarking is becom ing a standard feature of most forms of electronic documents.

Boundary detection: This is considered one of the key prob lems associated with virtual realit environments, where a user's body may interact with, or actually pass through, a virtual object, such as a chair or wall. It presents a perceptual problem because these objects should have a solid consistency but, in the VR environment, may put up no resistance at all, thereby taking on a ghostly character. The emerging technologies associated with tactile feedback are consid ered to hold the ultimate solution to this problem, enabling the user to move around in a virtual environment and, when the system is appro priately cued by boundary detection logic (or devices), to feel the appropriate sensations when bumping into things. Virtual reality re search is a long way off from perfecting such systems. In the mean time, designers are experimenting with a number of ersatz solutions, such as sound systems that correlate varying sound effects with the detection of different types of boundary collisions.

Boundary representation: From the realm of computer graph ics, this term refers to one of

the main methods of "solid modeling," in which the object is described by its geometry

and topology.
BPS: This term stands for bits per second and is a standard measure of transmission speed

or transfer rate in the computer world.
Branchpoint: The basis of machine intelligence relies on the computer's ability to change

its preset sequence of instructions, a most common phenomenon in programming known as

branchingÐ the code branches from one location in the prog ¼ram to another. A

branchpoint is, quite simply, a location within a program where a branch occurs. With

regard to interactive forms of entertainmentÐ video games, edutainment programs, and the

likeÐ most of the branchpoints are dedicated to giving the user (learner, gamer, etc.)

some element of control over what happens next in the program.
Brightness: Along with hue and saturation, this is one of the three fundamental

dimensions of color. Brightness refers to the differences in the intensity of light

reflected from or transmitted through an im age.
Broadband: This term is used frequently in communications to refer to transmission med ia

and channels that possess relatively larger carrying capacities or bandwidth.
Browsing: In the current hpertext and hpermedia environment, this term describes the

oft-practiced user behavior of meandering through the available electronic information,

looking simply for in teresting associatio   ns. The metaphor corresponds with paying a

des ultory visit to your favorite bookstore to peruse the stacks.
Browsing path: Based on the browsing behavior of users, this term refers to the specific

sequence of hperlinks that a particular user selects while moving through a large

hpertext or hpermedia application. This information can be very useful, especially if the

designer of the hypermedia application wants to establish usage pat terns relative to the

content and preference patterns relative to spe cific user profiles.
Brush: With reference to computerpaint s stems a brush is a marker that draws a line or

pattern on the display surface, thereby emulating the action of a real paintbrush.

Buffer: Is a small part of a computer's memory that temporarily stores data. Buffers can compensate for a difference in data flow rates when transmitting data between two devices or can hold data likely to be used in the near future.

BUFR: Thi Æs term stands for binary universal form for representa tion, a standard digital imaging file format used by meteorologists to represent the visualizable aspects of weather data.

Burst: This term has become a popular one for describing flows of data, otherwise known as data transmission. It acknowledges the al most universal aspect of reality that phenomena are not evenly dis tributed in time, but rather tend to occur in bursts, separated by periods of relative quiet.

Bursty traffic: From the world of network management, this term refers to the types of data flow experienced with respect to tradi tional, alphanumeric (i.e., character) forms of data. On the traditional network, traffic is said to be bursty because, for the most part, the network is clear of traffic and so single data conversations are able to be quickly established and released without degrading the overall performance of the network.   From time to time, though, the volume of requests for access to the network surges, which in turn leads to the need for invoking some sort of contention scheme to determine who has access, and in what order. Owing to this variable traffic pattern, the traditional PC network is said to experience bursty traff1c.

Bus: This commonly used computer term refers to the circuit or pathway through which data is transmitted. It most often is used to refer to the main such pathway that serves to connect the major com ponents of a computer system to the CPU.

Bus interface: From the realm of computer design, this term relates to the fact that everything in a computer is attached to the CPUÐthat is, every device that is a part of the computer must com municate with the CPU in some way. To do this, these devices (e.g.,

disk drives, monitors, printers, etc.) must be connected to the computer's bus so that

they can exchange data. This point of connec tion is calle ¤d the bus interface.
Button: An important term in graphical user interface (GUI) de sign, a button is a

relatively small screen object, usually labeled with text or an icon or both, and

typically used to initiate instantaneous actions, such as completing operations defined

by a dialog box or acknowledging error messages. Buttons represent hot spots on the

screenÐby clicking or touching them, one initiates some computer mediated action. In

designing buttons, the traditional wisdom has it that the label of the button should

describe the result of using (click
ing, touching) the button, rather than some abstract term about the function that is

being performed.
Byte: In the world of computers, the ubiquitous byte is a unit of measure of 8 binary

digits (i.e., 8 bits) representing either two num bers or one character.
Bytes per second: Again, in the world of computers, this is a unit of measure for the

speed of digital transmission of information.
Cable headend + : This term belongs with the emerging language of the information

superhighway, as it represents one of the key dis tribution nodes on the network. Within

that segment of the highway dedicated to cable TV, the cable headend is the central point

at which TV signals are downlinked from satellites and are modulated onto the cable by

local stations. In other words, it is a key port of entry for the distribution of video

content.
Cabling: Any discussion of the technical aspects of communica tionsÐtelephony, data

communications, LAN, and WANÐusually makes reference to one of its most fundamental

features: the type of cabling, or transmission media, being used. There are three major

forms of cabling in use today. In order of lesser-to-greater capacity, they are the

following: Twisted-pair: the copper wire medium that connects the household telephone to

the Public Switched Telephone Network (PSTN). It is the oldest cabling technology and can

be eit Îher shielded, or not. Reliance on this largely outdated medium is what is

considered to be the largest disadvantage for the telephone compa nies in the heated

competition to control home ineractive media. Coaxial cable: long been used for cable

television connections be cause of its ability to handle a relatively large number of

signals or, in other words, different channels, simultaneously. "Coax," as aficiona dos

like to call it, has four basic parts: a solid metal wire forms the core of the cable,

surrounded by insulation; a tubular piece of metal screen surrounds the insulation, and

an outer plastic coating com pletes the cable. Coax is capable of high bandwidths and is

therefore a popular choice for LANs that must carry a large amount of network traffic.

Fiber optic cable: considered the transmission medium of the future, fiber carries light

pulses rather than electrical signals. There are several advantages to fiber: immunity

from electromagnetic in terference, e   normous bandwidths, and the ability to carry

signals for a very long distance. Fiber cable consists of a core fiber enclosed in glass

cadding, with a protective outer coating that surrounds the
cadding. LEDs (light-emitting diodes) are used to send the signal down the optical fiber.

At the receiving end, a photodetector is used to re ceive the signals and convert them

into a digital computer format. Owing to its very large bandwidths, fiber is the core

transmission technology of the integrated services digital network (ISDN), and is

considered by many experts to be a necessary ingredient in the future extension of

multimedia applications.
Cache: In its traditional usage, cache is a temporary storage area for data requiring

very quick access. Most contemporary CPUs (e.g., Intel's 8   r0486, Motorola's 68040)

carry a specification for their cache size, which denotes the size of the memory held on

the CPU itself. This CPU cache is the location where frequently accessed code and data

from the current application are stored. But the CPU is not the only "place" in a

computer system where the strategy of supplying a cache is commonly employed. As a

process, caching is now a commonly employed strategy for building bridges between every

form of memory and its next-slowest, but higher capacity companion. Thus, caching is done

between optical and hard disk storage, between hard disk and RAM, and between CPU cache

and RAM. In the coming era of multimedia, where extremely large amounts of digital data

will need to be moved on a constant basis, the importance of using caches will grow

dramatically. In this usage of the term, a cache is roughly synonymous with th Àe term

"buer," and caching is synonymous with "buffering."
CAD: Otherwise known as computer aided design, it is a widely used term most typically

associated with engineering and architec tural applications for computer graphics. With

the advent of virtual realit systems, especially those that render visual scenes in real

time, CAD is taking on a new role as an integral support component in these complex

programs. In a very real sense, CAD is becoming an enabling technolog for the virtual

realit industry.
CAI: Stands for computer assisted instruction; along with CBT(com puter based training),

this is one of the early acronyms for describing programs that use the computer as an

instructional tool, rather than as an automation machine. As the computer becomes the

teleputer, his torians may view CAI as a truly seminal use of the first generations of

computing machines.
Camera field: In film and video, this is the area being photo graphed ®by the camera.

The camera field constitutes what is visible to the audience at any given moment.
CATV: Stands for community-antenna-television, which is the sepa rate transmission

infrastructure that was created to meet the needs of the cable television industry. This

infrastructure was needed to serve cable TV, because the copper wire transmission system that serves the ubiquitous residential and business needs of telephony is not ca pable of handling the bandwidth (carrying capacity) demands of tele vision broadcasting. Thus, during the decade of the eighties, the cable industry was forced to create its own ubiquitous transmission infra structure by laying the higher bandwidth coaxial cable into millions of homes and businesses around the country. This higher-capacity infrastructure now gives the cable operators a somewhat serendipi tous advantage over the telephone companies with respect to offering interactive services ã, especially to the home market.

CAV: Stands for constant angular velocity, one of two distinct video disc formats (CLV [constant linear velocity] being the other). With CAV, the frames are laid down in concentric circles. Each frame has its own 360-degree track on the videodisc, thereby making it possible for the laser reader to jump from one track to the next. This format is the strongest option for providing rapid random access to frames and is thus the preferred format for interactive videodisc applications.

CAVE: A virtual reality project under development at the EVL (Elec tronic Visualization Lab) in Chicago, the CAVE is a room in which a viewer stands and becomes totally immersed in a 3-D audiovisual experience. The visual components of the CAVE are produced by multiple projectors, with each projector being responsible for flood ing one of the wall sides. The images are projected in an interlaced video fashion, and the viewer wears stereoscopi c glasses. Fallout ap plications of the CAVE include biomedical imaging, architectur al ren dering, interior design, and mechanical design of heavy equipment.

CBR: Stands for content based retrieval and represents an emerglng class of programs that seek to automate the process of searching large information bases. Operating on the grounds of user-defined content characteristics, these programs automatically perform

search and re trieval functions against large information bases in an effort to un earth

gems of information from the mountains of data. An example of a CBR program would be one

that scans the massive flow of stock
data that emanates from Wall Street each day and culls from that dataflow just the

infornnation that relates to the user's individual port folio of stocks. Negroponte's

concept of personal television may be implemented through what we are today calling CBR.
CBT: Stands for computer based training and represents one of the oldest acronyms in the

intera Úctive business. The term was dominant during the early PC era and was used to

describe interactive training programs thatÐowing to the constrained presentational

capabilities of early PCsÐwas limited primarily to text and ASCII graphics. By far, the

most common application for CBT was the software tutorial, where the computer was used to

teach end users how to use common computer software applications such as word processing,

database, and spreadsheet. The term is still alive, and there are those advocates who are

trying to migrate it to the more updated, multimedia-based forms of interactive training.

For the most part, however, the term is now used to describe older generation interactive

courseware.
CCD: Stands for charge coupled device and represents the dominant technology used in

scanners and other devices for converting light to electronic impulses, the first step in

digitizing lightsources of infor mation. CCDs consist of a silicon semiconductor and a

series of elec trodes. Whe Ûn light passes into the silicon, that light frees electrons

within the silicon atoms. The brighter the light at a given point on the image, the more

electrons are freed.
CCITT: Stands for Consultative Committee on International Tele phone and Telegraph, a

telephone industry standards-making body.
CCITT H.261: Also known as Px64, this is the video compression standard for video

teleconferencing.

CDDA: Stands for compact disc-digital audio, and represents the earliest standard in the

CD industry. Also referred to as the Red Book standard, CD-DA is an audio-only standard,

specifying how audio CDs should be formatted.
CD-I: Stands for compact disc-interactive, a self-contained multi media platform

developed by Philips Corp. One of the early plat forms for home multimedia, CD-I

possesses its own proprietary operating system, known as CD-RTOS. As a standard for

multime dia, CD-I is also known as the Green Book Standard. Currently, there are about

l00,000 CD-I players in commercial use.
CD ¦ MA: Stands for code division multiple access, one of two emerg ing standards for

digital wir eless communications. CDMA works by splitting a single radio channel into a

large number of voices, using a unique identifier code for each voice. The receiver uses

a code book of sorts to detect and capture the desired signal from the substantial

background noise. The accepted analogy for CDMA is that everyone in a room filled by many

people can hear just the message intended for him or her because each person is

concentrating on (is decoding) a single conversation. Along with its sister technology,

TDMA (time division multiple access), this standard represents a new form of trans

mission capacity and is therefore being heralded as being able to ad dress the emerging

bandwidth crisis that threatens to thwart the vitality of multimedia. In a sense, because

digital wireless does not use ca bling, as do all other forms of data communications,

CDMA and ® its near cousin TDMA represent "found" bandwidth in a contemporary world

that is increasingly bandwidth-scarce.
CD R: Stands for compact disc-recordable, which represents a re cent family of CD players

that make it possible for end users to record their own data, albeit only once. CD-R is

part of the emerging Or ange Book standard, which includes most of the CD technologies

that ena ble end users to record, including the emergent magneto-opti cal technologies.

CD ROM: Stands for compact disc-read only memory and refers to the dominant form of

direct access, mass storage for the early years of multimedia technology. Refer to

"compact disc" for a more com plete discussion.
CD ROM-XA: This is an extended architecture for CD-ROM that permits the interleaving of

sound and data for purposes of synchroni zation when these two data types are merged in

motion picture and animation segments.
CD RTOS: Stands for compact disc-real   time operating system, which is the proprietary

operating system developed by Philips for its CD-I platform.
Cel: Short for celluloid, this term actually refers to the sheets of acetate laid down on

top of one another to produce a singleframe, or exposure, of an animated feature.
Cel Animation: Refers to a moving picture produced by display ing a series of complete

screen images in rapid succession.
CELP: This acronym stands for code excited linear prediction, and it represents one of

the more innovative forms of digital audio com munication. As MlDl (musical instrument

digital interface) works with respect to music, CELP works by transmitting an encoded

represen tation of the voice, rather than a waveform signal of the voice itself. The

technology is based upon a "codebook" that stores the basic sound elements of the human

voice. The transmitting end of the communi cation decomposes the sounds of the "sending"

human voice into their codebook   values, and then transmits a set of pointers, plus

any modi fying parameters needed to capture the unique characteristics of the speaker, to

the receiving station. In turn, the receiver uses the point ers to look up the codebook

elements, which it then incorporates into a decoded version of the speaker's voice. The

primary advantage of this technologyÐlike its MIDI cousinÐis that it greatly reduces the

bandwidth needed to transmit the human voice. In a sense, it is a form of compression.

Its primary disadvantage is that it is extremely CPU intensive, and typically requires

the use of a special purpose DSP (digital signal processor).

Center for Creative Imaging: Opened in May of 1991 by Eastman Kodak Company, this training center is designed to help videographers, photographers, and graphics artists make the transition to the new media artforms made possible by the many new and sophisticated electronic imaging products entering the market. Located in Camden, Maine, and founded by longtime Kodak executive Raymond DeMoulin, the Center provides hands-on experience with a broad range of scanners, cameras, printers, storage media, and software applications.

CGA: Stands for color graphics adapter, a vestigial remnant of the early days of desktop computing, a time when any form of graphics was considered a luxury. As some will recall, the original IBM PC came with a monochrome monitor that could display text only. As the forces that would ultimately lead to multimedia began to take shape, IBM responded with the first of its graphics adapters, namely CGA. Equipped with a color monitor and a CGA card, the user could display up to 16 colors in RGB format, with a resolution of 640 x 200 pixels. However, if you want to remember how bad a standard this was, recall that if you wanted to display graphics, you had to first go into a thing called "graphics mode." And, if you wanted to display text while in graphics mode, you had to switch out of 80-column and into - 40-column mode. This technical compromise produced some of the least attractive type fonts in the history of communications. Early forms of CBT (computer based training) were particularly haunted by this standard, because if you wanted to incorporate graphics and text on the same screenÐwhich is a pretty compelling combination when you're trying to teach something to somebodyÐyou had to use the extremely blocky and pixellated type fonts of 40-column mode. In the lineage of PC graphics standards, CGA comes just after "MDA" (monochrome display adapter) and just before EGA, which then gave way to VGA and SVGA.

Channel: In the computer world, this term refers to a path or cir cuit along which information flows. Most channels are measured in terms of how much information they can carry, which is also referred to as their bandwidth.

Channel explosion: This term is now in popular use by ob servers of the rise of the home media market. It describes the rapid expa +nsion in the number of TV channels that, in the first phase, was made possible by the creation of the CATV (cable TV) infrastructure. This first phase resulted in the laying of coaxial cable into cable connected homes, which provided a form of transmission media that has much more effective bandwidth than the copper wire of POTS (plain old telephone service). With the application of compression technologies to the signals being transmitted over CATV, it is ex pected that home cable will soon offer upwards of 500 channels, making pos sible a whole new generation of home media services. In the near future, a second phase is expected to appear in which TV will move to an all-digital format and, more importantly, make use of fiber optic, rather than coaxial, cables. This move to a digital, fiber optic transmission infrastructure will cause yet another "explosion" in bandwidth, which, in turn, will likely serve to keep this term in vogue well into Ãthe next century.

Chapter level entry points: In an effort to join the Age of Interactivit, many film producers are manufacturing interactive ver sions of their feature films. However, as the process is currently be ing managed, the interactivity is "put into" these movies as an afterthoughtÐas a sort of high-tech adornmentÐrather than being designed into the artworks from the outset. In order to put the interactivity into these pictures without disrupting their narrative flo, many producers have found a safe bet is to create entry points at ob vious locations, such as at edit points between scenes. Using the ob vious analogy of text-based narratives, these entry points are often referred to as chapter-level entry points.

Character-based applications: This historical term is used to describe PC software applications before the current era of graphi cal user interfaces (GUls). These applications were said to be "char acter-based" because they did not   make use of bit-mapped graphics, the desktop metaphor, mouse input, or any of the GUI elements that are part of contemporary computing. Rather, they were constructed entirely out of ASCII characters. For example, many PC-users will remember the old, character-based version of Lotus 1-2-3, which was an industry standard for spreadsheets until the late eighties. Most ap plications have either migrated up to a GUI format or simply mi grated into the blissful sunset of extinction.

Character generator: From the realm of traditional video post production, this term refers to a device dedicated to creating and su perimposing text on top of video. Hence, when a person's name appears below their talking head in a televised interview, you can be sure that you are witnessing the work of a ch   aracter generator. In the coming age of desktop video production, the function of placing text over video will become almost trivial.

Check box: With graphical user interfaces (GUls) that are based on the desktop metaphor (such as the Apple Macintosh interface or the Microsoft Windows interface), this is a standard interface design element. Used most commonly in dialog boxes, the check box is a square structure that operates like a toggle switch to turn particular functions on or off. To activate or de -activate a function, the user simply positions the cursor within the confines, or hot spot, of the corresponding check box, and then clicks the mouse button.

Check disc: Manufacturing a long run (l   =arge number) of any form of optical disc (e.g., CD-ROM or laserdisc) has traditionally been a relatively expensive and, because of their read-only nature, perma nent venture. Because of this, it is customary to proceed

with an abun dance of caution by first printing one, or a few, test discs that can be

thoroughly checked for accuracy before launching the full quantity run. These preliminary

discs are usually referred to as "check discs."
Chroma keyer: A commonly used device in video production, a chroma keyer is used to

process two video sources where one sourceÐ referred to as the "foreground"Ð is to be laid

down on top of the other source, referred to as the "background." The device works by

first specifying a particular color that plays the role of the "key." Once this key is

specifiedÐ the most common key being bl   øueÐany object in the background that is the

same color will drop out and let the background show through. Perhaps the most commonly

known use of chroma keyers occurs where they are used to show TV meteorolo gists,

apparently standing in front of a weather map, but in fact stand ing in front of a blue

wall. (Is nothing sacred?)
Chrominance: This term refers to one -half of the information that typically goes into

making a video signal. Chrominance is the color portion of the information contained in a

full color elec tronic image. The other half is luminance, or light intensity, which an

image requires to make it visible. Of the two, chrominance is the component with regard

to which the human eye is less sensitive. For this reason, many of the compression

techniques employed to handle the transmission of digital images do more to reduce the

presence of chrominance information than they do to reduce the presence   -   of lu minance

data.
CinepakTM: Considered one of the most popular motion video codec

(compression-decompression) standards, Cinepak was developed by SuperMac. It is capable

of playback at 320 x 240 pixels, the same resolution as the first generation of the MPEG

(Motion Picture Ex perts Group) standard, but can only do so at 15 fps (frames per sec

ond). Also, Cinepak is a severely asmmetrical codec, with the compression process taking

300 times longer than decompression.

CIRC: This term stands for cross interleaved reed-solomon code, an error detection and

correction method for audio CDs.

Circuit switching: A less flexible form of data communica tions than its leading rival,

packet switching, this term refers to a method of handling data transmissions in which a

circuit is estab lished for the entire duration of a particular transmission, no matter

how large the associated files or the amount of time required to com plete the

transmission. For long, data Ë-intensive transmissions, this method is considered quite

rigid because it makes no provision for re-routing the data flow even though the

availability of bandwidth may shift around on the network during the time of the

transmission. However, in the case of digital video, where it is critical that the flow

of the streaming data not be interrupted in any way, the establish ment of a circuit is

almost mandatory.

Clipboard: This term refers to an interace design component that is used to supply

temporary storage for elements that are being cut and pasted from one application or

place in a document to another.

Clip consciousness: The growing awareness that original me dia contentÐimage, audio, and

especially videoÐis laced with value in the form of clipable pieces of image, audio, and

video. For ex ample, the well-known animation firm Hanna -Barbera has turned over some its

best known sound effects to Microsoft for inclusion in digi tized clip audio CDs.

Clip media: ßThis is an overarching term used to describe the in creasing propensity

to cut, index, store, retrieve, and revise media elements, much as we have done with

alphanumeric data during the early decades of the computer age. Common subtypes are clip

art, for small pieces of artwork; clip audio, for small pieces of music and speech; and

clip video, for small, categorizable segments of video. The move to clip media is one

that possesses profound implications for society. The primary purpose of "clipping,

indexing, and storing" these various media elements is so that they can be recombined with other elements for various commercial, artistic, or other purposes. It is just like the boilerplating behavior that occurs with respect to docu ments, especially with legal documents. One of the most profound consequences is that, as our cut and paste technologies gain sophisti cationÐw hich they already have a good bit ofÐ it will become virtu ally impossible to tell real from constructed media.   Thus, audio recordings, printed images, and recorded videoÐ all traditionally thought of as accurate and unimpeachable sources of informationÐ will now become subject to all sorts of distortion and forgery. Also, legal issues will require resolution regarding re-usability with author ship, copyright, and licensing of clip media elements.

Clock: In computers, this is a device that marks the time and gener ates periodic signals that control the timing of all computer opera tions. One of the primary functional specifications for a computer is its clock speed, which is a measure of how fast its clock pulses and, therefore, is also a measure of how quickly it turns over its instruc tions and other processes.

Close up: From the world of film and video, this term refers to a camera shot used to establish a desirable intimacy between the sub ject and the viewer. The close-in shot of the romantic interlude repre sents the exemplar of close-ups. This ter   m is often held in contrast to the long shot, which is a camera POV (point-of-view) that is distant from its subject and is typically used to establish the general setting of a scene.

Closure: This term refers to a psychological habit of the human mind exploited by every manner of artistÐ but especially filmmak ersÐ wherein a partial view of a subject is provided with the intent that the audience will use its imagination to construct individual ver sions of a completed subject. In film, for example, a close-up of a tapping foot is often used to signify impatience, instead of showing the entirety of the

impatient subject. In the Age of Interactivit, branchpoints may be used as a way of

getting audience members to externalize their sense of closure.
CLUT: This term stands for color lookup table, which is an image encoding method. Under

this method, the numeric value of eachpixel is used to look up an RGB (red, green, blue)

value in a t   able of color registers. This reduces the amount of data required to

store an image by limiting the number of colors available. CLUT is a method that is

usually employed for "computer-style" or "cartoon-style" graphics and animation.
CLV: This term stands for constant linear velocity, one of two dis tinct formats for

videodisc (the other being CAV [constant angular velocity]). With CLV, the information is

laid down on the disk in one continuous spiral, as opposed to the separate, concentric

tracks of CAV. For this reason, CLV is the preferred format for videodisc ap plications

with long, continuous video plays, such as would be char acteristic of a feature-length

film.
Codec: A contraction for "compression-decompression," this term describes one of the key

technologies of the information age. One of the first applications of codec technology

was facsimile transmission, where it was realized early-on that the massive amounts of

informa tion gen   î erated by faxing documents all over the globe dictated a need to

compress the documents for transmission and then decompress them back to their original

form when they arrived at their destinations. Using this transmission strategy made it

possible to increase the ef fective transmission bandwidth by a factor that was directly

propor tional to the amount of compression that could be achieved. For example, a 10:1

compression ratioÐnot at all uncommonÐmade it possible to increase the transmission

carrying capacity of one's com munication lines by 10 times without changing any aspect

of the trans mission medium. With the advent of multimedia, codec technologY
has become an even more important area of research and develop ment, underscoring the

need to facilitate the dramatically increased bandwidth required by digital forms of the various media—audio, image, and video. Reflecting the magnitude of · this pursuit, there are now a large number of codec techniques (e.g., delta techniques), and an even larger number of commercial codecs (e.g.,Apple's Quickme, Intel's DVI [digital video interactive]) which are streaming into the market. Much of the debate over today's computer standards has to do with the search for an agreed-upon codec standard.

Codes of resemblance: This very useful term is one of many invented by the famous French film theorist Andre Bazin. Writing in the first half of the century, Bazin felt as though the primary secret to the power of film was its ability to encode reality in ways that re sembled reality. Put in simple terms, film is successful because it rep resents the world in a very familiar form. As we enter an era of increa ₂ singly immersive media, i.e., an era dominated by the new forms of virtllal reality, it would appear that Bazin's term should wear well with time. The new forms of tactilefeedback, motionplatforms, and the like are nothing if not new codes of resemblance.

Collaboration technology: This term seeks to embrace a group of technologies and behavioral science concepts and approaches that may be defined by their collective goal of facilitating and en hancing the daily work and interactions of people and machines bound together under the umbrella of a common goal, project, or job.

Color space: This term refers to all wavelengths in the electro magnetic spectrum that produce a visible color effect—that is, color perceptible to the human eye.

Combination v aiew: From the realm of graphical user interface (GUI) design, this term refers to any screen in a windows-style inter face that has two or more windows open at one time. The purpose of seeking such a view is that it permits comparative perspectives on, and/or interchanges of data and information between, the contents presented in the combination of views.

Combinatorial explosion: Perhaps the most troublesome as pect of our early days of

interactive fiction, this term refers to the phenomenon that occurs when an author of

interactive content per mits each decision point in a decision tree to spawn several

outcomes. When every decision point spawns several outcomes, and every one of those

outcomes, in turn, leads to its own multi-outcome decision point, the tree-like structure

of the program spins out of control, ex ploding into an insupportable number o Øf

branches, or combinations of outcomes. This problem was first encountered in the computer

world by scientists who were attempting to build problem-solving programs that they

thought would lead to artificial intelligence. As they at tempted to define the ways in

which even a simple problem might be solved, these early pioneers discovered that there

might be literally trillions of ways in which the computer program could pursue the

solutionÐmany, of course, leading to incomplete solutions or down blind alleys. This

intractable problem is now revisiting the industry by vexing the efforts of those who

would attempt to build convincing interactive stories.

Command line interface: This is a term used to describe an interface design that preceded

the now popular graphical user inter faces (GUIs) like Microsoft's Windows. With the

older interfaces, the user interacted with the computer's operating system by typing in

¼commands on a rather spartan interface that featured only a drive designation followed

by a colon. Often referred to as the "DOS prompt," this approach to obtaining input from

the user has been re placed, for the most part, by a mouse-driven world of desktop

metaphors and the like. Still, there are a few propeller-heads left who prefer the

command-line interface to the graphical user interface.

Compact disc: Is an injection-molded aluminum disc that stores high-density digital data

in the form of microscopic pits and lans that a laser beam can read. Conceived by Philips

and Sony, it was origi nally designed to store high-fidelity music, for which CD-DA is

the standard now accepted worldwide. Because of its large capacity when compared against

magnetic disks, the CD was seized upon by the computer industry when it became evident

that computers were pro cessing the higher bandwidth sources of informationÐ audio, image,

and vide ¡ o. Thus, CD-ROM (compact disc-read only memory) has be come the first viable

direct-access storage standard for the MPC (mul timedia personal computer). However, its

origin as primarily an audio storage device has created some early problems for

multimedia com puting, most of which have to do with the standard transfer rate of 150

Kbytes between the CD player and the computer. This transfer rate is ideally suited for

audio, but does not completely serve the needs of high density graphics, digital images,

or video. Consequently, while optical storage may be the storage medium of the near

future for mul timedia computing, it is likely that storage manufacturers will soon
be called upon to make fundamental changes to the original compact disc technology so as

to make much higher transfer rates possible.
Compiler: This is a computer program that converts the source code of a high level

language program into the machine code of a   computer for processing.
Component video: One of two major types of video, the com ponent video stream is

transmitted as separate luminance and chromi nance signals to provide a higher quality

image. Often compared against composite video, which combines all of the video elements

into a single signal, component pays a price for its higher quality in that it requires

more than one connector and takes up a greater amount of bandwidth.
Composite signal: Most signals received by the human sen sory system are of a composite

nature. Reflecting the multisource nature of sensory reality, composite signals consist

of many separate components that propagate at different frequencies and amplitudes. A

simple example of a composite signal is that generated by a pipe orga Èn. Each note

produces a single tone, but when several notes are combinedÐ as they typically are when

playing an organÐthe several notes that emanate from the instrument merge to form a

complex wave form, which is another way of describing a composite signal. In the era of

modern media, the scientific analysis and understanding of composite signals has made it

possible to electronically decompose and recompose those signals. In the coming era of

digital media, this process will reach a new level of abstraction and flexibility through

the exploding media manipulation capabilities made possible by DSP (digital signal

processing) and other media-processing technologies.

Composite video: One of two major types of video,   P the com posite video signal

economizes on bandwidth and connectors by com bining the RGB (red, green, blue) and

synchronization signals into one. This is the type of video used by television and VCRs.

It is often compared against component video, which transmits the video stream as

separate luminance and chrominance signals to achieve a higher quality image, but at a

higher cost.

Compositing: Typically thought of as a part of video post-pro duction, this term more

generally refers to the practice of layering one media image (sound or picture) on top of

another. The practice of building a complex image with multiple layers usually proceeds

in phases, with intermediate stages called "pre-composites" and the last stage, where the

finishing element is laid down, called the "final com posite." In the coming era of

desktop video production,   { this practice will become fairly simple, and with the more

sophistic ated tools, raises the much feared specter of digital forgery, whereby a skilled

user creates a fraudulent visual or audio recording that, for example, in criminates an

innocent party by placing him or her at the scene of an illegal deed.

Compound document: This early term covers the business communications usage of multimedia

and refers to electronic docu ments composed not only of text and graphics, but of audio

and video segments as well. As an example, tomorrow's business letter as a com pound

document may contain a textual introduction, followed by video clips taken from a

corporate h)permedia process knowledge data base, accompanied by an executive's voice

annotations.

Compound document architectures: An extension of the tagging languages that govern the

structural characteristics of highly formatted (p ¢ublished) documents, these

architectures seek ways to encode, and therefore make manipulable within the context of a

single document, all of the mixed media data tpes that go into mak ing up compound

documents. A relatively recent phenomenon in the industry, the ISO Open Document

Architecture (ODA) and DEC's CDA (Compound Document Architecture) are the two early

leaders in the effort to create these standards.

Compression: Any effort to understand the technical problems of the emerging multimedia

industry must start with a simple fact of life: computers were originally designed to

handle alphanumeric forms of information, not high bandwidth forms such as audio, image,

or video. That audio, image, and video should have enormous value added to them once they

become digitized, and therefore be susceptible to the program control of the computers,

is an absolute revelation, and one that is fairly governing the entire computer industry

at present.   ôBut it has introduced one enormous problem. Consider this: one sec ond of

video digitized at a resolution (image quality) comparable to today's broadcast

television takes up no less than 22 megabytes of storage. One second! That means that a

feature length film of, say, two hours would take on the order of 15 8 gigabtes of

storage. Hence, there is now a huge research and development effort around the world to

find new and better ways to compress digital forms of image and video. The goal of these

efforts is to achieve compressionÐthat is, smaller file sizeÐ while only throwing away

information that vlll

not be visually significant. As an indicator of the magnitude of the effort to find new

and innovative compression techniques, consider that a substantial portion of this

glossary is given over to terms which name and describe the techniques thus far concocted

by the industry (e.g., JPEG, MPEG, QuickTi me, DVI, Fracfal Transform).
Compression ratio: A term of great significance in the multi media industry, compression

ratio refers to how good a job a particu lar compression technique does at reducing the

size of a file made up of some form of digiti,ed media. At the low end, compression

ratios for fax machinesÐw hich work with bit-mapped images of black-and white documentsÐ

average in the range of 10:1. Thus, if an uneompressed bit map of a document takes 100 K

of storage, its com pressed eounterpart at this ratio will take only 10 K. The current

JPEG (Joint Photography Experts Group) standard for compressing color still images ranges

up into the neighborhood of 40:1. Fractal trans form teehniques, the most ambitious

compression technology to date, ean rang Ïe comfortably up into the 200:1 range.
Console cowboy: This term refers to cyberpunks who prove their valor by donning virtual

realit headgear and performing heroic feats in the imaginary world of cyberspace. Not to

be confused with real cowboys as depicted in John Wayne and Clint Eastwood movies, though

many console eowboys must certainly view themselves as such. In both worlds, various

mythic behaviors are embodied whose sources, among others, are Greek drama and mythic

initiation rituals.
Construction visualizer: From the w orld of scientific visual ization, this is an exemplar

of the industry, a program that helps con tractors plan site layouts by visualizing the

movement of materials. machines, and trucks for rea <l estate development projects.
Consumer software: This is the popular term used in the busi ness media that includes

home interactive rmedia programs. Of the titles that today would fall squarely into the

category of interactive multimedia technology, Broderbund's Where in the World is Carmen

Sandiego? is commonly thought of as the first major success among consumer interactive

software programs.

Contention protocols: From the world of computer network ing, this term describes the

dominant and traditional f'orm of manag ing dataflow over networks. Under contention

schemes. only one data conversation can have control of the network at any given time.

However, because most traditional data files are based on alphanumeric (character-based)

sources of data, and are therefore of rela tively small size, most data convers éations

are of relatively short dura tion. Thus, the strategy of limiting flow on the network to

one data conversation at a time is eminently tenable and only leads to degrada tion

during atypical bursts of dataflow. This contention protocol, how ever, is not well

suited to handling the high bandwidth sources of data that make up mixed media data

types. With the audiovisual data types, networks must be able to handle large,

continuously flowing, time critical streams of data. Consequently, as we enter the era of

multime dia, this network management protocol is likely to be on the decline.
Context sensitive help: Considered one of the seminal ideas behind performance support

systems, this term refers to an intelligent extension of the help screen whereby the help

is specific to the situa tion that the users find themselves in at the moment they invoke

the help function. It implies a hel   ùp system that is intelligent enough to interpret

what the user is trying to accomplish at any given moment and has given rise to such

related concepts as embedded training and job aids.
Continuity: In the film and video industry, this term is used to refer to the importance

of maintaining the logical order and consis tency of what is seen on-screen. With the

advent of interactive cin ema, where the audience may travel a multitude of possible

paths through the film experience, maintaining continuityÐw hat Aristotle called "unity"Ð

will be among the most difficult challenges of the enterprise.
Contrast ratio: A measure of image quality in video playback equipment (e.g., CRTs and

LCDs), this ratio describes the ability of a device to capture the differences between

bright and dark areas. Gen erally, CRTs have a much better contrast ratio than LCD

screens, mean ing, for example, that they have better shading a ònd smoother lines.

This concept is somewhat analogous to the audio notion of dynamic range, which measures

the ability of an audio playback device to capture the ditferences between loud and soft

tones.
Convolvotron: Based on technology developed at the NASA Ames Research Center in

collaboration with Crystal River Engineer ing of Groveland, California, this is an

extremely powerful audioDSP (digital signal processor) that changes, or convolves, an

analog sound source using RTF (head related transfer functions) to create a 3-D
digital sound effect. Sound that is computer-synthesized. or that is drawn from an

external source like a compact disc, can be filtered through the Convolvotron and placed

in a space around the listener. The sound-space resolution of the Convolvotron is

virtually infinite, meaning that it can take analog sounds and distribute them to as many

sound source positions within the 3-D s §ound space as is desired.
Couch commando: This is a term held in contrast to the "couch potato," signifying an

individual in the next generation of the view ing audience, who will interact with, and

participate in, the content.
Courseware: This is a general term used to describe programs that embody the convergence

of software and instruction. The term educational software is a near-synonym, though many

purists in the field of instructional technology would insist that the term "courseware"

applies to any form of instructional media, including paper-based products, instructional

videos, etc. However, in general, courseware has become synonymous with educational

software.
CPU: One of the most common terms in the computer industry, this acronym r efers to the

central processing unit. Also referred to as just the processor, the CPU is the brains of

the computer, the engine that drives all other aspects of the system that is a computer.

The entire personal computer industry is subdivided on the basis of which CPUs are employed by the manufacturers. The DOS/Windows portion of the industry is based on processors manufactured by Intel Corpora tion (the popular 80x86 family), while Commodore's Amiga and Apple's Macintosh systems are based on processors manufactured by Motorola (the famous 680x0 family).

CPU intensive: As we enter the age of multimedia, this term is becoming a veritable catch phrase because so many applic   *ationsÐ from 3-D animation to compression-decompressionÐ are pushing the limits of the current families of processor technology. An application is said to be "CPU-intensive" when it demands a largc number of CPU cycles in order to be performed. The rendering of a 3-D anima tion is a good example of a CPU-intensive application. The terms ' compute-intensive" and "processor-intensive" are widely used syn onyms.

CRT: This term stands for cathode ray tube and refers to the most common type of video display technology, both with regard to com puting and television. With this technology, a vacuum tube with an electron gun at one end and a phosphor-coated screen at the other is used to convert voltages into patterns of images on the screen for viewing.

Cropping: A process common to the manipulation of dig   yital im ages, this term refers specifically to the discarding of unwanted por tions of an image. Cropping is most commonly done with freshly scanned images where the scanner has picked up unintentional de bris around the edges of the target image.

Cross fader: From the realm of audio engineering, this term re fers to a knob or slider that enables the engineer to balance the level of two audio inputs, performing a smooth transition between the two At one end of the continuum, it passes only one source, and at the opposite end, it passes only the other. In between, it blends the two sources proportionately.

Cue sheet: From the world of video production, this is a form that shows the mixer where

various sounds on a track stop and start. It is used during post-production when

combining the tracks (compo nents) of a picture onto one master track. Much of the

production "logic" co ümmunicated by cue sheets is now embodied in the time line

interfaces used by several popular authoring systems.
CUI: This term stands for character user interface, and it refers to the computer

precursor to the graphical user interface (GUI), in which the entire interface was

constructed from alphanumeric characters. Users of earlier generations of personal

computers will recall that the CUI phase in the history of desktop computing was

characterized by the DOS-prompt, a total reliance on the Ascn character set, and the need

to use typed commands in order to get anything done on the computer.
Curator file: This term refers to a use of hypermedia applications that is becoming

increasingly common. A curator file is an encyclo pedic, hypermedia collection of items

that represent a museum's stock of artifacts. Typically, these hypermedia programs will

include digi tized images of the ar útifacts, text, and audio overlays that explain

their origins, meaning, and/or significance. Many producers of these pro grams are now

adding video sequences that add depth to the meaning of selected artifacts. More and

more, museums are building such hypermedia creations as a way of capitalizing on their

unique media assets. In so doing, they are alsoÐperhaps unwittinglyÐadding to the growing

canon of surrogate travel products, which, of course, are
designed to eliminate the need to travel to the places where the arti facts originated.
Cursor: This refers to a position indicator that can be a symbol on the screen (a screen

cursor) or a handheld device for entering coordi nate points (a hand cursor).
Cursor plane: In the world of digital video, this plane is the up permost picture plane

used to render the computer screen. It is a small area, typically no larger than 16 x 16

pixels, and is used to display the current Á position of the cursor.
Curtain: From the realm of DVE (digital video effects), this is a two-plane effect in

which the image on the front plane parts or closes like a pair of curtains to reveal the

image on the back plane.
Cut: From the world of filmmaking, this term refers to the end of one scene, to be

followed by the beginning of the next scene.
Cut and paste: This is an interactive technique for moving items from one location to

another within an electronic document. Origi nally, this term referred exclusively to the

movementÐthe cutting and pastingÐof text segments within word processors. However, as

mixed media data tpes have found their way into the computing en vironment, this term has

gained much wider application, and it can just as easily refer to moving audio, image,

graphic, or video seg ments from one place in a compound document to another.
Cuts only editing software: Among the slew of new video post-production sof òtware

tools, this is one of the simplest, specializ ing in the automation of some of the

tedious tasks associated with A/B roll editing. Basically, these products offer many of

the same controls found on analog editing decks, such as enabling the video editor to

view, catalog, and tag video segments, as well as create EDLs (edit decision lists).
Cutting room: This is the editor's work area, and in traditional filmmaking, the central

place of post-production activity.
Cyberarts: This is a general term for describing the various emer gent forms of

interactive entertainment and art. Included in these forms would be interactive cinema

and interactive fiction, the various immersive gaming devices associated with virtual

reality, and a num ber of entertainment genres that rely on high bandwidth communica

tions to bring geographically dispersed parties together in order to benefit from some

type of shared exp ƒerience (a.k.a. cyberspace).
Cybernetics: This term, which now stands for an entire disci pline, was coined by Norbert

Weiner of MIT during World War II. At the time, Weiner was designing a system for

anti-aircraft guns. Dur ing this project, he realized that the key element in a control

system of any making—natural or artificial—is a feedback loop that gives a controller

information on the results of its actions. He called such systemic considerations

cybernetics, a term that has been expanded to refer to the science of communication and

control theory. Obviously, with the prospects of such technologies as voice and optical

recognition in the offing, the future of this discipline is very bright.
Cyberpunk: A term originally used to describe a specific type of individual—a modern-day

beatnik of sorts—it has recently expanded to refer to an entire subculture. It is a

subculture that combines an infatuation with ƒhigh-tech tools and a disdain for

conventional ways of using them—a sort of counterculture taken with such postmodern

phenomena as psychedelics, smart drugs, and cutting edge technology (especially virtual

reality). Cyberpunk seems to be part-in-parcel of the shift from a reverence for the

wisdom of the past to the veneration of a technology-driven future.
Cyberspace: This now-famous term originated in the cult classic The Neuromancer, written

by William Gibson in 1984. A basic definition of cyberspace is a 3-D domain in which

cybernetic feedback and control occur. As currently defined, a cyberspace system is one

that provides users with a 3-D, interactive experience that includes the illusion they

are inside a world rather than observing an image. It will seem obvious that one of the

reasons why this term has gathered so much popularity is that in its multiple meanings,

it tracks very closely with the concept ° of virtual reality.
DAC: Stands for digital-to-analog conversion. It is the reverse process of ADC

(analog-to-digital conversion) that occurs on the play back side of the digital equation

for producing computer-mediated media. For example, with digital audio, the ADC converts

analog, or waveform, audio into a digital stream of data, and the DAC converts it back to

an analog form that drives loudspeakers or headphones.
DAGTM: Stands for Data Acquisition Glove, a device developed at the NationalAdvanced

Robotics Research Center in the United King dom in conjunction with Airmuscle, Ltd. This

device is used in tan dem with the TeleTact Glove, developed by the same principals. The

DAG, as the name implies, is a glove used to capture the force pat tern ° data

associated with grasping various real world objects (e.g., the gearshift of a racecar.

When you put this glove on and grasp a real object, the force-sensitive resistors

register distinct force patterns. These patterns are in turn converted to proportional

electrical values (i.e., they are digitized) and are stored in computer memory. Engi

neers then use this data to create templates of how various objects feel, and, over time,

build up a library of force pattern templates in much the same fashion that makers of

MlDI(musical instrument digital interface) wave tables build u p patch sets of musical

instrument sounds. These digitized force feedback patterns are then u Ksed with

theTeleTact Glove, which is the output device used to recreate the tactile sensa tions

associated with a particular virtual reality application.
DARPA: Stands for Defense Advanced Research Projects Agency, a military organization that

has been responsible for funding innu merable research and development projects that have

led to new me dia prototypes. A recent example is SIMNET (simulated network).
Data capture: This commonly used term in the computer indus try is nearly synonymous with

the term "digitizing." It refers to the point in the information processing sequence

where noncomputer sources of information (like pictures of the real world, and the real

world itself) become digitally encoded so that they may be subse quently submitted to

some form of manipulation by the computer.
Data communications: This is the gen meral term used to de scribe the very general

phenomenon of exchanging digital forms of information between two or more locations.
Data conferencing: An enhanced derivative of document conferencing, this term refers to a

form of all-digital communications in which there is simultaneous voice and data

transmission on the same communications line. With data conferencing, the voice is digi

tized and treatedÐin multimedia fashionÐas just one more element in the data stream.
DataGIoveTM: A prototypical virtual reality (VR) product from VPL Research, this "input"

device permits users to reach into the 3-D environment of a virtual world and, while

viewing a virtual hand cor responding to their own real one, grasp and move virtual

objects, as well as perform various gestural commands. It works through the performance

of fiber-optic bundles located along the glove's finger ×, thumb, and palm surfaces.

These bundles work by responding to de grees of flexibility and positioning of the

various hand feature, and then by sending encoded signal pulses to the processor. In just

the short time in which this product has been on the market, it has taken on generic

status, such that VR aficionados now refer to data gloves as a type of virtual reality

device, much as the general public uses a term like Kleenex in lieu of "facial tissues."
Data rate: This term refers to the maximum sustainable through put for an input/output

device. In the era of multimedia, this rate of ten determines the fitness-for-duty of a

given peripheral device.
DataSuitTM: Produced by VPL Research, this VR concoction makes total immersion possible

through the electronic performance of iner tial and positioning sensors. The wearer of

this suit can move (either freely around a room or on a treadmill) and interact through

+ the full range of the body's movements.
Data tablet: Also referred to as a "digitizing tablet," this terrn describes a flat

working surface drawn upon by a stylus or hand cur sor to produce an input stream of

coordinate data.
DATV: Stands for digital advanced television, which is a term re cently invented by

FCC-sponsored efforts to establish a set of trans mission standards for the

soon-to-emerge all-digital television. This
standard may eventually replace NTSC (National Television Standards Committee), which has

reigned as the standard for television in the United States for several decades.

DCT: Stands for discrete cosine transform, an increasingly common compression technique used, for example, with the JPEG (Joint Pho tography Experts Group) standard. Essentially, DCT algorithms throw out redundant pixel data and analyze the frequency of the color data, chrominance, contained in a video frame so as to discard the least important visual data.

Decisio Ûn based scripting: This is another term for interac tive scriptwriting, or the writing of scripts for interactive programs. It reflects the fact that scriptwriting in the interactive domain must take account of the user's ability and desire to participate in the decision makin g process. In this regard, scriptwriters must think in terms of decision trees, alternate scenarios, multiple outcomes, and the like.

Decision tree: For those who would attempt to build interactive fiction, or any form of multimedia like it, the decision tree is a key concept. Drafted into the world of multimedia development from such business and scientific disciplines as management science and artifi cial intelligence, this term captures the notion that a single decision point will have multiple outcomes, each of which will spawn addi tional decision points, each of which will, in turn, spawn several more outcomes, ad infinitum, leading to a program that bears a logical, flowchart-like structure that imitates the Ð visual form of a treeÐespe cially a Christmas treeÐ that has been turned on its side. Thus, with out any type of reconvergent or other constraining strategy, the natural progression of an interactive fiction or business case study will likely lead to a combinatorial explosion of decision points and outcomesÐ one of the early, crucial development problems faced by authors of interactive multimedia.

Declustering: Another term for file striping, declustering is a high performance strategy allowing for distribution of a single file over several storage devices. This strategy is important in the age of multimedia technology because it permits rapid movement of the

enor mous amount of files associated with mixed media data types.

Decompression: The flip side of compression, this term refers to the process by which

compressed forms of digitized media are re constructed for presentation or further

processing. With many of the simpler codec (compression-decompression) t +echnologies,

the decompression process is roughly comparable in effort to its compression counterpart.

However, for the more sophisticated techniques that achieve higher compression ratios,

the decompression process takes much less effort. For this reason, these more

sophisticated techniques are called asymmetrical codecsÐthat is, they take more time and

com puting resources to compress the media than they do to decompress it. Whatever the

codec, however, because decompression typically occurs in real time, just before the

media is presented to the end user, it is the extremely time-sensitive half of the codec

process.

De facto standard: This refers to any standard that arises out side of the formal,

standard-setting activities of industry-sanctioned committees. Most commonly, de facto

standards come into being be cause an innovative, often entrepreneurial solution appears

in the marketplace. Because this previously unheard of solution is so far superior + to

the current standard being offered up by the industry ma jors, the invisible hand of

consumer selection chooses it to be the standard for its particular industry niche. It is

the result of capitalism, and it occurs with almost maddening frequency in the fast world

of computer technology and the ultra-fast world of multimedia technol ogy. It leads to

that most wonderful, yet dreaded, economic phenom enon known as functional obsolescence.

Degrees of freedom: This term is commonly used as a gauge of sophistication with regard

to the forms of virtual reality (VR) that seek to immerse the user in a virtual world.

The most sophisticated VR systems accommodate up to six degrees of freedom: three in the

Cartesian coordinate space of left/right (x), up/down (y), and forward/ backward (z);

and, three having to do with the changes in orientation known as pitch (motion around the

x-axis), roll (motion around the z-axis), and yaw (motion around the ¥y-axis).
Delivery system: This general term refers to the combination of hardware and software

components needed to deliver a particular multimedia or courseware program. For most of

the industry's his tory, multimedia solutions have been brought to their audiences via

stand-alone systems, i.e., delivery systems not connected to any net work. Typical of

these traditional standalone systems is the interac tive video workstation, which usually

includes a laserdisc, a persona computer, and a television, all interconnected and

controlled by a pro gram developed using an authoring system. Rarely have these work

stations ever been connected with one another over a network However, as we sail into a

future occupied by such technologies as
interactive television and the information superhighway, multimedia delivery systems will

increasingly involve the same sorts of network ing features that now characterize

advanced data processing systems in the co   rporate world.
Delta encoding: This term refers to one of the more common strategies for compression of

image data. With this technique, the actual value of each pixel is not what gets stored

and/or transmitted. Instead, what gets stored is the amount that must be added to the

current pixel value to produce the value of the next pixel in a scan line. For each scan

line, the true value of the first (leftmost) pixel is stored, but thereafter a series of

differences, or deltas, is stored for each subsequent pixel. The assumption underlying

this technique for compression of visual data is that the range of deltas will be small

relative to the range of the true pixel values.
Desktop: As with the use of the term "environment" in public dis course, the use of the

term "desktop"   Ú in the computer industry is gath ering so many references that it runs

the risk of losing any of the semantic specificity required of useful terms. However,

there are two major areas of meaning to which this term may be confined in its

contemporary usage: 1) as the central metaphor of theApple Macintosh and Microsoft

Windows graphical user interfaces (GUls), and 2) as an adjective for describing various

computing devices and functions that have been so thoroughly down-scaled in size and

price that they are capable of being employed on the individual desktop, as in video

production.

Desktop accessories: With regard to the Apple Macintosh desktop graphical user interface

(GUI) and the Microsoft Windows GUI, these are programs of relati   .vely limited scope

that can be opened while other applications are running. Examples are the Note Pad, Alarm

Clock, and Calculator.

Desktop entertainment systems: This term relates to the emerging assembly of media

production features that enable personal computers to 1) interface with the various audio

and video instru ments normally associated with traditional media production, and 2)

offer software-driven post-production capabilities covering most of the mixing, editing,

and refining functions traditionally associated with the large post houses. Taken

together, these board and software com binations now make it more affordable and possible

for individuals to create their own film productions without incurring the great expenses

typically associated with such undertakings. It is projected that these   Xemerging

capabilities will become standard components in the MPC (multimedia personal computer),

and will give rise to whole new class of amateur film authors.

Desktop metaphor: One of the early centralizing concepts of graphical user interface

(GUI) design, the desktop metaphor was first utilized in the marketplace by Apple

Computer to serve as the key organizing principle of its Macintosh GUI, and was taken up

later by Microsoft Windows. This interface design has become ubiquitous and has virtually

replaced and outdated the character-based application interfaces of DOS and the older

mainframe, text-heavy, graphically sparse environments predominant in the '70s and part

of the '80s. Some of the standard components of the GUI desktop interface in clude the

use of windows as a visual model for accessing and viewing documents, the use of the cli

 qck-and-drag method for moving objects about on the desktop, and the use of the trash

can as a receptacle for files that the user wishes to delete. As an interface paradigm,

the desktop metaphor may be falling out of favor, as many feel that a more robust user

interface is required to handle the rich data types of multimedia.

Desktop video production: This term arises out of the fact that at some point in the near

future desktop computers will be equipped with all of the electronic tools necessary to

perform the essential functions of today's video production studio. In other words, the

everyday user will he able to do all of the editing, mixi1lg, titling, and special

effects needed to produce a professional video. This mix of tools will help launch the

age of the compound document, where professionals communicate with one another by

composing documents that have image   ©, audio, and video components.

Desktop virtual reality: The low end of virtual realit (VR), it is also commonly referred

to as "Window VR." Using the broadest definition, it includes early products like

Microsoft's "Flight Simula tor" but typically refers to programs that enable one to

navigate through 3-D rendered worlds. Architectural walkthroughs and other surro gate

travel programs represent common, early examples of this form of VR.

Device driver: Refers to the systems-level code, usually written in assembly language or

C, responsible for translating high-level in structions from the computer into codes that

a particular hardware

device can understand. Thus, we often speak of a display driver or a printer driver,

these being the codes that make it possible for the com puter to work in harmony with

specific models of display and printer, respectively.

D1 digital video: This high-end form of component video has become a popular inp _ ut

source among the service bureaus that per form MPEG (Motion Picture Experts Group)

compression. Owing to its digital format, Dl can be copied any number of times without

suffering generation loss.

Dialog box: From graphical user interface (GUI) design, this is an interface element

where a windowed portion of the screen is set up to enable the user to more completely

specify the details of a particular function before launching it. Selecting the number of

copies that one wants before launching a print process provides a good example of how a

dialog box might be used.

DIB: Stands for Device Independent Bitmap, an interoperability strat egy for interactive

video. In a market that is constantly introducing new multimedia devices and platforms, a

DIB enables the developer to move programs from one platform or device to another without

having to re-digitize or reformat the images.

DICOM: Stands for Digital Imaging and Communications in Medi cine, a standard file format

used Ò by the medical industry to represent digital images and other forms of medical

information.

DigiCipher IITM This is a codec that intends to compete with MPEG (Motion Picture Experts

Group) 2 for the right to become the standard among cable operators for all-digital TV

transmission. DigiCipher II has a compression quality that is on par with that of MPEG 2,

plus it has the additional ability to scramble, or encrypt signals to prevent piracy.

This codec is a product of Chicago-based General Instrument Corp., a leading supplier of

cable TV decoder boxes.

Digital: This is a term of such wide applicability and appeal that one suspects it gets

involved in the naming of things that aren't even digital. To be digital, something must

be encoded in binary format, where all information is ultimately stored in the on-off

signals that computers can process.

Digital audio production systems: The aural counterpart to desktop digital video systems,

these hardware-software creations are now ri   valing their analog, tape-oriented,

studio forebears in terms of being able to produce sophisticated, broadcast-quality sound

tracks.

Digital audio special effects: Like their video (DVE) coun terparts, these digital tools

now make it possible for audio editors to produce entirely synthesized forms of audio

special effects, such as reverb, flanging, and chorusing.

Digital imaging: Is an emerging, technology-based artform made possible by the

digitization of visual elements, especially the photo graphically captured image. Perhaps

the most powerful form of artis tic manipulation made possible by this technology is that

of electronic compositing, which enables the artist to integrate disparate visual el

ements into a single imagistic metaphor. Thus, for example, an artist can create a sense

of *ony by placing a device like a traff1c light in the middle of an otherwise

all-natural scene like a meadow.

Digital puppetry: This is a new form of puppetry in which the movement ãs of on-screen

animated actors are controlled by real-life humans wearing tracking booms and special

facial sensors. The most well-known digital puppet to date is the commercially available

PAS (Performance Animation System) by SimGraphics, which allows ac tors to control the

movements of computer generated 3-D characters in real time.

Digital thermometer: An example of an A/D converter, which is a probe or sensor that

performs sampling of temperature data to convert it from analog to digital form.

Digitize: This widely used term refers to the process by which some form of analog media

source (picture, slide, audiotape, etc.) is input to computer by converting it into

encoded signals that can be stored digitally and processed electronically.

Dimmed: In the world of pull-down menus and interJace design, this term refers to the

gray tone applied to menu items that, for what ever reason, are not available to the user

for selection at a given mo ment. A ûs we move into the era of interactive cinema, it

is easy to imagine an analogous artistic instrument whereby certain on-screen objects

possess dull tones when they cannot be interacted upon by the user (participant).
Direct manipulation: A graphical user interface (GUI) design term, direct manipulation

refers to the simplification of the interface that occurs when the user can manipulate

objects directly without
having to memorize and use abstract commands. The classic example occurs in the Apple

Macintosh or Microsoft Windows GUI, where one drags icons of files from one place to

another to execute the same copy function that, in the old command-line interface of the

DOS world, required the strict syntactical construction of a "copy" command.
Direct neural input: This is one of the most feared and even hated visions being

contemplated today for new media. The idea is obvious: bypass the body's sense or }gans

and send information di rectly to appropriate areas of the brain.
Discovery learning: A term made popular in the educational world by Jerome Bruner, it

refers to an approach to learning that em phasizes the intrinsic motivation and

self-sponsored curiosity of the learner. This term has now become popular among

instructional de signers because it matches well with the inherent design characteris

tics of hypertext and hypermedia in that both rely upon the associative thinking patterns

of a naturally curious learner.
Disk, Disc: These two terms are often used interchangeably, though the tendency now is to

use disk, spelled with a "k," to refer to mag netic storage media, and disc, spelled with

a "c," to refer to optical storage media. In either case, the term refers to a circular

platter used to store digital information in a format that makes that information

randomly accessi úble, rather than sequentially accessible (as is the case with

sequential media like magnetic tape).
Display list: With reference to computer graphics, this term de scribes a list of display

instructions for specifying how an object is to be drawn on the display surface. Vector

graphics, for example, make use of display lists.

Display mismatch: One of the principal types of bug found in virtual reality systems, it occurs when the visual, auditory, or tactile systems get completely out of sync or are otherwise mismatched. For example, if you stepped on a virtual gas pedal and got the toot of a car horn as a response, you would be safe in saying that your virtual car had a display mismatch.

Display surface: That part of a computer graphics display de vice (such as a CRT or pen plotter) that actually displays the graphi cal data, i.e., the screen itself or the plotting surface.

Dissolve: This term refers to a transiti onal effect between scenes that makes it seem as though one scene has dissolved into the next. With the explosion of PC paint systems, there are now virtually hun dreds of dissolve routines available for desktop video production.

Distance learning: A popular term in educational circles, dis tance learning simply refers to the use of broadcast media to extend the geographic span of (presumably) high-quality teaching. The most commonly cited application of distance learning has to do with trans mitting instruction into rural and otherwise remote geographic areas.

Distractor: This term comes from the world of education, where it is used to name an option in a multiple-choice question that is in correct, i.e., that is put in place to distract the learner. With all forms of computer based learning, the distractor has become a potentially powerful design tool, often put in place to induce learners to exhibit that most dreaded of learning blocks, the intuitively appealing mis assumption. Good instructional designers will use distractors to lead learners into alternative pathways that remediate these common mis assumptions, thereby accelerating the path to enhanced learning. This term even has utility in the field of video game design, where it can be used to describe lures placed in the game to challenge the player's ability to exercise sound judgment.

Dithering: An anti-aliasing effect common to most graphics pack ages, dithering is used

to give objects the appearance of higher reso lution by blending their edges (boundaries)

into the background so as to help remove the unappealing affect also known as the

jaggies.

DLL: Stands for dynamic link library and represents one of the more prominent elements in

software design today. With so many aspects of our lives being automated, and therefore

encoded in software rou tines, there is an increasing concern about duplication of effor

¿t and the needless decrease in productivity it causes for all of us. The dy namic link

library is a generic software design concept intended to combat duplication of coding

effort, and therefore, to make a signifi cant contribution to productivity in the

software industry. More spe cifically, the DLL concept is based on the notion that most

applicationS call on a standard set of routines which are so commonly used that they need

to be duplicated in nearly every application. To avoid this duplication, DLLs are created

as a way of sharing these routines among their constituent applications. The routines are

stored on disk in only one placeÐthe dynamic link libraryÐthereby saving space on a
computer's hard disk and the effort involved to incorporate them into the compiled

versions of the various applications that need to use them. This idea of making a public

resource out of widely used ele ments is as old as the ages, but i °n computing, and

especially in soft ware engineeringÐwhere localized sources of complexity and uniqueness

seem always to foil the best-laid intentionsÐthe concept of the DLL is welcome.

DM: Stands for direct memory access, which is a technique used to transfer large amounts

of data into or out of computer RAM off of or onto peripheral storage devices without

involving the CPU to carry out the operation. This frees the CPU to take on other tasks.

In the age of multimedia, where vast amounts of digital data for representing the various

forms of media will be involved, the use of DMA as an architectural strategy will grow

increasingly important.

Docugraphic system: Is a network that contains and links scan ners and printers.

Document conferencing: A °hybrid form of interactivity, this term refers to a type of

activity that combines the benefits and fea tures of videoconferencing and groupware. As

two or more geographi cally separated parties work on a shared document, a window

embedded in the document is supplied that enables the current speaker to be viewed by

others on the team whileÐone assumesÐthe com munication is directed toward some aspect of

the document-as-shared work product.

Document exchange lormat: This term refers to text for matting and styling standards

intended to support cross-platformport ability of highly formatted documents. SGML

(standard generalized markup language) is perhaps the best known Nexample. The present

challenge is to create such formats for files that contain audio, graph ics, and full

motion video, the mixed media data types.

Document mapping: This term refers to a process by which the contents of a traditional

text document are made more accessible, i.e., where those contents are more readily

matched to specific user interests and needs. There are now special purpose authoring

systems that help automate the process of document mapping. These tools help create,

among other things, tables of contents with live links to the content sections named in

the table, back-of-the-book indexes, chapter outlines, and maps of hypertext links

(hyperlinks).

Dolly: From the world of film production, this term refers to a track ing structure that

allows a scene to be shot by a moving camera. Thus, this cinematographic device ó is

used to create a moving POV (point of-view). Increasingly, digital video software,

especially those pro grams associated with virtual reality, are able to create this

effect entirely within the software, where it is referred to as ying (i.e., the user, in

essence, takes control of the POV and flie through the com puterized setting).

Download: In the most general sense, the copying of information from one computer to

another. Traditionally, this term has been viewed as the transfer of documents, database

files, or other text-oriented data from a larger system to a smaller one. For example, a

user would download a desired news item from one of the online information services.

Increasingly, though, the process of downloading will in volve mixed media data types,

and, in the near future, it may become common parlance to say that one wants to download

a movie, for instance.
DPI: Stands for dots per inch, a common me ûasure of resolution for devices, such as

scanners, associated with image processing. It rep resents, for example, the number of

pixels that a scanner can physi cally distinguish in each vertical and horizontal inch of

an original image.
Dragging: This interactive technique, made very common through its use in the desktop

metaphor, is used to reposition an object on the screen. The most common form of dragging

is effected by position ing the cursor over the target object, holding down the mouse

button, and then dragging the object through the movement of the mouse until one has

moved the object to its destination, at which point the mouse button is released.
Draw systems: Used as a term that contrasts with paint systems, draw systems are programs

that create structured or vectorized graphics images. Paint systems are programs that

create bit-mapped graphics images. Draw systems can be simple or very compl ãex: they

can range from tools for creating simple two-dimensional images, all the way up to CAD

(computer aided design) programs that support 3-D mod eling of solid objects with surface

shading. With these systems, the artist manipulates objects rather than pixels. Most

programs include, at a minimum, commands for creating various geometric objects (such as

circles, rectangles, or boxes), assigning them attributes (such as
color), and manipulating their spatial properties (such as location on the screen).
Drill and practice: From the world of instructional design, this term refers to a

commonly used design strategy for programming CBT (computer based instruction). Drill and

practice programs, as their name implies, are typified by long strings of

multiple-choice, fill-in the-blank-type questions that strive to sharpen the learner's

skills with respect to a fairly narrow range of academic concerns. Math programs, in

particular, have exploited the dril Ìl and practice paradigm. For ex ample, a student

might be asked to answer a series of short answer questions regarding the addition of two

two-digit numbers. Easy to program, but facetiously referred to by many as "drill and

kill," this mode of instructional design has (thankfully) fallen out of favor with

educators over the past few years.

Driver software: This is a nearly ubiquitous type of software that provides

communications at the machine level between comput ers and their peripheral devices. For

example, one could not use an external CD-ROM player with a computer without first

installing that player's driver software in memory. With regard to peripherals that are

permanently attached to the computer (e.g., a printer), the driver software becomes a

part of that computer's boot (i.e., startup) pro gram and is automatically loaded into

memory when the machine is turned on without requiring any user intervention.

Drum: This term generally refers to scanning equipment at Ì the high end of the

publishing application spectrum. Film or paper is inserted on a drum which is rotated

past a focused light source. Drum devices are generally very high resolution machines.

Drum plotter: A type of pen plotter device in which the paper is rotated on a drum while

the pen moves along the opposite axis.

DSP: Stands for digital signal processing, a chip-based technology responsible for

converting analog signals (such as sound) to a com puter-readable digital format and

vice-versa. DSP chips promise to find their way into PCs in a massive way in the near

future. In fact, most industry analysts agree that without DSPs, multimedia technol ogy

would remain a pipe dream, because general purpose CPUs sim ply do not have the

horsepower to handle multimedia data efficiently. Thus, DSPs will fast become one of the

central components in the emergence of the multiprocessing architectures to make the

concept of a true MPC (multimedia personal computer) possible. A DSP eq uipped PC can

function as a digital answering machine, a fax mo dem, a CD-quality audio recorder or

player, and a file codec (com pression-decompression), without requiring additional

expansion boards.
DTD: Stands for document type definitions, utilized by tagging lan guages such as SGML

(standard generalized markup language) to define specific processing rules for encoding

and decoding a document's structure and the markup tags that determine the document's

structure.
DTM: Stands for digital terrain models, a texture mapping technol ogy for building 3-D,

photorealistic landscapes. With high-end sys tems, scenes may be computed on the fly,

enabling the user to freely explore the terrain. DTM could become a powerful tool, or

enabling technology, for creating the referential context of interactivefictions as well

as for training simulations.
DTVC: Stands for desktop videoconferencing, an emergent use for the PC which relies upon

levels of connect +ivity and network band width that are not quite in place as yet.
Dual resolution displays: This technology is used by virtual reality engineers to

manufacture wide field of view systems that re strict the high resolution portions of

their screens to windows that approximate the area of human foveal attention (which is

the high resolution portion of human sight). All other portions of the screen have a much

reduced resolution (smaller number of pixels), but, in theory, should not be noticed

because they are only visible to the low resolution portion of the human eye known as

peripheral vision. This type of display is used in close conjunction with eye tracking

tech nology to keep the high resolution window in front of the user's fovea and the low

resolution portions of the screen affixed to the user's peripheral vision. The advantage

of this technology is that it dramati cally reduces the total number of pixels to be

used, thereby reducing the computatio ¦ nal load and increasing theframe refresh rate.
Ducking: From the world of audio production, this term is used to describe the technique

by which the volume (loudness) of a music track is reduced to accommodate narration. This

process, designed to eliminate sources of competition in a production's sound track, is

readily handled using numerical methods with digital audio produc tion systems.
DVE: Stands for digital video effects, the growing library of digi tally constructed

visual effects that are being made available to desk top computers through a growing

number of desktop video products. The most common form of DVE is the transition, or

digital wipe.
DVITM: Stands for Digital Video Interactive and represents one of the earliest

technologies to attempt to digitize video and then com press the resulting datastream.

Originally developed by RCA at their laboratories in Princeton, New Jersey, during the

mid-eighties, DVI eventually ended up in the hands of   +chipmaker Intel, who purchased

it from interim owner GE in 1988. A multifaceted product that re volves around its own

proprietary codec (compression-decompres sion) technology, DVI has built a fair degree of

support for itself in the marketplace. IBM has endorsed the technology, several

third-party software houses have developed authoring systems around it, and the

technology now has a Microsoft Windows version known as Indeo. However, DVI suffers from

the fact that it does not conform to any of the widely accepted standards for digitizing

visual information: namely, JPEG (Joint Photography Experts Group), MPEG (Motion Picture

Experts Group) and H.261. The differences between DVI and, in particular, MPEG and H.261,

go to their respective product cores, namely, their respective codecs. Where both MPEG

and H.261 are based on the mathematics of DCT (discrete cosine transfer), DVI is based on

a kind of math called "region coding." (Because JPEG is concerned with s ¦ till image,

it is not appropriate to make direct com parisons.) Many technologists believe that DCT

is the superior form of math for doing compression-decompression. The bottom line is

that, in spite of the considerable progress that DVI has made, its fu ture in the digital

video market may be uncertain.
DXF: A file format that somehow stands for drawing interchange format, this acronym

refers to a platform-independent format for CAD (computer aided design) files developed

by Autodesk. As virtual re ality brings such phenomena as the architectural walkthrough

into the mainstream of desktop computing, expect standards like DXF, and its near-cousin

IGES (initial graphics exchange specification), to become increasingly common.
Dynamic range: In the world of digital audio, this term describes the difference between

the loudest and softest sounds that can be ex pressed by a system. It represents a

measure of audio resolution and is often expressed in decibels.　î
DYUV: Also known as delta luminance color difference, this image compression technique

takes advantage of the fact that data for neigh boring pixels are often similar. Thus,

instead of recording each pixel separately, it records only the difference between

pixels, line by line Like its YUV image encoding parent, it also exploits the fact that

the human eye is more sensitive to differences in brightness (luminance) than in color

(chrominance), and thus saves data space by storing less information about color changes

than about changes having to do with brightness.
EDI: Stands for electronic data interchange, which is a general term that refers to the

data communications technology needed for trading partners to transmit various forms of

business document correspon denceÐ such as purchase orders, bills of lading, and shipping

ordersÐ electronically across a network instead of sending them physica mlly through

the mail. It is expected that this form of electronic communi cation, like most others,

may increasingly be enhanced by the inclu sion of various forms of mixed media data types

such as digital images and voice annotations.
Editor: Is one who deletes or adds scenes to a picture by following the instructions of

the director, and who also keeps the sound tracks in sync. It has often been said that it

is the editor who actually makes the movie, because it is the editor who controls the

overall pacing of the film and thereby determines much of its emotional impact.
Edit point: From the world of film and video, this term refers to any place in a video

where the editor has intervened with respect to the visual flow. An edit point is

typically associated with some form of cut from one shot to another. Producers who wish

to make aes thetically appealing inter ì active programs will need to remember the fact

that virtually all points of interaction (branchpoints) will also be edit points of one

type or another.
EDL: Stands for edit decision list, which in the world of film pro duction is a list of

instructions for creating a final, single videotape out of multiple source tapes. This

particular film production tech nique is now a popular one among producers of desktop

video pro duction tools because, from a systems analysis standpoint, it represents little

more than a straightforward database function.
Educational softwar Nearly synonymous with the terms courseware and CBT (computer based

training), this growing type of application represents the use of software to educate,

rather than au tomate. Rarely heard of in the corporate world, this term is much more

commonly spoken of in the school market, where it is used to describe what many educators

feel t   o be the next major form of in structional publishing.
Edutainment: This contracted term is given to software that merges the functions

associated with educational and entertainment software. This new breed of software

exploits the media capabilities of the MPC (multimedia personal computer) and seeks to

expand the home market for software by blending the youth appeal of electronic games with

the parent appeal of educational software. More than just a marketing whim, the concept

of edutainment is based on the well researched overlap between sophisticated,

multidimensional games and the higher-order thinking skills associated with

problem-solving

EGA: This stands for enhanced graphics adapter, which is a vesti gial remnant of the

graphical ascent of DOS-compatible personal com puters. Falling in the lineal path just

after CGA and just before VGA, the EGA standard permitted 64 colors with a resolution of

640 x 350 pixels.

EISA: This term stands   Ì for extended industry standard architecture, a now somewhat

dated update to the original (and even more dated) ISA architecture of the personal

computer. The EISA standard pro vides for a broader data path than its ISA forebear,

which became a necessity in the late 1980s (1988, to be specific), when computer manu

facturers began to accelerate their attempts to enrich the computing experience with

multimedia data types. Because this effort has con tinued to grow in the '90s, the EISA

standard has fallen behind, and is now being patched by various local bus strategies,

such as Intel's PCI (Peripheral Component Interconnect).

E journal: Short for electronic journal, this phenomenon issues from the "Net," or, to be

more precise, the Internet. Considered to be the latest, best manifestation of democracy,

the Ejournal embodies the concept that anyone with access to a computer equipped with a

modem can produce and distribute an electronic magazine through a computer network.

Ejourn   ials are exploding in number and areÐpre dictablyÐoriented around special topics

such as computer law and AIDS prevention. The beauty of Ejournals is that they enable

many to publish who simply do not have the finances or other resources to bring their

ideas to fruition in the print publishing arena.

Electronic content: This term was created in the world of docu ment processing to refer

to documents stored in the form of electroni cally encoded characters such that each

character of the document
has its own encoded representation. Documents that have been con verted to their

constituent ASCII codes for storage on the personal computer system are an example of

electronic content. This form of representing document content is often distinguished

from electronic image, wherein the document is represented as a bit map of pixels.

Electronic, or ASCII-encoded, content is more useful because it can be searched on a

character-by-character basis (i.e., it can be parsed).
El   ectronic likeness rights: Related to intellectual property rights, this term refers

to an emerging trend for multimedia content vendors to create animated, or quasi-video,

representations of famous people, clearly making use of the publicity value that those

people possess. These rights help protect the publicity value owned by those people, and,

in most cases, translate into some form of royalty ar rangement.
Embedded PC: This term captures the notion that all of the tech nical components

associated with the personal computer can now be embedded in other, traditionally

low-tech, devices. Actually, the pro cess of embedding PC-like intelligence in other

technologies has been going on for some time: witness the microwave oven, the logical

func tions of which a   ÿre based entirely on microprocessor technology. The significance

of this term in today's market is that as the PC becomes the MPC (multimedia personal

computer), media-based applications, such as navigational systems for automobiles, will

become common.
Embedded training: From the world of instructional design, this term refers to use of CBT

(computer based training) in small, granular units that are brought as close as possible

to, and therefore become "embedded" in, the tasks for which they provide training. This

concept is held up as being superior to the traditional form of delivering instruction, where all of the training is packed into a single sess <ion or period of time, and is thereby separated from the time in which the learner will actually make use of it. Embedded training is used extensively in performance support systems, where the embed ded training pieces are also often referred to as job aids.

Emulation: The widespread use of this term in the computer in dustry in many respects serves as an indicator of the volatility of the computer marketplace in general, and the multimedia market in par ticular. Emulation occurs when the hardware-software combination that constitutes one delivery platform is made to operate like (emu late) the hardware-software combination of another platform. In the computer industry, one of the earliest widespread uses of emulation occurred when intelligent personal computers were made to operate like dumb terminals so that PC u asers could make use of the programs and data stored on large mainframe systems. In the current era of multimedia computing, with hardware-software combinations prolif erating from every direction, developers of multimedia applications are faced with an unprecedented need to emulate all sorts of delivery platforms so as to make their programs as widely usable, and there fore as marketable, as possible.

Enabling technologies: Refers to the growing mass of data storage and transmission products, computing/media platforms, sys tem software, authoring tools, etc., that taken altogether make it pos sible to deliver multimedia applications to the end user. Put in a bit more general sense, the term refers to any technology that makes an other, more humanly accessible, technology possible. Thus, a fiber optic transmission line is an enabling technology for pict ¼urephone, and picturephone is, in turn, an enabling technology for videoconferencing.

Endpoints: In vector graphics, these are the points that specify each end of a line

segment.

Environmental systems: This refers to a form of virtual re ality consisting mostly of

externally generated 3-D objects, but with little or no body paraphernalia. Users move

within a real physical space that reacts to cues triggered by their motions and actions.
Equitagonist: This term refers to an audience member who par ticipates in a game that is

so multivariate in nature as to have the feel of a real life narrative. Thus, it refers

to a human player in an interac tivefiction. It is derived from the traditional literary

terms of protago nist and antagonist; it implies that the participants will have their

performances assessed (scored) on the basis of criteria that are equally applied to other

(both electronic and human) players in the interac ti Åve fiction.
ERDAS: Stands for earth resource data analysis, a standard file for mat for representing

remote sensing images.
Ethernet: This venerable standard for L4Ns (local area networks) is now getting a bit

long in the tooth. C apable of only handling 10 Mbps (megabits per second), Ethernet is

overwhelmed by any sub stantive effort to network mixed media data types. A recent

upgrade to this standard called "Fast Ethernet" is capable of 100 Mbps, but
represents only a stopgap measure in the face of the multi-gigabyte demands of true

multimedia networking.
Event loop: One of the key design elements in constructing an interactive program, the

event loop is the central routine that at any given time determines the range of

acceptable user actions. All other things being equal, the broader this range of

acceptable actions, the more flexible and interactive the program will appear to be.
EVL: Stan ¯ds for Electronic Visualization Lab, a branch of the Uni versity of Illinois

at Chicago dedicated to leading-edge 3-D audiovi sual systems for use in virtual reality

applications. The CAVE, a virtual reality environment that features a room whose walls

and floor flood the viewer's senses with projected images, is the EVL's leading project.
Expansion board: This term refers to the many plug-in boards that expand the capabilities

of standard personal computers. With the rapid onset of market demand for multimedia

capabilities, video and audio expansion boards have proliferated in recent years because

single-processor PCs simply cannot handle the demanding computa tional requirements of

image, audio, and video.
Experiential prototyping: From £ the world of practical vir tual reality (an oxymoron?)

applications, this term is a near-synonym for architectural walkthrough. It refers to

entire environmentsÐ such as buildingsÐ that are created by the virtual reality media so

that they may be experienced by the user as if they were real.
Expert system: From the world of artificial intelligence, an ex pert system is a genre of

AI designed to solve problems at the expert level in some scientific, mathematical, or

medical domain. To date, expert systems have only been successfully used with regard to

rela tively restricted problem domains. The key step in constructing ex pert systems is

known as knowledge eng =ineering, wherein a knowledge engineer works closely with a

subject matter expert to untangle the decision rules and sources of knowledge that make

the expertise work. As expert systems become joined to multimedia applications, taking

advantage of such newborn software design techniques as the inter face agent, their

usefulness will likely become dramatically extended.
Exposure: In film and video, this term refers to one frame of film that has been exposed.
Extensibility: A term used frequently in software engineering, it refers to a desirable

system characteristic wherewith new features can be added easily, i.e., they can be added

without having to under take major redesigns. Extensible systems help avoid rapid

functional obsolescence. Very extensible systems are said to be future-proofed
Extrusion: This is an int   teractive modeling technique in which a further dimension can

be added to an existing definition, e.g., a line can be extruded from a point, a plane

from a line, or a solid from a plane.
Eye candy: This insider term refers to the richness and texture of the computerized image

generated on a multimedia screen.

EyePhoneTM: Manufactured by VPL Research, this was the first commercially available

stereoscopic HMD (head-mounted display) for virtual reality applications. This apparatus

uses color LCD dis plays with a resolution of 360 x 240 pixels to provide a horizontal

field of view measuring 100 degrees.
Eye tracking: This emergent technology, first developed for mili tary applications and

now being annexed by makers of virtual realiy gear, tracks the movement of the human eye

for purposes of machine interaction. The primary methods of eye tracking in use today in

volve bat   ^hing the eye in low-intensity infrared light. This light cre ates a bright

image of the pupil and a bright spot reflecting off the cornea, both of which can be

captured by a video camera foc used on the user's eyes. Image processing software then

analyzes the video image, finds the pupil and cornea, and calculates where the eye is

looking. Once the system knows where you are looking, the com puter can be controlled

through measuring gaze duration. Thus, for example, the user could press a button or

select a key by staring at it for a specific length of time. Or, in a virtual reality

environment, the user could navigate, or fl, through a landscape by simply staring in the

desired direction.
Face armature: Consisting of sensors to track the user's head, face, and lip movements,

this virtual reality equipment attaches to the head and permits real-life a   Sctors to

animate corresponding features of animated on-screen agents.
Fade in/out: A transitional effect whereby a scene starts as black and is gradually

brought, frame by frame, to full exposure, or vice versa. The process of creating "fades"

has been automated by the powerful pixel processing routines available in many PC paint

sys tems programs.
Fade margin: From the technical side of communications, this useful term refers to the

level of signal decay tolerated before com munications cease. One of the problems with

the emerging forms of all-digital communications is that with digital, the distance

between a completely valid signal and one that is utterly useless is both small and

abrupt.

Fantasy role player: From the world of video games, this term refers to the role that the

game player (user) takes while involved in some of the mo ×re sophisticated electronic

games. This term clearly points toward the future of electronic games, where these

interactive programs will seem less like games and more like the next generation of

storytelling products where the audience member will play a par ticipatory role in an

interactivefiction.

FAQ: Stands for frequently asked questions, a module that has be come so common in online

help, software tutorial, and CBT (com puter based training) programs that it has earned

the status of an acronym. It derives from the widely recognized tendency that, for most

products or systems, anywhere from 5 to 20 questions end up representing about 90 percent

of all questions asked about that prod uct or system.

FAT: Stands for file allocation table and refers to a common data structure used with

erasable storage media, such as hard disks. FATs are based on the notion that data

sectors are erasable and, therefore, reusabl   e. Generally located on the outermost

sectors of the disk, the FAT keeps track of files with regard to the addressable disk

sectors they occupy. FATs are generally considered to bring with them a con siderable

amount of overhead.

FDDI: Stands for fiber distributed data interface and represents the industry standard

for LANs (local area networks) based onfiber optic transmission. FDDI is a token-based

standard, which means that a station must have possession of the system's lone token in

order to place an object on the LAN for transmission. The advantages of FDDI over the

more common copper- and coaxial cable -based LANs are several: fiber is high capacity,

capable of transmitting up to gigabits of data per second; FDDI LANs possess

electromagnetic isolation properties, which means that they are not affected by external

elec tromagnetic fields that might cause interference, impulse noise, and crosstalk on

nonfiber networks; and, these fiber networ Ðks do not, them selves, emit radiation that

can cause interference with other equip ment. The FDDI standard is in its second

generation, termed FDDI II, which expands the capabilities of FDDI I by supporting

circuit switching for users who need LAN support for voice, video (picturephone), or

other constant-data-rate applications.
FDX: Stands for full duplex, which is simply communication in two directions

simultaneously on a communications channel.
Feature extraction: From the realm of optical character rec ognition (OCR), this term

refers to one of the more common tech niques for recognizing characters on source

documents. This techniques studies the structure of the character: the angles, slopes,

inflection points, holes, etc. The shape of the character is compared with sets of rules

(called "operators") about character shapes. For example, a shape with two vertical lines

that meet at the top with a horizontal line in the middle fits the rules for the letter

- "A." This technique is often compared with template matching, a less expen sive, but

less powerful, alternative.
Feelies: What is today being referred to by virtual reality aficianados as tactile

feedback was (perhaps originally) foreseen by the famous twentieth-century author Aldous

Huxley. Huxley wrote about 3-D movies that he called "feelies."
Fiber optics: This term refers to the use of an opticalfiber tranS mission of data by

means of a light beam.
Field of view: This term of visual anatomy is gaining popularity in the world of virtual

reality because it helps define the parameters of visual immersion. Large screen

technologies like IMAX Theatre, which seek to immerse the audience from a visual

standpoint, are quite concerned with field of view. Research has shown that to be totally

immersive, a screen must cover a 270-degree arc in front of the audience member. This

number is arrived at in the following way: When a user is looking straight ahead, ea

- ch eye is capable of provid ing visual information as much as 90 degrees of its central

axis. Com bining the images from both eyes provides a lateral field of view of

approximately 180 degrees. Because you can pivot your eyes to the left and right about 45

degrees, it is possible (even easy) to perceive an additional 90 degrees, making for a

total lateral field of view of approximately 270 degrees. Current research suggests that

a sense of immersion in an image requires a field of vision of at least 90 degrees.
FIF: Stands for fractal image format, the emerging standard for im age data that has been

compressed using techniques derived from fractal geometry. The standard was created by

Michael Barnsley of Iterated Systems, Inc.
File striping: Also called declustering, this term refers to a high performance algorithm

based on the principle of distributing a single file over several storage devices. Each

device, then, holds a stripe of the same file. Because Ì these drives can then work in

parallel, each one storing and retrieving data in near-simultaneity, striping offers a

much higher transfer rate. Reads, for example, are performed in a fashion whereby a

single read request is broken into multiple requests, each serviced by a different

storage device. This strategy holds great currency in the age of multimedia, where moving

enormous files rap idly poses one of the industry's greatest challenges.
Fill: From the world of computer paint systems, this term refers to a widely available

feature in commercial packages in which enclosed areas in a picture can be given a gray

shade, color, or pattern with a single click of the mouse.
Film scanner: This type of scanning device specializes in digi tizing slides and

transparencies.
Firmware: This term refers to computer programs stored in pro grammable read-only

memories (PROMs) that can be replaced but not reprogrammed by the user. Firmware is

common in the various board products that a ┊ re used to increase the media processing

capa bilities of multimedia personal computers (MPCs).
Flanging: From the realm of audio engineering, this term refers to an audio effect

created by placing two copies of the same sound in and out of temporal phase with one

another.
Flatbed plotter: Is a pen plotter in which the paper (or film based material) is held on

a flat drawing table where it is traversed by one or more pens in a pen carriage.
Flatbed scanner: One of the most commonly used types of scanner, it is distinctive for

having a flat surface onto which users place their artwork or documents one at a time for

scanning as the light source moves under the item-to-be-scanned. Many flatbed scan ners

have optional document feeders for scanning multiple pages au tomatically.
Flat panel dispiays: These are an emerging family of VDU (video display unit) that most

often uses technologies other than the CRT in order to reduce the bul Í k and power

requirements of the VDU. Good examples include the LCDs (liquid crystal displays) and

plasma panels that are often used with small portable computers.
Flicker: One of the most common artifacts of analog video, flicker can be seen as a

vibration of the entire screen, the horizontal lines, or the colors.
Flying: This term has been abducted by the virtual reality commu nity to refer to

movement through a virtual world that is enacted by hand gestures (such as pointing one's

data-gloved finger in the direc tion of movement). Thus, with reference to an

architectural walkthrough, one can say that they are flying through a particular

structure.
Flying mouse: Is a virtual reality version of the mouse input device that tracks motion

in three, rather than just two, dimensions.
FM synthesis: One of two primary forms of MIDI (musical in strument digital interface)

synthesis (FM stands for frequency modu lation, in case you didn't know). The other

primary form is w   ave table synthesis, which is generally considered to be the superior of the two. FM synthesis is the elder of the two, and it is by far the most common amongst the first generation of add-in sound boards. With FM synthesis, at least two digitally generated sine waves are required. One of these waves is called the "modulator" because it modulates or
changes the frequency of the second waveform, which is called the "carrier." While FM synthesis requires only two sine waves, FM syn thesizers typically use multiple carriers and modulators. Each of these sine waves is called an "operator." FM synthesis was invented in the 1970s by Stanford's John Chowning.Yamahaholds an exclusive right to the patent for his invention. Yamaha's first-generation chips used only two operators and produced sounds that were adequate to the early game market. Yamaha's latest chip, the OPL3, uses four opera tors and, predictably, is capable of generating more sophisticated
s   ©ounds.

FMVTM: Stands for Full Motion Video, Philips' MPEG (Motion Pic ture Experts Group)-compressed full motion video option. OptImage incorporates FMV in MovieStudio, an authoring tool designed spe cifically for use with CD-I (compact disc-interactive)
technology.

Foley effects: From the world of film production, this term re fers to sound effects that are manufactured, usually in a studio, for use in a specific film scene. These effects can be as mundane as some one walking across a linoleum floor, as spectacular as a volcanic erup tion. In traditional film production, foley effects are created in a post-production setting where the appropriately equipped individuals (e.g., foley walkers on sand, wood, or linoleum surfaces) make the sounds while viewing the actual film events with which those sounds will be later mixed. This process is similar to looping, which refers to the studio creation of voiceovers to replace dialogue recorded   Ëat the live

shoot. As MIDI (musical instrument digital interface) equipment becomes more common, thus

enabling the digital creation of sound effects and the construction of clip media audio

libraries, much of the creation of foley effects will become an automated process in

which the effects are selected from a database.
Footage: In film and video, this term is generally used to refer to film that has been

exposed by the camera operator.
Force feedback: Part-in-parcel of the effort to master the hu man-machine elements of

tactilefeedback, this subdiscipline of vir tal reality is involved with the re-creation

offorce patterns that give users the sense that they are coming into tangible contact

with some object from the real world, such as the gearshift of a racecar. The most

sophisticated force feedback systems to date make use of tables of digitized force

patterns, with each pattern representing a particular object and/or sensation.
Force patterns: Analogous to Í the sound patches stored in aMlDI (musical instrument

digital interface) wave table, force patterns are digitized patterns of force feedback

that emulate the human experi ence of interacting with various objects in the real world.

Thus, the feel of moving a gearshift from first to second speed might be re corded and

stored in a tactile feedback database of force patterns.
Format longevity: A feature of any media-related technology that describes its duration

or length of stay as a useful standard. The NTSC (National Television Standards

Committee) standard for tele vision is now into its fifth decade of format longevity. By

way of contrast, the CGA standard (the what?) for computer monitors was a mere flicker in

the technological night, lasting for about two years before it gave way to EGA, and then

its successor, VGA (video graph ics array).
Form factor: This term refers to the physical size and shape of devices such as computers

and interactive televisions. With a in in creasing move toward special purpose

equipmentÐthe portable PC, for exampleÐ there is a growing move away from a standardized

form factor and toward increasingly customized form factors to meet the needs of

specific applications.

Fovea: From the realm of human visual anatomy, this term refers to a region on the rear

wall of the retina responsible for one's center of visual attention. This region is both

the thinnest part of the retina and the part with the highest concentration of cones.

Figuratively speaking, it is the high resolution portion of the field of vision. All

other portions are, in a sense, low resolution, and are often referred to collectively as

peripheral vision. Some virtual reality engineers in volved in building wide field of

view devices are now taking advan tage of this foveal concentration of high resolution

vision by building dual-resolution displays. These displays reduce the high resolution

portions of their screens to windows that rough ¡ ly approximate the foveal portion of

human sight. They keep this portion of the display, or this high resolution window, in

front of the user's foveal line of sight by using eye tracking technology that keeps up

with the loca tion of the user's pupils. The value of this approach to VR engineer ing is

that it dramatically reduces the overall number of pixels that must be projected onto the

display, thereby reducing the computa tional demands placed on the system, and making

higher refresh rates possible.

FPS: Stands for frames per second and represents a primary mea sure of film quality. The

higher the FPS, the smoother the flow of motion, and, all other things being equal, the

higher the quality of the motion video.

Fractal geometry: The brainchild of IBM researcher Benoit Mandelbrot, this recent

intellectual creation thrives on the notion that nature seems to recapitulate itself at

different scales. Thus, large branches scal - e down into smaller branches, which scale

down into twigs, virtually ad infinitum. For the multimedia industry, fractal ge ometry

has given rise to a number of promising software technolo gies: for, among other things,

simulating portions of the natural world and compressing and decompressing images.

Fractal transform image compression: This is perhaps the most innovative, and certainly the most promising, form of codec technology yet to appear. Pioneered by Michael Bransley and Iter ated Systems, Inc., of Norcross, Georgia, this technology can achieve very high image compression ratios, with 100:1 being fairly stan dard. Based on the mathematics offractal geometry, this codec pos sesses the desirable feature of creating scalable images (i.e., images that are resolution independent) and can therefore output (decom press) images at any resolution.

Frame: An area of film equal to one exposure, this is the principal term used to describe the fundamental unit o - f both analog and digital forms of video.

Frame accuracy: This term refers to a device's ability to con sistently locate any single frame on a tape. The SMPTE (Society for Motion Picture and Television Engineers) time code is, for example, frame accurate. This means that SMPTE is extremely accurate be cause it can locate any one of 30 frames per second.

Frame dropping: A process that often accompanies the give and-take of scaling up the size of a digital video window, this term refers to the lowering of theframe rate (fps) of a digital video stream in order to maintain a constant data rate. The process of frame drop ping often leads to a herkyjerky video image, an artifact that results because key segments of motion are missing after a certain number of frames have been eliminated. The process is required only because of the present bandwidth limitations that surround the use of video on the single-CPU personal computer and will, in due course, be elimina ð ted by the increasing media -handling capabilities of personal com puters.

Frame grabber: This is a system component, usually imple mented as an expansion board with companion software, used to cap ture, or digitize, the video signal from a motion picture source (e.g., from a TV, video camera, or VCR). Often, the term is taken to be synonymous with a video digitizer.

Frame rate: This term refers to the rate at which single frames in a motion picture

sequence are displayed on a screen. With TV in North America, broadcast video is

displayed at 30 frames per second (fps); the 35mm motion pictures seen in the theater

play at 24 frames per second.
Frame refresh rate: Nearly synonymous withframe rate, this term has taken on a unique

importance in the world of virtual reality, where each frame the user sees is dynamically

constructed in real time from visual data stored in the computer's memory. Obviously, it

is far, far easier to create high frame rates when frames   are repre sented by

pre-recorded images stored on videotape, than it is to gen erate photorealistic images on

the fly from visual data. For this reason, it is widely accepted that it will be some

time into the future before we have virtual reality equipment that can render

photorealstic (film quality) images at anything approaching the frame rates of

television or movies.
Freeze frame: This feature, common to both analog and digital devices, is used to hold a

single frame of video motionless on the screen.
Frequency: With rega rd to the physical characteristics of a sig nal, the term frequency

is used most often to describe the number of times that a signal varies per second. In

this context, frequency is usually measured in hertz, or cycles per second.
Front plane: From the world of DVE (digital video effects), this term refers to the

uppermost of two visual planes used in two-plane effects to create transitions between

one scree ¸ n and the next.
Full body recognition: One of the enabling technologies of full immersion VR, this is a

dreamed-about capability of virtual real it,v that will make it possible for cybernauts

to enter a virtual world and have the tracking intelligence of that world recognize what

the entire body is doing, e.g., what the arms are doing, what the facial
expressions are like, how the body is moving through space, etc. Though this technology

is a long way off in any practical sense, early prototypes, such as VPL Research's

DataSuit, are already on the market.
Full immersion VR: This is the fullest form of virtual reali, wherein one dons head gear,

DataGlove, and bodysuit, and becomes completely immersed in the virtual world (such as it

is).
Full tex ÿt retrieval: This term refers to the most exhaustive form of search and

retrieval applied to a large database comprised of text based documents. With this type

of retrieval, users supply target words or phrases (representing the information they are

looking for) to the search engine, and the search engine scans, or parses, the entirety

of the documents contained in the database. Under this search strategy, the user can be

confident that no incidences of their target words will be missed. However, owing to the

massive nature of many document databases (imagine searching through every article of

every issue of the Wall Street Journal), many designers back of f of this

computationally intensive approach and perform only keyword searches, in which the only

text data parsed is a relatively small num ber of keywords to summarize the content.
Future-proofed: This is a characteristic of any technology that is not subject to the

rapid functional obsolescence that has typified the computer and electronics industries

from their inception. The only way that a manufacturer of multimedia hardware or software

can pos sibly achieve this characteristic is by creating a product that is either highly

scalable (can be upgraded through several generations with out a major re-design) or very

far ahead of the innovation curve.
Gaffer: From the world of filmmaking, this term refers to the chief electrician,

responsible for the safe and effficient setup of lights, è cables, and accessoriesÐan

important role in film production.
Gas plasma: This is the technology of the future for large, color flat-panel displays

(such as those featured in the movie Total Recall)

Gaze duration: Simply put, this is the amount of time a human spends looking in a particular direction. This phenomenon is now used as an computer input parameter with virtual reality systems that make use of eye tracking.

Generation loss: Is a characteristic of analog forms of media, such as cassette tape audio or VHS video, where, with each succes sive copying of the program, some of the original quality is lost. Thus a copy of a copy will possess less qualityÐmore generation lossÐ than a mere first-generation copy of an original. Generation loss is often cited as one of the most distinct disadvantages that analog forms of media have relative to their digital counterparts. With digital me dia À, where the original is stored in the form of a data representationÐ a binary stream of data, to be exactÐthere is no generational loss of quality no matter how many times the information is copied.

Genlocking: From the world of video production, this term refers to a device's ability to synchronize video signals from two tape sources so that they can be recorded together onto a third tape. The term has also been used to describe a signal synchronization technique essen tial to the process of creating a stable signal when overlaying com puter graphics with video.

Ghosting: An artifact common on LCD screens, ghosting refers to the faint continuation of solid linesÐalso termed "shadowing"be yond the actual ends of those lines. This effect is caused by the un controlled spread of electricity along the electrodes that turn screen pixels on and off.

Gibb's effect: The most common artifact for images that have been compressed using the DCT (discrete cosine transfer) technique (which is the base technique for the JPEG [Joint Photography Ex perts Group] standard), this effect appears as ripples running out from sharp edges such as street signs or tree trunks, giving an overall im pression of blockiness. As one would expect, this artifact becomes increasingly pronounced the higher the compression ratio.

GIF: Stands for graphics interchange file, a file format created by CompuServe to

facilitate the exchange of picture files between com puter platforms.
Gigabyte: Is one billion bytes; it is also the next level of common storage capacity, now

that multimedia technology is making mega bytes of storage passe. A gigabyte is typically

represented by the ini tials GB.
Gigahertz: Is one billion cycles per second.
Glass di - stortion: This refers to a form of DVE (digital video effect) in which the

image is altered so that it appears as it would when viewed through a piece of unfinished

glass.
Glyphs: From the world of scientific visualization, these are visual objects whose

attributes (e.g., shape, position, color, size, and orien tation) are bound to

independent variables and serve to provide a sym bolic representation of some aspect of

nature. Spheres in a molecular structure and color patterns in an anatomical graphic to

depict tumors represent just two examples of glyph usage.
Gopher: This term originates from the realm of the Internet, and it refers to a

navigational aid for searching out specific content from across the F vast wastelands

of information made accessible on the In ternet.
Gourad shading: This is one of the high-end forms of polygon shading associated with

computer generated graphics.
Gradient fill: This is a feature common to commercial paint sys tems in which the user is

able tofill a specified area of an image with a pattern, gray shade, or color that

displays a gradual transition from the foreground of the fill area to the background.
Granularity: This term refers to the size of the units by which something is structured.

The smaller the units, the more granular the structure. Placed in a commonplace example,

a foot-long ruler that provides tick marks for every tenth of an inch is more granular in

its markings than one that only provides tick marks for every inch. Gen erally speaking,

granularity is considered a desirable d ×esign feature for multimedia applications

because it implies an ability for the pro gram to take greater advantage of the random

access capabilities of the computer.

Graphics subroutine packages: The so-called toolbox sys tems, these packages help

programmers build their own graphically oriented application software using pre-written

graphics utilities.

Graphics tablet: An input device used by graphics artists, this is a touch sensitive

board over which the illustrator passes some form of hand-held input device, typically a

pen. Under its most common form of usage, the pressure from the pen as it moves across

the sur face causes the tablet to generate a stream of x and y coordinates, which a

graphics program will then accept and translate into a line drawing that appears on the

computer display.

Grayscale: The spectrum, or range, of shades of black an image has. Scanners' and

terminals' grayscales are determin ñed by the num ber of gray shades, or steps, they

can recognize and reproduce. A scanner that can only see a grayscale of 16 will not

produce as accu rate an image as one that distinguishes a grayscale of 256.

Great electronic machine: This is futurist Joseph Pelton's term for the world's biggest

existing machine: the massive interlinked system of cables, telephones, computers, and

broadcasting equipment that constitute the world's communications network.

Green Book: Related to the Red Book, Yellow Book, and Orange Book standards, this

standard for compact disc refers specifically to the CD-I (compact discÐinteractive)

technology of Philips. This stan dard specifies a specific operating system called

CD-RTOS and the disc layout. Like XA of the Yellow Book standard, the Green Book allows

interleaving of computer data and compressed audio on the same track.

Grid: This is an invisible layout that divides a screen into s ²eparate visual areas.

Grids are quite common in digital video production tools, such as paint systems, where

they are used as a tool for enabling a;t ists to blend more than one graphic object on a

single frame.

Grip: From the world of filmmaking, this term refers to the people who assist the camera

and the sound crews by helping to move equiP ment, props, costumes, and the like.
Grooming: Also referred to as file grooming, this relatively new concept is associated

with network file storage systems and describes an automated (defined by algorithm)

process whereby files are mi grated from online to near-line storage devices without any

operator intervention. As the name implies, the algorithmic intelligence asso ciated with

grooming will usually involve   °some deletion of files (a process traditionally

referred to as purging). In large scale multime dia systems, where gigabytes and possibly

even terabytes of perma nent storage are involved, grooming is a powerful labor-saving

technology.
Groupware: This term refers to software designed to enhance the sharing of an information

work product (for example, a large docu ment such as a corporate annual report) between

and among mem bers of a work group. This emergent technology typically relies upon some

form of networking technology to interconnect members of the work team and to provide

mutual access to the shared work product. A good example of this is Lotus Notes. Document

conferencing is a slightly more advanced application of groupware in which membe   frs of

the work team communicate via video windows embedded in a document work product.
GUI: Stands for graphical user interface, and is pronounced goo-ee. This standard buzz

phrase of the late eighties and early nineties refers to the interface design goals that

became predominant in the industry as PCs began to accrue significant graphics

capabilities. In essence, a GUI is supposed to make the computer easier to use by

creating graphi cal objects such as icons, buttons, and windows for the user to inter act

with, rather than the sterile systems of text commands that preceded GUIs in the

historical evolution of computer software. The desktop metaphor of the Apple Macintosh

and Microsoft Windows interfaces are the classic examples today of a GUI.

Hachures: In the world of computer graphics, this term refers to a series of lines representing the general dire üction and steepness of slope. Gentle slopes are represented by longer, lighter, or more widely spaced lines, whereas steep slopes are symbolized by shorter, heavier, or more cbsely spaced lines, just like a topographic map.

Hackers: Are persons who attempt to penetrate the security of a computer system, usually from a remote location, for nefarious pur poses.

Hand-off function: This term is used to describe the ability found with the wireless technologiesÐ such as cellular phone or RDS (radio data systems)Ð to automatically switch from one broadcast source to another as a moving destination (e.g., a car) travels from one geo graphic zone to another. The latest, and perhaps most innovative, use of the hand-off function can be found with RDS, where it will soon be possible in the U.S. for a cross-country driver to have the radio automatically retune itself to another station for nation °ally broadcast shows as the driver travels from one geographic zone into another.

Haptic system: From the realm of human anatomy, this system has taken on sudden importance with the emerging effort to provide tactile feedback in association with virtual reality products. The hap tic system has two major subsystems. The first is called mechanore ceptors. They are extremely sensitive mechanisms that measure pressure or deformation of the skin. They are critical in providing information about the texture of an object. The second subsystem is associated with the term proprioception, which has to do with the way in which our muscles and tendons work to discover the size, weight, and shape of an object based on how much effort they must exert when encountering that object. Together, the mechanoreceptors and proprioception make up the haptic system and provide haptic cues that convey information to our minds about the tangible qenvi

ronment.

HDF: Stands for hierarchical data format, a file format developed by the National Center for Supercomputer Applications and intended to serve as a standard for the scientific visualization community. HDF is ideal for this role because it is extensible, available in the public do main, and capable of handling data and images as well as scaling information.

HDTV: Stands for high definition television, an emerging standard for higher quality television broadcasts. Actually, the term HDTV has been with us for some time, and, in general, may represent the next generation of television. More recently, though, the term has become increasingly specific, as the Advisory Committee on Advanced Television Service in the United States has begun serious delibera tions with the goal in mind of recommending a single HDTV stan dard to the FCC. It is intended that HDTV bro Zadcasting begin by 1996 and air concurrently with traditional NTSC (National Television Standards Committee) broadcasts until the year 2008, at which time all NTSC transmissions are to be phased out. There are two primary elements of the HDTV standard: First, and foremost, the new stan dard offers higher resolution, somewhere in the vicinity of 1,000 scan lines, which is roughly twice the NTSC number of 525 scan lines. This resolution delivers broadcast quality that is roughly equivalent to 35mm film (the quality one sees in today's movie theaters). Sec ond, the new standard will include a wider screen aspect ratio, an other feature that will bring television broadcasts into closer physical harmony with the motion picture industry. The dominant problem facing the various corporate/academic alliances who are in competi tion for establishing the ne qw HDTV standard revolves around the bandwidth reduction that must be achieved to deliver these new ca pabilities within the bandwidth constraints that have been put in place by the FCC.

Headend: This is becoming a general purpose term for describing source nodes in the architecture of the information superhighway that are responsible for storing and serving up the various elements of content that users of the highway want. As the superhighway takes greater shape, headends will provide mass storage of multimedia con tent, projected to be in the terabyte range within the near future.

Heads up display: This type of display is soon to become com mon with respect to RDS (radio data systems) that are used in auto mobiles, wherewith any digitally displayed information is projected onto a small viewing area on the windshield, so that drivers do not have to redirect their lin °e of sight away from the road to see the digi tally transmitted information.

Heat mapping: From the realm of scientific visualization, this visual procedure produces a surface plot in which height and color are used to represent different variables such as stress intensity or age of data. Obviously, the higher the height and the warmer the color, the greater the intensity one adduces to the variables being represented.

Hertz: This is a measure of frequency in cycles per second.

Heuristics: This term is important to artificial intelligence, for it refers to rules of thumb that suggest rules to be used in given situations.

Hidden-line removal: This technique is used in sophisticated graphics programs whereby lines are removed from view that would normally be hidden on a real object by virtue of being obstructed by the front surfaces of the object.

High fidelity simulation: This term represents the conver gence of high- +end business training applications, such as the flight simulators sponsored by the airline industry, and the use of the immersive technologies of virtual reality, such as full field-of-vision video.

High intensity amusement attractions: One of the lead ing edges of new media design and production, these attractions form the backbone of the late-twentieth century theme park (e.g., Disney World and Universal Studios in Orlando, Florida). These attractions use a

combination of 3-D sound and video, environmental props, and live actors to create

hyper-real experiences for their audiences.

High level language: From the archives of software history, this term refers to a family

of software tools that came into existence early on (circa the 1960s) to make it easier

for humans to write pro grams that computers can understand. In the initial years of

comput ing, all programs were written using the binary code of ls and 0s, a phenomenon

called "machine language."   ÔThis was very difficult, and was mastered by only a few

(nerds). Thus, a thing called "assembly language" was invented. It enables programmers

to use more human like commands to build their programs. When they (think they) are

finished, they simply submit their code to a thing called an "assem bler," which

translates the assembly language stuff into machine lan guage. This is still very

difficult, and still attracts mostly nerds. Then

along came the invention of high level languages, which enable pro grammers to use

almost-human language to write their programs. Again, when finished, they submit their

programs to a piece of soft ware that translates their code into machine language. In the

case of high level languages there are actually two such families of translat ing

programs, one called an "interpreter," the other a "compiler." Early examples of high

level languages include COBOL and Fortran, both of which are still in fairly wide use.

More recent, and currently more popula   Ýr examples of high level languages include

Visual Basic and C++, both of which are commonly used to author multimedia cre ations. In

spite of their name, however, high level languages still re quire considerable technical

training to be able to use them with any proficiency, and, as a consequence, are not the

end of the road when it comes to pursuing the dream of inventing software tools that en

able the layperson to program the computer. There are now software tools called "Fourth

Generation Languages," or, more popularly, "4GLs." These programs are also called "code generators," because they enable users to interact with a graphical user interface (GUI), which then generates useable code on the bases of those interactions. In many respects, most of the programs that pass for authoring sys tems are 4GLs. However, it must be reported that when you use a 4GL, you give up a considerable amount of control and flexibility, and often cannot create what it is possible to produce using a high leve õl languageÐwhich is why many multimedia developers still rely heavily upon programmers working with high level languages.

High Sierra format: The first widely accepted standard for positioning files and directories on CD-ROM, this terms owes its ori gins to the fact that it was initially conjured in the mid-eighties at a meeting of industry representatives held at the High Sierra Hotel in Lake Tahoe, Nevada.

H MD: Stands for head mounted display, one of the more noteworthy contraptions of the dawning virtual reality medium. This device typi cally houses stereoscopic glasses and headphones and is somehow connected to power and processing sources.

Hologram: Refers to a 3-D optical image formed by storing 3-D information about an image or pattern of light. Where two beams of laser light cross, they produce an interference pattern of microscopic light and dark fringes. If this pattern is recorded, the result is a holo gram that contains full information about the two beams that form ýed it.

Home interactive media: This term represents the youngest, but most rapidly growing, segment of the multimedia market. The home market, traditionally characterized almost solely by the video games that are computer applications disguised as entertainment, is now starting to expand into a host of other applications, such as home shopping.

Home page: An updated version of the main menu that character ized first generation software programs, this interface design term refers to the main point of entry into amultimedia program. The home page typically possesses icons or buttons representing the

largest cat egories into which the program's content has been divided. This screen also

usually serves the role of being the first and last screen the user sees when entering

and exiting the program, respectively.

Home shopping: Considered one of the true prototypes of inter active television, this

genre is already being exploited in a very suc cessful fashion by mixing the technologies

of tel   evision and telephony. With contemporary home shopping, viewers watch a visual

proces sion of products on TV, any one of which they can order by calling the listed

phone number. For future interactive versions of home shop ping, it is envisioned that

this shotgun type of approach will be re placed by systems that enable viewers to

navigate through a hypermedia collection of products to view content more specifically

related to their current purchasing needs.

Horizontal correlation: Also referred to as "horizontal redun dancy," this term relates

to the fact that with most video images there is a great deal of similarity in the

chrominance and luminance quali ties of horizontally adjacent pixels. This tendency makes

it possible for broadcasters to use various forms of compressionÐfor example, RLE (run

length encoding)Ðto reduce the bandwidth requirements of their broadcasts and recordings.

Simply put, horizontal correlation occurs when adjacent pix   ûels on the same scan line

have the same (or similar) color and brightness qualities. When this occurs, the broad

cast signal can be digitized in such a way that only one of the values needs to be

transmitted or recorded, thus reducing the effective band width requirements in half for

that portion of the image.

Horizontal scrolling: Occurs when the developer loads an im age into memory wider than

the display screen, and therefore sup plies the opportunity and motivation for the user

to move sideways across the imageÐto pan the imageÐto see what is there. A common
application of horizontal scrolling occurs where the developer loads an image of a town

larger than the display, and then makes it possible for the user to scroll back and forth

to see the entire town, a screenful at a time.

Hot spot: From the realm of graphical user interface (GUI) de sign, a hot spot is an area

of the screen that can be manip ãulated by the user to launch some activity, such as an

on-screen action by a graphic character or by a branch to another screen. To date, most

hot spots have been activated by either clicking on them with a mouse-driven cursor, or

by simply touching them if the system has touch screen capabilities.

Household buy rates: This term, commandeered from home shopping by interactive television

savants, describes the rate at which residential consumers make use of such pay per view

cable services as movies-on-demand. These rates are very important to the cable operators

because they determine the capacity, and therefore the in vestment in hardware such as

video PBXs, required by these new servlces.

H RTF: Stands for head-related transfer functions, a term associated with the

mathematical modeling of the various sound transformations performed by the human audio

perception system. These functions are used to create 3-D acoustic pictures of sound.

They are bei Ëng developed by virtual reality engineers so that they can be used as

interpretive filters that take incoming sound sources and modify them for output to

headphones or speakers, such that the user hears an immersive, 3-D form of sound.

HTML: Stands for hypertext markup language. Written in SGML (standard generalized markup

language), HTML is a specification for marking hypertext documents.

H.261: Also referred to as Px64 by the CCllT (Consultative Com mittee on International

Telephone and Telegraph), this is the videoconferencing standard for compressing moving

video images for transmission over telephone trunk lines. Capable of very high com

pression ratiosÐ on the order of 100:1, all the way up to 2,000:1Ð this is also a very

lossy compression technique, reflecting the still primitive state of video telephony.

Hue: This refers to that dimension of color related to wavelength and the classification

of the color as, say, a blue, a green, or a red.

Human centered computing: This phrase was coined by IBM in conjunction with the development of PowerPC technology. The idea it conveys is a simple one: computers should be made easier to use by forcing them to conform to how humans communicate, rather than vice versa. Thus, for example, one image of future computing that has been proposed under this conception is an advanced form of graphical user interface (GUI) governed by an interface agent that possesses speech recognition and works in slave-like fashion to carry out the voice-generated wishes of its user (master?). I dream of com puter genie?

Human factors engineering: This design discipline is fo cused on creating optimal designs for major technologies such as au tomobiles, airplanes, etc. It is one of the key applications for virtual reality systems, wherein designers are allowed to become immersed (CAD [computer aided design] visualizations) in the physical envi ronments they are creating. The primar y benefit of such virtual worlds is that they reduce the need for costly prototypes and identify human factor design flaws that might otherwise go undetected. Examples of the issues that can be addressed by such visual models include foot traffic problems, element positioning, and aesthetic concerns.

HyperCardTM: Introduced in 1987 by Apple Computer, this soft ware program is designed to facilitate the creation of hypertext and hypermedia applications. Much of the langua ge used by Apple to de scribe the functionality of this program has become part of the gen eral nomenclature of graphical user interface (GUI) design. Terms such as button, card, and stack are nearly universal among those who design and build GUI and multimedia applications.

Hyperfiction: This term refers to what is perhaps the most com mon form of work to be found in the emergent medium of interactive fiction. Based on the hypertext model of structuring information, read ers cut their own paths through ¢the narrative work. Thus, consuming a work of hyperfiction is more like browsing through an intercon nected

body of information than it is like starting at the beginning and moving in linear

fashion to the end, as is the case with traditional fiction. It is a nonlinear, discovery

experience. In searching for mod els to understand this new form of fiction, one is drawn

to the 1978 work Story and Discourse by literary critic Seymour Chatman. In that book,

Chatman made a distinction between two types of fiction: the first, and by far the most

common, is what he terms "the resolved plot," by which he means the traditional narrative

that uses rising
action and climax to hold the reader's interest; the second, and much more avant-garde,

form is what he termed "the revealed plot," by which he means the novel that seeks more

to reveal the nature of human experience by bringing the reader close to anectdotal

events that do not necessarily have to occu   ? r in any particular order. With stories

told in the tradition of "the resolved plot," the order in which the events are told has

everything to do with the impact of the workÐ one cannot tamper with its authored

sequence. For stories told in the form of "the revealed plot," however, sequence is not

nearly so criti cal. Thus, it would appear that this second type of narrative, "the

revealed plot," may be the predecessor to hyperfiction and supply us with some form of

design model for how these works should be con structed.
Hyperfootage: Currently, most stockfootage houses organize their libraries with systems

that combine electronic and manual ele ments. The indexes that point to particular clips,

or film segments, are electronically encodedÐ are, in most cases, databases that rely upon

ke   iyword indexes to enable their users to find the desired foot age. However, the film

clips themselves are still located on tape, and the huge volume of tapes that make up the

stock footage libraries are stored in vaults. Thus, the electronic indexes point not just

to particu lar titles, but also (and perhaps more importantly) to the locations of the

particular tapes within the tape vault. Fetching the tape is still a manual procedure.

Though systems of this sort are today considered state-of-the-art, the day will soon come

when the film footage itself will be digitized and stored on disk, thereby obviating the

need for tape altogether and making access to desired film clips as easy as accessing a

record in one of tod   Cay's many electronic databases. When this occurs, stock footage

houses will become hyperfootage houses.

Hyperlink: This term refers to the branching logic that connects pieces of related

information within a hypertext or hypermedia pro gram. Hyperlinks are typically

implemented through some type of button or hot spot, both of which enable the user to

click on a desig nated object on the screen to move instantly to the related piece of

information.

Hypermedia: This term refers to a form of information design that is an extension of

hypertext, incorporating other media in addi tion to text. One of the favored design

models for multimedia titles, hypermedia permits an author to create a linked corpus of

material that includes text, static graphics, animations, video, sound effects, music,

voiceover annotations, etc.

Hyperm   zedia applications: As the number of CD-ROM titles has exploded during the first

part of this decade, hypermedia must be considered one the of the dominant design models

for the wave of new media titles. Hypermedia applications are actually quite simple in

design and purpose: they provide a visually coherent form of navi gation through a

thematically interconnected body of material, and they are predominantly exploratory in

nature. Three examples of hypermedia applications are: 1) The Electronic Encyclopedia:

with much the same purpose as our voluminous, book-bound encyclope dias, the electronic

version has become the early exemplar of hypermedia. Examples of these are Compton's

Interactive Encyclo pedia by Compton's New Media and Encarta by Microsoft. These programs

provide visually oriented navigational interfaces to content that is presented using all

of the mixed media data Úypes: image, au dio, video, and, of course, good ol' text.

2) The Online Museum (also called a Curator's File): if you change your normal percep

tions a bit, and think of a museum as a physically-embodied database of human artwork,

then you will see in an instant why hypermedia is such an ideal design model for bringing

the hard-to-reach museum into your home. Many such products use the physical structure of

the museum as the interface, permitting the user to view its contents by walking the

halls, so to speak. In this regard, the online museum il lustrates the overlap between

the surrogate travel and hypermedia models of multimedia application. 3) The Electronic

Marketing Brochure: increasingly, corporations are moving in the directi bon of

building hypermedia programs to serve as powerful marketing infor mation aids. These

programs will typically array the company's prod ucts, people, and/or services in a

thematically oriented fashion, thereby enabling a salesperson or a potential customer to

move through the content to find whatever is of interest at the moment. A real estate

firm, for example, might have two dominant paths, one that takes the user to visual

treatments of their prime properties, and a second that introduces key executives and

salespeople. Many such brochures can be given the auto-run logic to flow automatically

through selected portions of their content so that they can be used at trade shows and

the like. When they follow this approach, with little or no interaction by the user, they

become what is referred to as a rolling demo.

Hypertext: In the early 190s, Theod kor Nelson coined this word to describe the idea of

nonsequential writing. A hypertext system is one that allows authors or groups of authors

to link information to gether, create paths through a corpus of related material,

annotate existing texts, and create notes that point readers to either bibliographic data

or the body of the referenced text. In essence, a hypertext system is a tool for creating

or following associative trains of thought through a document or body of documents.

Hypertext is a powerful tool for exploring large bodies of interrelated documents in

areas of expertise or of interest to the user. Hypertext has played an instrumental role

in the emergent discipline of interace design, because many of the prin ciples of this

discipline have been created by individuals and teams constructing various hypertext

authoring and viewing systems.
ICAI: Stan £ds for intelligent computer assisted instruction and refers to forms of

interactive computer based training that possess elements of artificial intelligence.
Icon: Is a stylized image that graphically conveys purpose or func tion in graphical user

interface (GUI) design.
Iconic authoring: This term refers to the category of authoring conducted on the type of

authoring systems that rely primarily on the manipulation of icons to produce multimedia

creations. The most popular icons in the world of multimedia authoring are those associ

ated with the flowcharting conventions of software programming. Thus, when individuals

perform iconic authoring, they do so by ma nipulating the sequences and

interrelationships between flowchart symbols, typically enacted by dragging the symbols

to appropriate positions on the screen. Two popular commercial authoring systems that

rely upon an iconic interface are Authorware Profes Ñsional by Macromedia and

IconAuthor by AimTech.
Idea map: From the world of multimedia application design, this term refers to a type of

document that some design methodologies insist should be created near the front end of a

development cycle. It provides an overview of a project's proposed content by displaying

links between the major conceptual components.
IFF: Stands for interchange file format, which is a file format stan dard first developed

by Electronic Arts for the Commodore Amiga. It was designed to allow different programs

to share a common file for mat. It works by propounding header information to the file,

which describes the amount and layout of the data.
IGES: Stands for initial graphics exchange specification, a standard file format used to

represent data in the CAD (computer aided design) industry.
IICS: Stands for International Interactive Communication Society, a professional

organization charged   ä with promoting the exchange of
ideas and opportunities between individuals involved in the interac tive multimedia

marketplace. As an example of the types of activities sponsored by IICS, the San

Francisco chapter recently worked to get the city of San Francisco to pass legislation

that would ensure future investments in the infrastructure needed to support multimedia

de velopment, e.g., local sources of high bandwidth transmission facilities.
IID: Stands for interaural intensity differences, a highly technical term that visits us

from the land of 3-D sound. IID is one of the key HRTFs (head-related transfer functions)

and is based on the fact that sound which originates to one side of the head (as opposed

to coming from directly in front or behind) will be received as louder by the ear that

faces the sound source. Also referred to as the "head shadowing effect," this phenomenon

has b   tecome a key element in virtual reality systems that seek to create a consistent

sense of sound sources, even while the participant is moving around in the virtual

environment.
Illustrator: Often compared with the role of art director, the illus trator on a

multimedia development project is the person responsible for creating the artwork. An

illustrator would, for example, be re sponsible for drawing the icons that go on buttons

or that serve as hyperlinks. Some illustrators are good art directors, but more often the

two roles are performed by separate people. The art director de velops the visual design

of a multimedia product, while the illustrator is responsible for executing the art

director's vision.

IMA: Stands for the Interactive MultimediaAssociation, an interna tional trade association based in Washington, DC. "The purpose of IMA is to promote the benefits of mu ltimedia technology; advance the growth of the industry through public education; develop specifi cations for hardware, software tools, and applications; develop in dustry-wide services; and provide government and media relations." Founded in 1987, the IMA's most interesting project to date is its "Cross-Platform Compatibility Project," which seeks to establish in dustry-wide standards that enable multimedia applications' portabil ity across different hardware platforms.

Image-enabled database: As we enter the era of multime dia, one of the first things to do is to enhance our existing database records with all sorts of mixed media data types, especially those that are in the form of digital images. This term labels that process. Many organizations today are, for example, adding document images of actual invoices to their accounts payable records, digitized images of resumes and pictures to their personnel records, and images of Åcorre spondence to their customer files. These visual sources add valuable information to the traditional database record, which historically has been based solely on alphanumeric forms of data.

Image extraction: From the realm of virtual realit, this term refers to the high end of position tracking systems, whereby video cameras are teamed with visual recognition systems to keep track of the location of virtual reality participants in their virtual environments.

Image processing: This term most generally refers to the sci ence of interpreting digital images by using computers and computer graphics techniques. The discipline originated in the relatively spe cialized area that deals with processing data acquired by remote sens ing devices placed aboard satellites or other spacecraft. With the onset of multimedia technology, the fruits of this discipline are finding wider usage throughout the compu

áter industry.

Imaging systems: One of the meat-and-potatoes activities of early multimedia applications will be that of converting our mass document storage standard from microfiche and microfilm to the emi nently more usefulÐbecause it is more accessibleÐmedium of opti cal storage. The manufacturing process for achieving this new standard goes by the name "imaging system." With such a system, paper docu ments are passed through a scanner, which digitizes the document, to create a bit-mapped image of it. Sometime during the process, the bit-mapped image is assigned keywords . The purpose of the keywords is to index the document, making it electronically retrievable. The primary problem with this approach to mass document storage is that the contents of the documents are in a bit-mapped form, and therefore are not themselves searchable. Only the keywords assigned to each image are in ASCII (text) format. Thus, the process of assigning key words must anticipate all of the ways in which future users might wish to search the document base. In other words, all content of a given document not represented by the keywords become the textual equivalent of a lost treasure.

IMAIC TheatreT: These theme park establishments use large-for mat motion-picture film and huge parabolic, metallic projection screens. They seek to achieve a vivid 3-D, almost holographic, pan oramic realsm for audiences. IMAX has become synonymous with the concept of creating a wrap-around or surround environment for entertainment purposes.

Inbetweener: With traditional animation, this term refers to a job role wherein a person is given the responsbility of producing in between drawings, thereby creating, for example, the sense of a character's motion between a beginning and ending posture. Many of the paint systems now provide functions for automating this activity.

IndeoT: A software ver §sion of Intel's DVI compression-decompres sion standard, it is delivered in conjunction with VFW (Video for Windows). It is scalable, compatible across platforms, and compress ible in real time.

Infomercials: You know 'em when you flip past 'em on the dial: this relatively recent form of television advertising is characterized by a relatively long durationÐcommonly running up to a half-hour in lengthÐand by a relatively high proportion of in-depth informa tion, often purporting to be scientific in nature. Many media futurists believe that this form of advertising is a prototype of what will be available en masse on the information superhighway.

Information design: This field of communications design ex ploits the online reference and presentation power of the computer to access and show information to the user in discrete, defined units visually segmented and organized so that information is easy to un derstand and use.

Information designer: An information designer is a profes sional technical c ?ommunicator skilled in the methods, techniques, and tools of information design. It is worthy to note that an information designer is capable of working with various forms of hypermedia applications and platforms.

Information superhighway: This is a phrase coined by the Clinton administration to refer to the emerging national communica tions networkÐthe NII (National Information Infrastructure)Ð which will enable an ever increasing level of communications of every sort: data communications, personal communications, and, of course, mul timedia communications. Most industry analysts believe that the In ternet is the prototype and origin of the information superhighway.

Information visualizers: A relatively new advance in user in terface design under development at Xerox PARC, this technology strives to take traditional alphanumeric forms of data and convert them into 3-D objects that the user can interact with in ways that are perceptually familiar. With visualizers, it is hoped that users ca Ún see their information, touch it, and rearrange it, thereby achieving a deeper, almost tactile, understanding of its structure.

Instruction cache: From the realm of processor design, this term refers to a specialized

type of cache featured on some microprO cessors that enables faster execution by storing

frequently used in structions in a form of memory that is physically adjacent to the CPU,
Instructional design: This field of communications design ex ploits the instructional

power of the computer. The emergence of in structional design can be directly attributed

to the convergence of media and computing.
Instructional designer: An instructional designer is respon sible for designing

interactive forms of CBT (computer based train ing) and multimedia applications. An

instructional designer, for example, works with end users to decompose knowledge and

tasks into their constituent concepts, skills, and procedural steps, and then use that

information to design appropriate forms of prog Ôrammed in struction. It is worthy to

note that an instructional designer are ca pable of working with various forms of

multimedia applications and platforms, including first generation CBT.
Instructional technology: In many respects, this term now has the same expansive meaning

to the world of education that the term multimedia has taken on with regard to the world

of commerce. Instructional technology is an umbrella term that refers to any tech nology

used for training and education. In the literal sense, then, a chalkboard represents an

instructional technology. However, when used in the school market, this term generally

refers to the burgeon ing supply of hardware and software solutions now crowding their

way into our schools.
Intellectual property: One of the most explosive topics of the information age, this is

an umbrella term for the ownership rights that individuals have when they can demonstrate

that they have added value to an information product. Actors in a film, c   omposers of

mu sic, programmers of software, and art directors of multimedia inter faces are all

examples of individuals who thusly add value. Their recourse for recording and protecting

their rights in this respect are embodied in the laws of copyright, trademark, or

patents, or some combination of these. With most multimedia products, because many of the

markets are still small and/or poorly defined, the entity that pays for building the

product will usually be forced to induce the
development talent to sign nondisclosure agreements, most of which contain work-for-hire

provisions which transfer all of the ownership rights to that sponsoring entity. Where

royalty payments are contem plated, a potential thicket of problems awaits, because

digital media assets are so fungible, so readily subjected to electronic forms of cut

andpaste, that downstream use of those assets will be nearly impos sible to track.

Stockfootage houses and purveyors of clip media have a partial sol ùtion to this

problem, in that they handle all of the royalty arrangements for the various artists, and

relieve users of any worry about usage fees beyond those that are embedded in the

purchase priceÐ unless, of course, they willingly give those media assets to others, who

use them for economic purposes without paying any pur chase price. Expect intellectual

property to be a bonanza for the legal profession in the age of multimedia.
Intelligence augmentation: One of the goals of all com munications media, but especially

appropriate in the age of multime dia, this term refers to the general objective of using

computer media to increase the capability of people to conceptualize, approach, and gain

solutions to complex problems.
Intelligent job aid: Often thought of as an ingredient inperfor mance support systems,

intelligent job aids are granular multimedia applications designed to lead a learner

through an interactive training session to solve a specific type of jo Áb-related,

procedural problem.
Intelligent tutoring system: This is an expert system whose domain of expertise is

instruction. Such systems usually contain an expert system relevant to the subject domain

the tutoring system is teaching about. The objective of an intelligent tutor is to enable

a machine to process both the concept to be taught and how best to present that concept

to the student.

Interactive cinema: This term refers to an interactive form of entertainment that is most

closely related to film. While both interac tivefiction and interactive television have

abundant prototypes on the market, interactive cinema is very, very early in its

evolution. How ever, it is worthwhile to note that the New York Film Festival has been

offering awards in an interactive category for several years now.

Interactive document: This is a document whose content or sequence of presentation can be

altered through direct intervention by the rea ¦ der at the time of reading.

Interactive fiction: Considered by many to be the next major transformation of our

storytelling tradition, interactive fiction refers to the convergence of interactivity

and narration. Interactive fictions are stories with branchpoints, contingent subplots,

alternate outcomes, and the like. As the various genres of interactive entertainment take

shape, interactive fiction will be seen primarily as text-based content, whereas

interactive cinema and interactive television will be viewed as the interactive forms

that make use of high-end media such as full motion video. In many respects, then,

interactive fiction stands in the same relationship to interactive cinema that hypertext

stands with re gard to hypermedia. Still in its embryonic stages, interactive fiction has

explosive potential as a new medium, perhaps on par with mod ern film.

Interactive multimedia: Multimedia applications are not necessarily   interactive. For

example, a rolling demo has all the char acteristics that we are coming to associate with

multimediaÐ audio, image, and possibly video, all running on a computerÐ but, by de sign,

possesses little or no interactivity. Thus, because there are some forms of multimedia

that are not interactive, it is considered by some to be a worthwhile exercise in

language to designate those forms that are.

Interactive television: Most media industry futurists agree that this is the inevitable near-term destiny of home entertainment: a single device that merges the capabilities of the computer and the television. Also referred to as the smart TV, this device will make it possible for users to do such things as temporarily store films that they have downloaded from libraries supplied by public media ser vices; play interactive games on their televisions, without the special attachments required by today's games such as Sega Genesis; and Í create, edit, and store one's own personal video productions.

Interactivity: The defining characteristic of the emerging forms of education and entertainment associated with multimedia applica tions and hypermedia applications, this term refers to the ability of users to communicate directly with the computer and have conse quential impact on whatever message is being created.

Interface: Taken in its most general sense, this term refers to a shared boundary. In computing, the term refers to the boundary be tween two subsystems or two devices. In this more specialized con text, the term refers to the device (called the interface) that matches these parts of the system.

Interface agent: Can be defined as a character, enacted by the computer, who acts on behalf of the user in a virtual (computer based) environment. The use of interface agents implies an authorial effort to create computer based personae and, through their use, to heighten the naturalness of the inte !rface, both in terms of cognitive accessibil ity and communication style. Obviously, the fuller implementation of this interface design strategy waits on further advances in the field of artificial intelligence known as natural language processing, which seeks to imbue computers with the ability to speak on a human, con versational level. This term is roughly synonymous with "interactive agent."

Interface design: Also referred to as human interface design or human-computer interface design, this intellectual pursuit is rapidly ascending to the status of an academic

discipline. As the term im plies, it has to do with designing computer interfaces that

make com puters easier to use. Originally focused on issues having to do with screen

designÐe.g., the desktop metaphor that drives the Apple   Macintosh and Microsoft

Windows interfacesÐthe discipline is rap idly extending itself to include all issues

having to do with the input and output of information to and from the computer. In

essence, inter face design has to do with human-computer communications. With the advent

of mixed media data types, that is to say, with the coming of multimedia and its

progression into the marketplace, the potential for extending the purview of this nascent

discipline would appear to be virtually without limit. Expect colleges and universities

to be ac knowledging the legitimacy of this academic pursuit over the next decade by

creating subdisciplines or even entirely new departments.
Interface paradigm: One o [f the truly big terms in the indus try, it refers to the

dominant metaphor that people encounter when interacting with the operating environment

of their computer. With both the Apple Macintosh and the Microsoft Windows environments,

the dominant metaphor has long been the desktop. The designers of these highly similar

interfaces have tried to represent all of the ob jects with appropriate metaphors from

the cornmon office environ ment. For example, files are represented as file folders, and,

in the Apple Macintosh environment, there is the well-known image of the trash can, which

is used to delete files. Many industry analysts be lieve that we will soon be ready for a

new dominant metaphor, a new interface paradigm. Some of the early candidates are the

personal newspaper, which would deliver information tailored to the individual's needs in

a pri   ƒoritized format similar to the headline-and column structure of the newspaper;

the geographic information sys tem (GIS), which would give all information items a

geographic locationÐas they actually have in the real worldÐand permit the user to pan

and zoom to get about to the desired locations in geo graphic space; and, the 3-D

building, which is actually an enlarge ment of the desktop metaphor that would provide a

more variegated set of sub-metaphors with which to access much larger knowledge bases.
Interframe codec: A form of video compression-decompres sion that works on the basis of

eliminating the redundant components that occur between (as opposed to within) frames. To

date, these are the most powerful forms of codec, achieving compression ratios on the

order of 50:1 on up to 200:1. The MPEG (Motion Picture Experts Group) standard codec is

an interframe technology, and works by, basically, looking forwards   ½and backwards in

a video stream and then recording only the information that changes during a given

segment. Interframe codecs are said to be asymmetrical, because it is much more

time-consuming and expensive to encode (compress) the video stream than it is to decode

(decompress) it. This owes to the enor mous computational resources that must be expended

to define the various visual patterns in a video sequence in terms of their degree of

change. Interframe technologies are often compared with the less pow erful, but also less

expensive, intraframe techniques, which lie at the core of today's most popular codec

standards, such as JPEG (Joint Photography Experts Group).
Interlaced video: The way a standard television picture is cre ated, interlaced video is

a technique that can be described as follows: a television picture is drawn onto the

picture tube by one or more electron guns, which fire a stream of electrons at the f

- ace of the tube one horizontal line at a time. The horizontal lines that make up the

arrays of pixels that comprise the TV screen are referred to as scan lines. The electron

gun draws all the even lines first, then goes back to the top of the screen and draws the

odd lines. This alternating pro cess is what is known as interlaced video.
Interleaving: This term refers to a technical strategy for laying down mixed media data

types on storage media, particularly on CD

ROM. With interleaving, as the term implies, one type of information is "interleaved"

with another, so that the two types can be physically close to one another on the storage

device. The most common ex ample occurs with digital video and audio data types, each of

which has its own unique format and therefore must be stored as separate files. They are

often interleaved when they are laid down on CD ROM because this storage strategy makes

it easier to synchronize the picture and soundÐas, for e ¸xample, when lipsynching.

This strategy is made necessary by the fact that transfer rates on most digital stor age

devices (especially CD-ROM) are still relatively slow when com pared against the demand

to load both types into computer memory so that they may be played in synchronization.
Internet: The successor of an experimental network built by the U.S. Department of

Defense in the 1960s, this communications sys tem links at least three million computers.

A good portion of the con nections belong to universities and research and development

organizations. Today, many users connect to the Internet by phone (modem) to share

information or tap into many rich data banks. Also known affectionately by Internet users

as "The Net."
Interoperability: This polysyllabic tongue -twister simply refers to the system design

feature wherewith a system can operate on sev eral different computer hardware platforms.
Interpolation: Used in its most general sense, this term refers to the process of

introducing or in ³ serting additional values between the existing values in a series.

The process is used frequently in computer graphics, especially in color shading and

various codec techniques. In a more specific sense, this term is now used to describe any

form of motion compensation (i.e., temporal codec) in which a frame is constructed during

decompression based upon the difference in in formation between the original frame (which

is determined during the compression process) and both its previous and subsequent key

frames. This process is also known as forward and backward predic tion, and tends to be a

very expensive, CPU-intensive process that requires off-line compression using mainframe computers.

Interprocessor communications: This term refers to data communications that occur between two processors within the same computing system. The integration of DSPs (digital signal proces sors) into the personal computer to handle the onerous processing requirements of the various media types has made the issue of interp ³ rocessor communications of particular importance to multime dia computing. The future of media-oriented, interprocessor commu nications seems to be headed toward the use of specialized operating systems (such as Spectrum Microsystems' SPOX) designed to handle the personal computer-DSP connection. Over time, these program ming effortsÐand the interprocessor communications they make pos sibleÐw ill make it increasingly easy to add new media capabilities (e.g., voice recognition) to the personal computer.

Interrupt: From the world of software engineering, an interrupt is a procedure whereby a program that is currently running on a com puter is temporarily suspended so that the CPU can devote its time to process another program that has been determined to be of higher priority. It is sort of like relaxing in a colleague's office and then being summoned by a superiorÐthe process of relaxing becomes in terrupted by the higher priority task of making a living.

Interrupt driven: This is a software structure that Óuses inter rupts to determine what tasks can run and/or be given control of the CPU.

Intraframe codec: This is a form of video compression-de compression technology that works by eliminating redundant infor mation within the frames that make up a video sequence. The very popular Motion-JPEG standard is based on intraframe and achieves compression ratios in the range of 20:1 up to 50:1. Intraframe tech nologies are often compared to the more powerful interframe codecs, such as MPEG (Motion Picture Experts

Group). The interframe tech niques are much more expensive because they are asymmetrical,

re quiring powerful computers (mainframes) to perform the encoding process. In contrast,

most of the intraframe codecs can be done in real time, i.e., on the fly.
I/O: One of the earliest, and still most standard, of computer acro nyms, I/O stands for

input/output. It represents a most fundamental truth about computers, which is that they

cannot survive as closed systems, but rather mus somehow receive input from the world,

and, through the magic of digital processing and the programmer's inter vention, provide

useful output. Traditional I/O devices include the keyboard and mouse for input and the

monitor for output. As we sail into the age of multimedia, I/O devices will become

increasingly ori ented toward the mixed media data types of image, graphics, anima tion,

audio, and video.
Iridium Project: One of the major new telecommunication de velopments of the 1990s, this

project is being carried forward by Motorola and involves the development of a system of

small satel lites that operate in low Earth orbit, providing worldwide personal

communications services. It also complements existing systems by providing telephone

service where it does not exist today.
IRIS: Stands for Institute for Research on Information Systems, an organization located

at Brown University in Providence, Rhode Is land, that has been responsible for much of

the groundbreaking re   search of hypertext systems and graphical user interface (GUI)

design.
Iris out: Is a special video effect in which a series of masks con taining circles of

diminishing size obliterates the action.
ISA Bus: The ISA stands for industry standard architecture, and the term represents one

of the foremost bottlenecks in the computer industry today. The ISA bus problem is

particularly acute with mixed media data types, like digital video, and owes its origins

to the one of the most common of all problems associated with computing: func tional

obsolescence. Designed during the initial generations of per sonal computers, the ISA bus

is basically the expansion bus on a PC into which users plug expansion boards for

purposes such as attach ing peripheral devices (a CD-ROM player, for example) or

enhancing machine performance (e.g., accelerator boards). Inasmuch as it was designed

during the era of alphanumeric computing, the ISA bus has a very limited bandwidth, only

8 MHz or so Î. When trying to accom modate multimedia applications, such as digital

video or compound documents, the ISA bus simply gets clogged up, creating a major

performance problem. One of the most common responses to this problem today is the local

bus solution, which bypasses the ISA bus, routing data through the bus that is attached

to the computer's CPU.

ISDN: Stands for integrated services digital network, an end-to-end digital service that

is standardized throughout the world. Among other accomplishments, ISDN may help do away

with most (if not all) forms of analog transmission, which today is demanded by the

(twisted pair) copper wire, last-mile loop of the telephone network. You might think of

ISDN as a digital socket on the wall, just like the electric power socket, that transmits

and accepts digital streams of bits. ISDN could be a kind of universal service for

digital forms of information. Owing to its much greater bandwidth capabilities (carrying

capacity), ISDN m õay become the transmission network for a variety of interactive

multimedia services.

ISO: Stands for the International Standards Organization, a group composed of the

national standards organizations of its member coun tries. As the name implies, the ISO

seeks to establish worldwide quality standards. The ISO has defined standards for data

communications, most notably, the ISO model for OSI (Open System Interconnections)

Isochronous distribution: From the challenging world of net worked video, this term

refers to digital forms of audio and video that are guaranteed to arrive at the same

time. It is a strategy for network ing video that separates the audio and video channels

from other data transmissions to avoid the interference that leads to errors and a lack

of synchronization.

ITD: Stands for interaural time differences, a technical term that comes to us courtesy

of the rapidly advancing world of 3-D sound. ITD is one of the key HRTFs (head-related

transfer functions) and ref ãers to the obvious fact that sound which originates from

one side of the head (as opposed to coming from directly in front of or behind the head)

will reach the listener's ear facing the sound source. ITD is used to perceive sound

direction and has become a critical element of efforts to create realistic sound

environments in virtual reality sys tems where the participants are permitted to move

around, thus chang ing the orientation of their heads.

IVD: Stands for interactive video disc, and is a term that, histori cally, has become

associated with a particular platform strategy for delivering interactive video. It

refers to a platform that combines a personal computer with a laserdisc. As such, it also

refers to the first generation of interactive video platform. Most industry experts be

lieve that the laserdisc is destined for technological extinction and that CD-ROM, or

some other type of all-digital media, will come to replace it for delivering in

+teractive video.

Jaggies: This slang term refers to aliasing, perhaps the most widely recognized artifact

of digital media. This distorting effect is most evident on low resolution displays,

where the outlines of objects take on a jagged appearance that silhouettes the square

shapes of the pix els that form their boundaries with the rest of the image. In a low

resolution picture of a mountain range, for example, the edge be tween the mountains and

the sky is apt to appear jagged as a result of possessing this artifact.

JBIG: Stands for Joint Bi-Level Image Experts Group; this stan dards organization is

related to, though much less well known than, JPEG (Joint Photography Experts Group) and

MPEG (Motion Pic ture Experts Group). It was formed to address issues related to com

pressing "one -bit," bilevel, black-and-white-images such as a fax machine might send or a

digital scanner might create from a page containing black text on white paper. The

standards that Ï emerge from this group will serve the industry segment focused on the

conver gence of fax, copier, and laser print technologies.
JFIF: Stands for JPEG File Interchange Format, an image file for mat based on the JPEG

(Joint Photography Experts Group) standard for compression and decompression of images.
Job aids: From the world of instruc tional design and CBT (com puter based training),

these are relatively small, granular devices de signed to prompt user performance

relative to specific, job-related tasks. An instructional designer may develop job aids,

also known as quick-reference aids, to avoid the time and expense required to develop

memorized responses.
Joystick: This remote control device for a computer, which looks and operates much like

the gearshift for a car, is often used in video and arcade games. As home interactive

media come of age, varia tions on the joystick, such as CD-l's so-called "thumbstick,"

are apt to become increasingly popular.
JPEG: Stands Á for Joint Photography Experts Group and has come to be synonymous with

the compression standard for still images de vised by the same organization. This

compression technique relies upon DCT (discrete cosine transformation), as do many of the

other most common codecs (e.g., MPEG [Motion Picture Experts Group] and H.261). JPEG is

an intraframe, as distinct from an interframe, codec, meaning that it deals with

compressing single frame sources of content, rather than motion picture sources. While

the actual com pression achieved depends on the frequency content (or colors) of the

compressed image, compression ratios in the vicinity of 20:1 are typi cal for JPEG

encoding.

Juke box: This is an increasingly prominent form of mass storage device often used for image processing systems, wherein multiple CDs or digital tapes are held in separate slots on a carousel or eleva tor type of container, with individual storage units being brought un der the read head by some form of robotic device as the information it contains is requested by users. In today's market, it is not uncommon for this form of near-line storage device to have as much as one terabyte of storage capacity. Even with systems this large, access times do not typically exceed 10-100 seconds.

Jump cut: From the world of film and video, this term refers to edit points between camera shots that change the scene of action ei ther between extremely different or extremely similar shots.

Kaleida Labs: Established in 1991, this joint venture of com puter giants IBM and Apple was created to execute the mission of developing standards for multimedia products that span the personal computer, consumer electronics, and communications industr 6ies.

Karaoke: Now one of the more popular applications for musically oriented CD-ROM titles, this term refers to any entertainment prod uct whose primary purpose is that of inspiring the audience to sing along. The better systems, which might be found on videotapes, laserdiscs, or, of course, CD-ROM, display the lyrics, as well as pos sibly even graphics and/or video clips.

Key frame: A term used in conjunction with motion compensa tion forms of video compression, a key frame is a baseframe that has not been temporally compressed, but rather serves as a base against which the change, or delta, elements of subsequent frames are mea sured.

Key grip: From the world of film production, this term refers to the individual who manages the grips, who are the people respon sible for moving equipment, props, costumes, ~ and the like.

Keywords: With regard to hypertext systems, keywords represent a subclass of link where a

word is highlighted, or in some way de noted as special. By clicking on that word, the

user is taken to an item of information associated with it. The most common example

occurs where clicking on a keyword opens a text window in which that word is given a

dictionary-style definition. However, keywords are used for many other purposes,

especially those related to connecting (link ing) one document section with a related

section of another docu ment. A pr ime example of this is where clicking on a name keyword

takes one to biographical information about the named person lo cated at some other place

within the hypertext system. Keyword is a term also frequently used in the related area

of text search and retrieval, where it refers to terms that are drawn from a document ow

ing to t ©heir assessed value for characterizing or summarizing the overa content of

the document. In this search and retrieval context, key words are placed in some form of

header record offered up to the search engine as a more compressed, and therefore more

efficient, item to be scanned for matching the document's content against the user's

interests.
Kiosk: One of the major early applications for interactive multime dia, kiosks make use

of multimedia technology by encasing the nec essary delivery platform in some sort of

architectural structure Typically deployed in stand-alone fashion, i.e., without any

human accompaniment, most kiosks hide everything from the us er but the computer screen

and employ touch screen technology to enable inter action with their programs. The

building or campus directory is a typical example of how kiosks are used.
Kinesthesia: This is the sensation of movement or strain in muscles, tendons, or joints.

This physic zal sensation is the goal of most of the high-intensity amusement

attractions.
Kludge: This is a slang term for an awkward and unsophisticated implementation of

technology. Early interactive video workstations were, for example, often patched

together by joining incompatible devices never intended for such use. Walks through early computer trade shows (circa the early 1980s) would typically yield for the acute listener frequent grumblings about what "kludgey" systems these in teractive video workstations were.

Knowledge engineering: This is the art of building expert systems by working with subject matter experts to codify their knowledge.

Ladder of challenge: A concept stolen from the world of aca deme, this term refers to a common gaming strategy whereby as soon as a player masters the challenges presented by a game at one level, the gaming logic automatically upgrades the édifficulties of the chal lenge to a new and heightened level. The purpose of this logic, of course, is to sustain interest and induce the player (also covetously viewed as a consumer) to stay with the present game, rather than moving onto that of a competitor. Fortunately, this concept has also been extended into the realm of educational software, where it is used to produce what are called "adaptive learning systems," which are programs that attempt to match the level of academic difficulty to the learner's demonstrated level of skill and knowledge.

LAN: Stands for local area network, a widely used term which refers to data communications networks that span a physically limited geo graphic area (less than 10 km); are implemented using some type of switching capability and high bandwidth communications on a rela tively inexpensive medium such as coaxial cable; and are owned by the use ¥r, as opposed to using public (e.g., public switched telephone network) communications facilities. With the onset of multimedia, a great deal of pressure is being placed on the LAN producer commu nity to add both greater transmission bandwidth and greater central (server) storage capacity.

Laser: One of the dominant technologies of the information age, a laser is a device that

generates light in which all of the photons are exactly in step and produce a coherent beam. Laser light has one wavelength and is more easily controlled than other kinds of light.

Last-mile loop: This term refers to the transmission media that make up the final segments of the telephone and TV networks, i.e., those low bandwidth segments that actually connect the global and national networks to our homes. For a long time, the last-mile loop has been viewed as a prohibitive bottleneck with respect to deliver ing high bandwidth, high-quality media services such as pictur Îephone and movies-on-demand into the home. In the phone system, the bottle neck is that last bit of copper wiring that connects the Public Switched Telephone Network to our residences. With regard to cable TV, the last-mile roadblocks are the long cascades of amplifiers that run from the cable company's transmission headquarters to the home, boosting the signal every quarter-mile or so, and frequently introducing all sorts of electronic noise. Traditionally, media futurists have believed that it would take a massive investment in residentialfiber optic con nections to make the likes of point-to-point interactive video and HDTV (high definition television) possible. However, recent innova tions in compression technology have paved the way for possibly using the existing stock of last-mile media to carry at least the first generation of home interactive media into our living rooms.

Large format scanner: This is a type of scanner used for scanning engineering drawings an

Íd other large documents too big for standard sheetfed and flatbed scanners.

Laserdisc: This term refers to a form of optical storage that is very much on the wane. Most industry critics believe that it is being replaced gradually by CD-ROMtechnology. Like CD-ROM, laserdisc stores information in an optical format, i.e., one that relies on patterns of pits and lans burned into the disc surface, and that is read by a head that

is sensitive to the reflectance values that occur when a laser beam is bounced off of that storage surface. Unlike CD-ROM, which em ploys an all-digital format, laserdisc stores its information in an ana log format. Hence, laserdisc is not nearly as compatible with the computer environment as is CD-ROM.

Latency: With reference to virtual reality (VR), this is a measure of the time between when a person moves in a virtual world and when the computer governing the virtual world registers that movement. In systems that are primarily visualÐ as most V R systems are todayÐ this term is closely associated with frame refresh rates. Obviously the key to success in displaying the computer-generated imagery that these systems rely upon is low latency and high frame refresh rates.

LBE: Stands for location based entertainment, which is the primary use of surrogate travel technologies for entertainment purposes. This term is now being applied to the theme park uses of surrogate travel such as those embodied in virtual rides and IMAX Theatres.

LCD: Stands for liquid crystal display, a rapidly evolving form of computer display. LCDs are popular with users and manufacturers of small machines owing to their low power demands and light weight. LCDs differ significantly from CRTs (cathode ray tubes), the most common form of video playback device, because they are light modi fiers, or valves, rather than light producers. They typically consist of two small panes of glass, between which · are a vast array of cells, also referred to as pixels, which contain a liquid crystal substance. When no electrical current is sent to an LCD pixel, the crystals are oriented in a particular direction, blocking light from passing through and thereby causing that pixel to remain dark. When a small electrical current is sent to a cell, the crystal's orientation is altered, allowing light to pass. The patterns formed by these electrically manipulated pixels are what create the images we see on an LCD screen.

Learning styles: From the world of learning theoryÐand, more recently, from instructional designÐthis term is used to describe a classification scheme that is based on the realization that people learn in widely varying ways. One group of people may í learn better, for example, by working through related tasks with other people, while others may be better able to master the same content by reading from an instruction manual in solitude. Some people learn more from what they hear, while others excel in learning from what they see. Being able to determine learning styles by observing learners using a par ticular piece of educational soJtware is one of the more ambitious goals of contemporary instructional design. Progress in this area of research will serve the larger goal of individualizing multimedia con tent relative to the specific needs of the user.

LED: Stands for light-emitting diode, a device used widely ± for a broad number of applications in the world of computing and elec tronics. LEDs are basically transmission devices, in that they emit pulses of light energy in response to various sorts of stimuli. They are usually coupled with photosensors, which serve to convert light en ergy to electrical energy to be used, for example, to create the logical, digital patterns of computing devices.

Levels l-IV: Refers to levels of interactive videodisc; see Vdeo disc levels.

Life quality: As Walt Disney was pushing the world of cartoon animation to new levels of quality with his feature films (e.g., Snow White and the Seven Dwarfs), this term emerged in the press to describe the effect his obsession with realism and detail had on audi ences (and criti Qcs). For example, he was reputed to have sent all of his animators through seminars and coursework in animal anatomy in advance of the making of Bambi.

Light pen: This handheld device detects light emitted by elements comprising the picture on the screen. It can, for example, detect the presence of lines or points.

Linear: As in "linear video," this term refers to the dominant mode for producing media for at least the last several centuries. In fact, not since the oral storytelling

tradition waned as our primary mode of delivering socially sanctioned stories has the

linear tradition received any considerable threat to its hegemony. However, with the

apparent imminence of interactive media, that unchallenged dominion is now in doubtÐand

the implications are potentially staggering. To under stand these implications it is

necessary to exa £mine the ingrained hab its of mind that dictate the behaviors of

those who produce linear media. For example, with linear, all segue, or branching,

decisionsÐ such as what scene follows another, or when a particular scene should end and

its successor beginÐare left entirely under the author's (director's) control. With

interactive, most of these branching deci sions are transferred to the user, who now

becomes a participant in a medium that can be characterized as a form of shared

authorship. The big question that is raised by this impending challenge to linear me dia

is just this: will the same people who have made a living (a for tune, actually) making

linear media be well suited to producing interactive? Think about it.
Line driver: From the world of data communications, this term refers to a signal

converter that conditions a signal to ensure reliable transmission over an extended

distance.
Line level inp +uts: From the world of audio production, this term refers to inputs

made to a recording device that originate from another electronic source, such as a tape

deck, VCR, or CD player. This form of input is often contrasted with microphone level

inputs, which originate from natural sources and, as the name implies, are captured to

electronic storage through a microphone.
Line segment: In vector graphics, this term refers to the portion of a line bounded by

endpoints.
Link: With regard to hpertext, this term has a quite specific mean ing. It refers to an

icon, or other visible hot spot, that makes a conne
tion between one location in a hypertext system and another location. Links are based on

some sort of association between the origin and the destination. The icon that denotes a

link is Isually styled to repre sent the conceptual basis of that connection. For

example, in a geo graphic portion of a hypertext system, a magnifying glass icon mi §

ght be used to indicate the availability of a zoom link, i.e., a link that shows some

portion of a map in greater detail.
Linked list: Is a data structure in which each element points to the next element.
Lipsynch: From the earliest days of film and TV, lipsynch refers to the synchronization

of lip movements on screen with the vocal sounds of the soundtrack. Lipsynching confronts

a renewed challenge in the world of digital video, where techniques such as the interleav

ing of voice and image on disk must be used in order for the computer to access these two

disparate, memory-hungry forms of data quickly enough and in close enough proximity to

one another to achieve the desired synchronization effect.
Local bus: From the world of processor design æ, this term refers to an emerging tweak

of standard personal computer architectures de signed to speed the processing of the

massive amounts of data that accompany multimedia applications. A number of local bus

designs have come to the market in an effort to address the processing de mands of

multimedia technology, the two most dominant to date be ing VESA's (V1deo Electronics

Standards Association) VL-bus and Intel's PCI (Peripheral Component Interconnect). Local

bus circuitry speeds the processing of media-intensive data types by transferring data

directly to the system processor using a broader data path so that faster throughput can

be achieved Gthan on the traditional system bus of PCs (e.g., the 16-bit ISA bus). In

all likelihood, the local bus will be remembered as a momentary annoyance and minor

footnote in the computer's transformation from being just a computational machine to

being an interactive multimedia machine.
Localization cues: This term is used with respect to 3-D sound to describe the localizing

effect created when sound arrives at one ear before the other. These cues enable human

listeners to create an audio picture of their environments.

Lofting: This term refers to an interactive graphics technique in which the third

dimension is obtained from a 2-D representation. A good example of lofting would be the

creation of a 3-D image from the elevation contours contained in a topographic map.

Logical assets: As opposed to the media assets of a multimedia ì application, this term

refers to the branching, performance assess ment, and other software design features

that, taken together, supply a program with its sense of having intelligence. Generally

speaking, in today's multimedia market, high-end gaming and simulation pro grams possess

the strongest logical assets.

Long document handling features: In the early days of desktop publishing, most of the

programs advertised under this moni ker were ill-equipped to handle large documents such

as books or magazines or lofty proposals; they were better suited to handling the company

newsletter. However, with time and market pressure, these programs have taken on a set of

features that makes them well quali fied to work with large or long documents. These

features include automatic tables-of-contents, automatic back-of-the-book indexes, fa

cilities for chaining multiple documents, and the like. The appear » ance of these

features represents a maturation of the electronic publishing industry. The next major

push for this industry segment will be the features associated with ERD (electronic

reference docu ments), such as hyperlinks and full-text search.

Long shot: From the world of film and video, this term refers to a camera shot with a

vantage point relatively far from its subject. An aerial view of a cityscape would be a

prime example of a long shot. This type of shot has been most commonly used at the

beginning of movie scenes to establish the locale or atmosphere. The long shot is often

held in contrast to the close-up, which is used to provide inti macy between subject and

viewer.

Lossy compression: Refers to a group of compression tech niques that sacrifice exact

reproduction of data for better compres sion. A common example of a lossy compression

technique is the MPEG (Motion Picture Experts Group) standard for motion video Î

compression, which achieves ratios on the order of 100:1, all the way up to 2,000:1, but

sacrifices quite a bit in terms of image quality. A second common example is the H.261

standard, used for video tele conferencing.
Luminance: The intensity, or brightness component, of an elec tronic image. By itself,

luminance creates an image in black, gray, and white. With color television, it is

combined with chrominance to
create a color image. Because the human eye is more sensitive to luminance than it is to

chrominance, when it comes to compressing color digital images, more is done to reduce

the chrominance content of the image than is done to eliminate the lumin ance information.
LV ROM: This term stands for laservisionÐread only memory, a laserdisc format developed

by Philips UK in conjunction with a num ber of other media and computer interests in

1986. The format ac commodates analog video, digital audio, and digital data.
Magnetic positioning systems: This term re ¿fers to the pri mary position-sensing

technique used in virtual reality (VR) research today. The underlying concept of these

systems is simple. Electrical current sent through a coil of wire generates a magnetic

field oriented along a single axis. Conversely, when a coil of wire is exposed to a

magnetic field, an electrical current is generated which is proportional to the field's

strength. The closer to the axis of the magnetic field, the greater the electric charge

generated. Then, if you mount three coils of wire at right angles to each other and feed

them electrical current, the coils create magnetic fields along three axes. And if you

move a second three-coil set through these magnetic fields, it produces three distinct

electrical charges depending on its position and orientation. It is then possible to

process these values mathematically to provide position (x, y, and z) and orientation

(roll, pitch, and yaw) informa ø tion about the sensor. All of this magnetic magic

makes it possible for a VR system to track the movement of objects through a virtual

world. The first, best known example of this three-coil, magnetic system is the Polhemus

Tracker.

Magnetoencephlamography: Perhaps one of the longest words in the English language, this

term refers to a futuristic, perhaps frightening form of computer input now being

contemplated in some research labs. Based on medical brain scanning, the concept is that

scientists will be able to measure the electromagnetic signals coming out of your brain

and match them with a map of what previous brain scans revealed. One of the hopes is that

we might be able to teach computers to recognize certain types of brain activity. Going

beyond this, it is theoretically possible that particular thoughts create distinct

patterns of brain activity, and that the equivalent of MIDI (musical instrument ±

digital interface) wave tables could be filled with recorded thought patterns such that

the computer could read the human mind. Scary thought.

Markup tags: Used by tagging languages such as SGML (stan dard generalized markup

language) and HTML (hypertext markup language), markup tags enable users to embed

specialized publishing and document formatting characteristics within documents.

Mass deployment: This general term is now gaining a very specific meaning: it is corning

to represent that awaited moment in our national future when we convert our

communications infrastruc tul eÐourNlI (National Information Infrastructure), if you will

Ðfrom one dominated by the traditional analog set of technologies to one governed

primarily by digital techno   hlogies. When this occurs, all of the now -anticipated forms

of information and entertainmentÐsuch as VOD (video on demand), the virtual mall, even

the personal news paperÐwill move from the status of blue sky to reality.

Mastering: This term is used most commonly in reference to a critical step in the process

of producing a CD-ROM. As the word implies, it refers to the process of creating the disc

from which all others will be produced. It involves the burning of pits and lansÐthe CD

equivalents for binary dataÐinto the photoresistent surface of the master disc.
Matte: From the world of traditional film and video, this produc tion tool is essentially

a mask. There are two types: the female mask, which is the character or object

photographed over a black background; and the male mask, which is a silhouette of a

character or object shot on a white background. W ôhen applied to the realm of DVE

(digital video effects), this term refers to the two-plane effect, in which a de fined

area of the front plane is made transparent, revealing the image on the back plane.
MCC: Stands for Microelectronics and Computer Technology Cor poration, a consortium of

American high technology firms established in 1982 to share technological innovations for

the purpose of ward ing off the competitive onslaught of Japanese firms. Located in Aus

tin, Texas, the founding corporations of MCC include Digital Equipment, Motorola,

National Semiconductor, Advanced Micro Devices, Honeywell, Martin Marietta, and Bell

Communications Research.
MCITM: This term stands for Media Control Interface, and it refers to a multimedia

software utility in Microsoft Windows. It is used to pro vide standard methods for

accessing the various devices that one as sociates with multimedia delivery platforms,

Ãsuch as CD-ROM, laserdisc, and the like through the Media Player.
Media assets: As opposed to the logical assets of a multimedia application, this term

refers to the video, audio, and text elements that together convey the media production

value of a program.
Media integrators: This term refers to the low end of software tools used to build

multimedia presentations. When compared against the high-end authoring systems, media

integrators seek ease of use as their primary goal. Examples in today's market include

Macromedia's Action! and Interactive Media's Special Delivery.

Media Lab: Founded in 1985 at MIT by Jerome Weisner and cur rent director Nicholas

Negroponte, this center receives fame for the research it conducts on the future of

communications technologies The founding concept of the Media Lab was a belief in the

inexorable merger of three previously separate and distinct industries: broadcast and

motion picture, print and publishing, and comp ¯uters. The center is funded mostly by

grants from corporations and governments, all of whom hope to see the future of

communications 30 or so years down the road.

Media PlayerTM: This is a software utility in Microsoft Windows that is the main

interface to the MCI. It utilizes VCR-like buttons to control remote devices, such as the

CD-ROM player on the MPC (multimedia personal computer).

Memex: In 1945, Vannevar Bush wrote an article entitled "As We May Think," and many

people hold it out as the inaugural work of the information age. In that article, Bush

described a machine, which he referred to as a memex, that could be used to browse and

make notes in a voluminous online text and graphics system. The memex con tained a large

library of documents as well as personal items such as notes, photographs, and sketches.

This imaginary machine was to have several screens and a facility for establishing a

labeled link between any two points or nodes in the library. The memex is an ßobvious

an cestor of the concept that we today refer to as hypertext.

Memo field: From the world of database design, the memo field is a design feature that

enables users to place fields in records that can receive data of widely variable size or

length. With traditional data base design, data fields have a maximum length specified in

the database's data dictionary. For example, a name field might be de fined in the data

dictionary as having a fixed length of 30 characters

This means that the designer of that database anticipates that no name will exceed 30

characters in length. Virtually all of the fields speci fied for the typical database

possess this type of length specification, which provides pre-determined structure to the

data and makes it easier to manage. The memo field was introduced to account for the in

creasing tendency for users to want to add information to a database that is of

considerable length, and that varies in size, so that it is nearly impossible to an   ß

ticipate size with any degree of accuracy. The first such incidents of this must have

been "memos" that people wanted to add to data records, as in adding a memo to an

accounts receivable record that explains why a particular customer has been extended

credit. With the advent of mixed media data typesÐof audio, image, and videoÐthe need to

add information that varies widely in size/ magnitude is going to grow dramatically.

Thus, to many the memo field is viewed as a point of entry for extending the capabilities

of traditional database management tools and systems into the age of multimedia.
Menu: Perhaps the most basic element of graphical user interface (GUI) design, the menu

is a pulldown list of functions available in a software application.
Metadata: Is information about a data file that is also part of that file. Typical

examples would be the name of the file, the date of gen eration, statistical information

about the data, and so forth. As mixed media data types and thei   r assorted codecs and

media handling rou tines proliferate, this sort of information will become a critical por

tion of the media file's metadata profile.
Methodology: In the world of computing, a methodology is a defined, structured approach

and process to developing a software application throughout its life cycle. A typical

process involves analy sis, design, evaluation, development, installation, and

maintenance. Within these phases, various roles (players, such as the instructional

designet; the programmer, and the information designer) interact and perform specified

activities to create process deliverables (i.e, docu ments that define and describe the

application as it is in the various stages of its development, such as the requirements

document or the design statement) that will eventually culminate in the application

itself. It is hoped that developers of multimedia applications and hypermedia

applications will follow a methodology to help i ensure product usability.
Microphone level inputs: Refers to forms of audio input that originate from natural

sources and are captured to storage through a microphone. This term is often contrasted

with line level inputs, which refer to inputs that originate from other electronic

sources, such as VCR, tape deck, or CD player.
Microwave: Refers to the following: 1) radio transmission which uses very short

wavelengths; 2) a high bandwidth facility that pro vides line-of-sight radio

communications and that requires repeater stations to be placed every 40 km or so because

of the curvature of the earth's surface.
MIDI: Stands for musical instrument digital interface and represents one of the most

powerful early innovations in multimedia technol ogy. MIDI is both an interface used for

connecting MIDI instruments and a music description language that reproduces instrumental

sound (just as PostScript by Adobe Systems is a page description language used to create

printed   +and other graphic output). The technology is based on the analytical

decomposition of sound into its fundamental and electronically reproducible elements.

There are two types of MIDI synthesizers, the devices used for creating electronically

generated music: FM synthesizers, which use oscillators to reproduce sound waves; and

sampled sound orwave table technology, which uses digi tally recorded samples of

instruments. Commands from the MIDI de scription language tell the synthesizers what to

play. MIDI devices assign different instrument sounds to different channels and use those

channels to play back or record MIDI songs. Because MIDI devices use a symbolic

representation of sound which then generates a syn thesized version of that sound on the

fly, rather than the space-hun gry, digitized equivalent, this technology represents a

powerful form of audio compression. Using MIDI, an hour of stereo sound can be stored in

less than 500K.

MIPS: Stands for mil Ôlions of instructions per second and is the stan dard measure of

processor speed in the computing world. In the early 1990s, personal computers are

equipped with microprocessors that operate in the 20 MIPS range. These speed levels,

though impressive7 will need constant improvement if the personal computer is to be suc

cessfully migrated into interactive television.

Mix: In film and video, the mix is a recording session during wnich all the tracks for

dialogue, music, and sound effects are combined onto a single master.

Mixed media data types: This phrase has emerged as an other way of referring to the

realization that information processing must now be inclusive of the nontraditional, high

bandwidth sources of dataÐnamely, audio, image, and video.

Mode: This very generalÐsome would say overusedÐterm refers to "one among several

alternative methods of operation." Being a classificatory term, each mode has some

characteristic or set of char acteristics that sets it apart from a ´nother mode.

Model sheet: Used extensively in the world of cartoon and fea ture animation, this is a

group of drawings showing various views of a character, designed to show the animators

and assistants how the character is to be constructed. In many respects, the model sheet

il lustrates an object oriented approach to animation, inasmuch as it isolates the

characters as objects from their immersion in a story.

Modem: A contraction for modulator-demodulator, this term refers to a data communications

translating device that links a computer to a telecommunications network (usually the

public switched telephone network). A modem converts the digital signals of a computer to

ana log signals for transmission over the telecommunications network, and then converts

those analog signals back to digital when they ar rive at their destination. It is

generally believed that as we enter the age of multimedia, the demand for modems may wane

as all-digital transmission media gradually replace the older s Êtock of analog de

vices. This trend will be precipitated by the immense demand for carrying capacity levied

by the mixed media data types, such as im age and video. Modems are simply not equipped

to handle the mam moth files associated with mixed media.

Modular WindowsTM: A subset of the popular Microsoft Win dows graphical environment

manufactured by Microsoft, this prod uct is aimed at the emerging CD-ROM player TV

accessory market. It is designed to be controlled by a TV viewer wielding a remote

control, and thus offers larger screen fonts and has a different look and feel than its

parent, Windows. An early user of Modular Win dows is Tandy's 1i7S (Visual Information

System) player, which is being sold through Tandy's Radio Shack stores as a direct

competitor to the Philips CD-I system.

Moire effect: This term refers to a noticeable pattern of wavy, regularly spaced spots

that results from the nearly parallel alignment of the axes of two superimposed dot scre

Øens. In the world of color printing, this effect is considered highly undesirable

because it re duces the clarity of the printed image.

Morphing: A special effects technique of fairly recent vintage, morphing is the now

familiar visual process whereby one object blends into another. Now abundantly used in

television, whenever one sees an object such as a face blend quickly and seamlessly into

another object, such as another face, the technique being used is that of morphing. Drawn

from the word "metamorphosis," this technique is based on very simple principles. To

create a morph, first, the begin ning and ending keyframes are selected. Each point in

the first key frame is associated with a point in the last key frame. The artist also

selects a number of points between these two bookend key frames, then specifies the

number of frames over which the transformation will occur from beginning to end.

Obviously, the ômore points that are selected for use with this inbetweening tool, the

finer the transition

Mosaic: This is a popular, public domain graphical user interface (GUI) standard

graphical front-end to access information on the Internet.

Mosaic effects: From the realm of DVE (digital video effects), this term refers to a

family of effects that are used to coarsen a video image. These techniques are typically

employed as a method for fad ing out of a scene and are most effectively used when the

fade coin cides with the psychological effect of losing attentional focus, such as when

someone is losing consciousness. There are two dominant mosaic effects. The first, pixel

repeat, zooms in on a portion of the screen, but without providing any additional detail.

The result is that the portion of the screen that is enlarged in the zoom comes to appear

increasingly coarser, or out of focus. The second technique, kn ÿown as pixel hold,

retains the whole screen (does not zoom) but creates a granulated look by taking the

color and tone (chrominance and lumi nance) of one pixel and extending it to neighboring

pixels. Typically, this process is continued until the whole screen seems to break up

into a set of increasingly hazy squares.

Motion compensation: This term refers to a breed of video compression techniques that

compress across video frames by saving only the differences between them. The MPEG

(Motion Picture Ex perts Group) standard is a prime example. Motion compensation codecs

are also referred to as interframe codecs.

Motion control photography: One of many technical inno vations created by George Lucas'

Industrial Light & Magic, this term refers to a family of products that use computers to

provide precision control of camera movement. This technology is used, for example, to

create multiple exposures of the s ¾ame scene, such that various spe cial effects can

be laid down on that scene in a seamless fashion.

Motion JPEG: One of the most popular codecs available today, it serves as the core codec

for Apple's QuickTime. Motion-JPEG (Joint Photography Experts Group) is an intraframe

codec, which means that it is symmetrical and can, for the most part, be performed on the fly (in real time).

Motion parallax: An anomaly of the human visual system, this term refers to the phenomenon that occurs as we move our heads from side to side; objects closer to us appear to move faster than ob jects that are farther away. This perception is caused by the fact that the images of closer objects are larger and move across our retinas faster than the images of distant ÷objects. This phenomenon can be put to dramatic effect by creators of visual media, often by simply getting objects in the visual field of action to move.

Motion platform: One of the outstanding new features of high intensity amusement attractions, motion platforms are used in con junction with high resolution video systems to create an immersive sense of motion associated with the action being portrayed in the video or graphic part of the system. As the name implies, the motion plat form actually moves in conjunction with the video, artfully using a relatively small amount of movement to create for the audience an amplified sense of motion. The most popular and effective uses of motion platforms are found in our country's high visibility theme pa]rks (e.g., Universal Studios and DisneyWorld both in Orlando, Florida).

Mouse: Aside from the keyboard, the mouse is currently the most common computer input device. It is a handheld device that inputs coordinate information and is chiefly used as a "pick device" for se lecting items from among icons, screen menus, and the like. The tech nology for the mouse was first developed at Stanford Research Institute in the 1960s and was later integrated into the seminal interface re search that occurred at Xerox PARC in the 1970s and '80s. The prin ciple behind mousing is a simple one: a small ball is placed inside a device that is rolled on a table. Sensors measure how far the ball has rolled forward, backward, or side-to-side, and computer algorithms translate these

movements into horizontal and vertical coordinate movements of an on-screen cursor.
Mout ~h action: This refers to the numerous shapes the mouth must take when speaking.

With an object-oriented approach to ani mation, these shapes are stored in an object

library, available to be inherited (with appropriate modifications, of course) by any

character

Moviemap: A subtype of the surrogate travel genre, moviemaps are used to enable people to

travel the roads and byways of geographi cally remote areas. The early examples were

created by, first, actually filming movement (by foot or by car) through the target

geographic area, and then by digitizing these travel segments and placing them on some

form of optical storage, most commonly laserdisc. Points within the moviemap where users

can change direction, e.g., turn down another street, are represented in the moviemap by

simple branchpoints that enable the various street segments to become (seamlessly, one

hopes) connected to o ᵃ ne another for the purposes of simulating move ment. The tedium

of capturing a city's geobase of street segments on film is apt to give way in the future

to terrain modeling systems that are integrated with geographic information systems to

enable dynamic and automated rendering of virtual pathways through the target city. The

Aspen Movie Map, created in 1978 by MIT's Machine Architec- ture Group, represents the

proof-of-concept prototype of the moviemap.
Movies-on demand: Made possible by the rapid expansion of the channel bandwidth available

to cable operators, this media ser vice makes it possible for cable viewers to order up

films at their own leisure. The full implementation of this service is projected to give

viewers access to vast libraries of film offerings (e.g., the complete MGM library) and,

therefore, to severely undercut, if not make com pletely obsolete, the VCR and the home

video rental industry.
Movin ¿g viewpoint commands: One of the emerging primi tives of interactivity, moving

viewpoint commands are a subtype of interactive branchpoint. As the term suggests, these branchpoints enable participants to change what occupies their field of vision as they move through a particular scene. With the more immersive formS of interactive story, i.e., with virtual reality, these commands will be effected by sensors that correspond directly with the participant's Own body movements (e.g., through the technology of the DataSuit). Con sequently, they will obtain high levels of sophistication with reSpect to the code of resemblance.

MPC: Stands for multimedia personal computer, and represents an increasingly important market specification set forth by the Multime dia PC Marketing Council of Washington, DC. Now in its second generation (MPC II), the first generation of the standard was pub lished in 1990, the second in 1993. Its goal is to encourage the adop tion of a standard multimedia computing platform, which, of course, stands to benefit hardware and title manufacturers as well as consum ers. The council grants a distinctive MPC certification mark to all hardware manufacturers who meet the functional requirements of the specification. In summary, the minimum requirements of Level 1 were as follows: 386SX CPU; 2 MB of RAM; 30 MB hard drive; single spin CD-ROM drive with 150 KB transfer rate and CD-DA outputs; VGA monitor (640 x 480, 16 colors); and MIDI 1/0, joystick. Most experts agree that this standard is simply not powerful enough. In fact, most of the recent multimedia titles have zoomed past this specification. The 1993, Level 2 standard is much more ro bust and includes the following specifications: 486SX, 25 Mhz CPU; 4 MB of RAM; 65,000-color graphics at 640 x 480 resolution; 160 MB hard drive; double-spin CD-ROM drive with 300 KB transfer rate; CD-ROM-XA ready; and multisession-capable MIDI I/O, joy stick. Given the rapid pace of the multimedia market, it would not be unexpected to see MPC III soon.

MPEG: This acronym, which stands for the standards committee known as the Motion Picture Experts Group, has become synony mous with one of the early favorites to become a dominant codec for delivering digital video. In contrast to its close cousin, JPEG (Joint Photography Experts Group), the MPEG standard is an interframe, or motion compensation, codec. Like all codecs, MPEG seeks out redundant information that can be removed fr Nom a data stream. Be cause it is an interframe codec, MPEG seeks out redundancies that occur between frames in a video stream, as well as those that occur within single frames (as is the case with intraframe codecs like JPEG). If it is a sure sign of viability when a standard moves into its second generation, then the MPEG standard is doing quite well. The first standard, originally just called MPEG, but now being referred to as MPEG 1, provides a level of image quality that has been likened to the VHS standard of our VCRs. Technically speaking, the MPEG 1 format, which was finally blessed by its committee in 1993, is ca pable of presenting a quarter-screen picture at a resolution of 352 x 240 pixels at the NTSC (National Television Standards Committee) stan dardframe rate of 30 frames per second (fps). While full screen imple mentati yons of MPEG are common, they are actually interpolated from the original quarter screen data. This first round of the standard is considered most appropriate for presentation on VGA monitors and for use with CD-ROM titles. The second iteration of the standard, MPEG 2, is expected by many to become the digital transmission standard for the broadcast cable industry. In fact, most industry ana lysts expect that the 50+ million cable subscribers in the U.S. will convert to digital set-top boxes with MPEG 2 decoders by the turn of the century. The MPEG 2 standard will bump the resolution of MPEG to 720 x 480, thereby achieving a full television-quality standard.

MSC: Stands for MIDI show control, a language extension to the MIDI (musical instrument

digital interface) standard that provides for the computer control of a variety of

equipment systems used in live performance and larg Ñe audiovisual productions.

Motorized stage equipment, pyrotechnical effects, various audio devices, lighting sys

tems, and videodisc players are just some of the devices that have been brought under the

control of the MSC language. As envisioned by its authors, MSC will provide strong

assistance to the traditionally harried board operators responsible for launching complex

sequences of on-stage events in precise order and with precise timing.
MSCDEX: This combination acronym-contraction stands for Mi crosoft CD-ROM extensions. It

is a program that enables the MS DOS operating system to "talk" to a CD-ROM drive.
Multidrop line: Also commonly referred to as a "multipoint line," this term refers to a

single communications line that is connected to two or more stations. The most obvious

examples of a multidrop line are the telephone and cable connections that provide phone

and TV services, respectively, to the residential   market.
Multimedia: Is the umbrella term that has been coined to cover all of the synergistic

uses of text, voice, music, video, graphics, and other forms of data to enhance the

computer's rs)le as a communica tions device.
Multimedia applications: Though the first years of this de cade have witnessed an

explosion in what are being called multime dia titles, few have stopped to question what

type of content denotes a multimedia application. We offer the following three-part

taxonomy as a tentative starting point for defining the array of multimedia ap

plications: 1) Structured Pathways: these are largely training appli
cationsÐ often called tutorialsÐ that tightly constrict the user's move ment through a

series of interactive presentational sequences designed to convey a specific set of

learning objectives. This genre of multi media is most often used with regard to content

that requires a large measure of rote memorization. Drill and practice progr   ams for

grade school math and end user training for software applications are two common examples

of this type of multimedia. It is best employed with learners who bring very little base knowledge to the learning experience, and therefore require that the scope and sequence of the content be laid out for them. 2) Exploratory: probably the most com mon type of multimedia title coming onto the market today, this type of program lies on the opposite side of the learner continuum from structured pathways in that it works best with users that are already quite familiar with the content. The exploratory category is best typi fied by programs that are termed hypertext or hypernedia. It pro vides a navigational interface to large volumes of hyperlinked, or relationally associated content. Elec tronic museums, electronic en cyclopedias, online help systems, medical databases, and surrogate travel programs are all examples of exploratory multimedia (i.e., hypermedia). This type of program is fairly easy to build in that it does not demand sophisticated software logic. Exploratory programs rise or fall on the merits of two factors: the desirability or appeal of their content, and the quality of their navigational interface.

3) Gam ing: this is the most demanding of the three from the standpoint of software design. Gaming multimedia programs succeed by providing an engaging context in which users are challenged to achieve one or more well-specified goals (e.g., find the buried treasure, slay the ap propriate villains, earn the imaginary fortune).Well-constructed games pro   ]vide abundant feedback and are highly interactive. Most games inspire repeated use by implementing what educators call the ladder of challenge: once the player has obtained mastery at one level of challenge, the program automatically upgrades that challenge to a heightened level of difficulty. Though games are frequently scoffed at by those in the corporate world, a deeper look would reveal that the much-respected business simulation is, in fact, based on the same software design principles as gamesÐthe only

substantive difference between the two is that the simulation is placed in a job context with real world variables and feedback systems.   Multimedia applications have their roots in standard training and education courses with or without exercises, CBT (computer based training) programs for education and training, and video games, simu lation ùs, and stories for fun and entertainment.

Multimedia database: This term has emerged in the nomen clature to pay witness to the fact that most database applications are making it possible to embed mixed media data types in their tradi tional database records. The most commonly cited example of this is a personnel database, where the employee picture is attached as part of the employee record.

Multimedia PC Marketing Council: This is a nonprof1t organization incorporated as a subsidiary of the Software Publishers Association. Using the multimedia PC standard set forth by Tandy Corp. in 1990, this council of 11 members established the standard of what constitutes a multimedia personal computer. As a way of en forcing this standard, the council makes available to all hardware ven dors the option of licensing the MPC (multimedia personal computer) trademark, which thereby stands as a validation that any work   istation thusly trademarked has achieved the level of technical sophistication demanded by the MPC standard.

Multiprocessing: This term refers to an emerging trend in per sonal computer design to incorporate more than one processor. Often confused with parallel processing, which denotes many small, identi cally constructed processors working simultaneously, in parallel, multiprocessing refers to the somewhat different notion of a com puter with two or more specialized processors. In the age of multime dia, multiprocessing will play an increasingly important role, as manufacturers discover that the most efficient way to handle the vari ous forms of encoded mediaÐtext, audio, image, videoÐis to sup ply each

with their own specialized processor. This is the approach that the ElectronicArts

offshoot, 3D0, has taken in designing its home interactive multiplayer of t Rhe same

name. The design approach of 3D0Ð which may replace the CPU-oriented designs of today's

per sonal computersÐ is to allocate to the CPU the function of "babysitting" a number of

other processors working independently on processing the sound, graphics, and animation.

The 3D0 design also incorporates a number of DMA (direct memory access) chan nels, which

further reduce the processing load of the CPU by making certain that the movement of the

various media files operates in a near-independent fashion.
Multisession: This term refers to the ability of a certain breed of write -once CD player

to be able to record data during multiple ses sions. The technology is essentially

analogous to the append function familiar to database applications, wherein the physical

placement of new data is located just beyond the existing data. With write-onc ƒe,

multisession CDs, this is the only place that new data can be placed, because once a

portion of the CD's surface is burned with its digital pattern of pits and lans, there is

no currently viable technology for "re-recording" these surfaces. However, multisession

is considered a significant step forward, inasmuch as most CDs are single session,

meaning that any disc surface that is unused during the mastering process shall remain

forever wasted. The Kodak Photo CD technol ogy is the best known early example of

multisession CD.
Multi threading: From the realm of operating system design, this feature makes it

possible for several processors to run the same code simultaneously. A feature like this

is critical to many high-end multimedia applications, where the volume of data to be

handled cre ates bottlenecks on most standard systems.
NAPLPS: Stands for North American Presentation Level Protocol Standard and is p ¿

ronounced "naplips." This standard is used for send ing computer graphics over the

television industry transmission in frastructure. It appeared over a decade ago, and

though it is still used by the major online services, such as Prodigy and America Online,

it is considered to be seriously out of date. Blocky graphics, slow transmission, lack of

built-in support for mice, and no audio are just some of this standard's shortcomings.

The RIP (Remote Imaging Pro tocol), created by TeleGrafix of Huntington Beach,

California, is a more up-to-date standard that is attempting to bring these online ser

vices up to the graphic user interface (GUI) standards that character ize modern PCs and

(especially) MPCs (multimedia personal computers).

Narrowband: Used in contrast to the term broadband, this word describes a transmission

channel that has a relatively low carrying capacity, or amount of bandwidth. It is

typically used to descri +be chan nels with voice grade bandwidth (4khz) or below.

Narrowcasting: In contrast to the traditional, mass-market, tele vision network

broadcasting predominant before cable television, this term describes media services

targeted towards relatively small, spe cialized vertical market segmentlinterest groups.

ESPN and A&E are prime examples. Narrowcasting is projected to continue as a power ful

trend into the information age as transmission bandwidthsÐand the

resulting number of available channelsÐcontinue their unabated expansion.

Natural language processing: This term refers to a branch of artificial intelligence that

specializes in programming computers with the ability to carry on normal, human speech.

This branch has become tightly connected with the technologies associated with speech

recognition (or voice recognition).

Navigation: A term that has found its way from seafaring originS to the world of

interface design and hypernedia, $it has become a

popular design concept associated with building comprehensible struc tures when

assembling large amounts of information into mixed me dia databases (hypermedia).

Building the navigable interface is, for the present, one of the great cha llenges and

research foci of the early stages in the age of multimedia.

Navigator: This term has been offered to describe an emergent software that searches and

manipulates content on various databases. Perhaps the outstanding feature of a navigator

is its ability to self navigate the network, seeking out the most appropriate information

items from the numerous public information databases.

Near-line storage: From the world of data storage, this newly minted term refers to a

transitional form of storage between online and off-line media. It di yffers from

online in one simple way: data is not processed directly from near-line devices. Rather,

data is migrated from an online storage device to a near-line device when it is not

needed and brought back to the online device when needed. Near line can be distinguished

from off-line storage such as traditional magnetic tape systems in two ways. First, the

media onto which the files have been placed is continuously and immediately available (or

nearly so) to the end user. There is no need for personnel to fetch and mount the media.

Secondly, no system administrator intervention is required to save files or to retrieve

them from storage. Examples of near-line storage include the opticaljuke box and the tape

autoloader. In the age of multimedia, where all forms of storage will be under ominous

pressure to increase capacity, this hybrid form of storage medium is apt to gain wid àe

popularity, if only as a stopgap measure until higher capacity forms of online storage

are made available.

Network operating system: Now a staple of the software world, a network operating system

is that body of software features that enables computers to communicate with one another.

Neuro-BabyTM: Created by Naoka Tosa of Fujitsu Laboratories in Japan, Neuro-Baby is a

computer-generated 3-D character pro grammed to learn by using voice-input and neural

network software. It reacts to the tone and frequency of a person's voice, and, for ex

ample, might cry or become angry if a person were to speak loudly to it. As such, this

cutting edge technology represents one of the earliest attempts at the creation of an

artificial personality.
Nll: Stands for national information infrastructure and is the offi cially sanctioned

term of the Clinton administration for the so-called information sup ®erhighway. If the

vision is on target, this cOmpOSite infrastructure of fiber optic, coaxial, and wireless

transmission facili ties, plus the machine intelligence to manage it, will play very big

in the future of multimedia. The emerging medium of interactive televi sion, for one,

will be utterly dependent on the viability and vitality of the NII.
Noise: In the media industry, this term refers to the in terference a signal picks up as

it is transmitted along an electronic circuit. "Static' on telephone lines and "snow" on

TV screens are two common ex amples of noise. From a broader perspective, and originating

from the lofty heights of information theory, noise refers to any random or unintentional

forms of information that get embedded in a message and become distracting, or otherwise

degrade the quality of that message.
Noise gate: Used by audio engineers, this device makes it pos sible to erase all sound

that registers tabove or beneath a specified level.
Noninterlaced video: This is a high quality form of video of fered by many video

digitizers, wherein the original, interlaced video signal (a signal painted on the screen

in two passes) is buffered into memory and merged into a single screen image before being

displayed on the monitor. A near-synonym is progressive scanning.
Nonlinear video: This term is used in the video industry to de scribe the random access

abilities afforded the producer when work ing in the digital format. Frequently used as

an off-line tool, nonlinear video editing is a process whereby video is digitized in real

time and stored on a hard disk. When video is placed in this digital format, the editor

can go to any single point in the digitized video sequence with out having to rewind or

fast-forward through other material.You might entitle the story associated wi ~th this

term: "Hollywood Discovers Random Access."

NTSC: Stands for National Television Standards Committee and is used most commonly to refer to the U.S. color video standard. This longstanding broadcast standard is represented by 525-line screen run ning at a rate of 60 fields/30 frames per second and at a broadcast bandwidth of 4 MHz. Most people in the multimedia industry equate this acronym not only with the standard per se, but also with the level of image quality that is associated with television broadcasts.

NTSC safe colors: For those who are creating graphics on com puter for eventual transfer to some form of television broadcast, this term refers to a set of constraints that limit the selection of colors to those that reproduce well on video.

NVOD: Stands for near video on demand and represents one of the earliest interactive products to be offered through interactive ú televi sion. Most industry analysts view NVOD as a temporary precursor to true movies-on-demand, or VOD. The service will be characterized by movies staggered on multiple channels with enough copies al ways playing so that viewers will never wait more than just a few minutes for their selection to start.

NVRAM: Stands for non-volatile random access memory and re fers to a typically small portion of computer RAM that is kept from losing its digital patterns when the computer is turned off by some form of battery. NVRAM is used to hold data of high priority, such as password information or key last-usage data. With the growing im portance of long-play video games, NVRAM will be used increas ingly to bookmark the progress of particular gaming sessions so that users can have the liberty to turn off their machine without having to restart a possibly involved game when they return.

Object oriented programming: This is th ¼e new philoso phy of programming. Rather than segregating software procedures from their associated data, as has been typical of the programming discipline for the bulk of its history, object-oriented programming

encapsulates procedures and data into tightly structured entities that the industry now calls "objects." Though there are many benefits to this change in approach to software engineering, its most notable ad vantage is that it promotes the re-use of code. This is an enormous leap forward for the software industry, which has been historically characterized by the re-invention of almost every algorithmic wheel, ad nauseum. Now, in the Valhalla promised by object-oriented pro gramming, programmers build libraries of objects which can be passed on to both their colleagues and their heirs. Though the impact of ob ject-oriented programming is global to the entire software industry, it has a very specific advantage within th e multimedia industry: soft ware simulations are far more easily coded when using an object oriented approach. In fact, one of the original programming environments to enforce the various rules and constraints of object orientation was a language called "Simula," which was invented to aid in the creation of simulations by encouraging programmers to write pieces of encapsulated code (objects, of course) that simulate objects in the real world.

OCR: Stands for optical character recognition, which is conceptu ally one of the most attractive and efficient methods for converting printed text to machine -readable character codes. An optical charac ter reader scans a typewritten or printed document, stores it as a bit mapped image, and then converts the letter shapes based on some form of pattern recognition into Ascn codes. OCR is far from being a perfected technology, owing to the difficulties associated with pat tern matching against the broad range Å of font sizes and styles that make up our canon of printed materials. Hence, the typical functiona specification for an OCR device will include its average error rate.

Off line compression: Refers to an expensive, CPU-intensive form of compression that typically requires users to send their source video to a service that uses more

sophisticated and time-consuming algorithms than are typically tenable on a PC. Off-line

compression is the high-end, expensive part of the codec equation and is also de scribed

as an asymmetrical codec because it makes the compression side of handling digital video

much more time consuming and expen sive than the decompression side.
Offline editing: The first of two phases involved in video edit ing, the second being

online editing. During the off-line phase, the editor reviews footage, makes edit

decisions, prepares a rough cut, and compiles an EDL (edit decision lis   wt). As desktop

video produc tion approaches, many production houses today are relying entirely upon

PC-based video editing tools to carry them through the off-line phase.
Off line storage: A venerable form of mass data storage, off line is distinguished from

online and near-line storage in that it re quires human intervention to make its store of

contents accessible to users. By far, the most common form of off-line storage is

magnetic tape. Typically, these tapes are stored on racks, and when a particular tape is

needed, an operator retrieves and mounts the tape on a reader that is online to the

computer system. Obviously, off-line is impracti cal for any type of data needed on a

frequent or regular basis, and so is primarily used for archival storage.
OLE: Stands for Object Linking and Embedding and refers to Microsoft's utility for

Windows designed to make interapplicat   pion data transfer easy to manage. Put

succinctly, OLE is intended to enable different applications to communicate and share

information. In prac tice, this translates into the ability for users to construct

compound documents, because, for example, OLE makes it possible for a user to embed a

digital video movie in a word processor, without, of course, requiring that the word

processor have any native video capabilities. Briefly, OLE is designed to work in such a

way that it is up to one application (called the source document) to take the

responsibility for the overall structure of the compound document, while the other, con

tributing applications participate by owning sections of the structure. Once the user has created a link to, or has embedded something from another application, that user need only double-click on a particular section to invoke its parent applicat Âion.

Online editing: This is the second of two phases involved in video editing, the first being off-line editing. During the online phase, the EDL (edit decision list) is loaded into an editing system that con trols the playback and record decks and automatically assembles the final production by dubbing the video and audio sequences selected from the playback deck onto the record deck. For most broadcast quality productions, producers still rely upon the high-end equipment found only in traditional video production suites.

The day approaches, however, when even online editing is done using a PC.

Online storage: This is the most immediate form of long-term (permanent) storage. A file storage medium must meet two criteria to be considered "online." First, data must be processed directly from the medium; that is, it must be directly accessible to the computer's internal memory (RAM). Second, there should be no operator or user interven tion required to access the medium. In today's world, mag netic disk is still the most common type of online storage, owing to its relatively large capacity, and fast access and data transfer speeds. As multimedia continues to exert its voracious appetite for mass stor age, however, the hegemony of magnetic disk is increasingly threat ened by optical disc and magnetic tape, two forms of storage that can be configured as online media, though they both suffer from deci sively slower access and transfer speeds than those of magnetic disks.

OPAC: This acronym stands for Online PublicAccess Catalog, which is a part of our emerging information superhighway that provides a place where schools, libraries, media centers, and other institutions can hook up via modem to obtain information on current news, scan the contents of electronic encyclopedias, etc.

Optical fiber transmission: This term refers to the increas ingly critical technology that makes possible the rapid and relati Óvely distortion-free transmission of information through fine optical fi bers. With this transmission medium, digital data is transmitted as a series of on-off pulses of light representing bits of information.
Optical juke boxes: These are otherwise known as jllke boxes.

Optical memory: This general term is used to describe forms of storage that rely upon the fundamental of light, rather than magnet ics, to record and retrieve digital information. CD-ROM and laserdisc are the two most common forms of optical memory. This type of memory is known for its much greater capacity, a feat made pOssible by the use of high-precision laser beams; but suffers in reputation for its slow transfer rates and lack of writability.

Optical printer: From the world of film and video production, this is a machine that is a combination of a projector and a camera. Generally speaking, it is used to combine live action and animation and also to make fades, dissolves, and wipes. These devices are al

so capable of creating split screens, skipping frames and superimposing text on film, and rotating shots and creating multi-exposure scenes. Optical printers are the devices most responsible for creating all sorts of special effects in the analog video world. As we move toward an all digital world, however, the importance of these machines may eventually wane.

Optical storage: By all indications, optical storage may rapidly become the dominant storage medium of the era of multimedia tech nology. Optical discs offer two advantages over other forms of mass storage: they have large storage capacities; and they are removable, providing users with access to many discs per drive. Both of these advantages owe to the fact that optical storage devices use a laser instead of a mag ñnetic field

to make marks on the medium. Given the vast storage requirements demanded by multimedia

applications (video, audio, image), optical storage may grow in parallel with the

adoption of multimedia technology in general.
Orange Book: Related to the Red Book and Yellow Book stan dards for compact disc, this

term refers to the latest set of standards for how information is to be organized on

compact discs. The Orange Book defines the standards that enable the user to write audio

and/or data to the disc. There are two parts to this standard: 1) Compact Disc-Magneto

Optical (CD-MO), where data can be written, erased, and re-written, and 2) Compact

Disc-Write Once   8(CD-WO), where data can be written, but not erased.
Organic video effects: This emerging class of DVE (digital video effects) simulates

natural phenomena as a way of transitioning from one video shot or scene to the next.

Examples include breaking glass or pouring liquids.
OSI: Stands for Open Systems Interconnection and is the name given to the model defined

by the 150 (International Standards Organiza tion). This data communications model

contains seven layers used for comparing and defining computer network architectures. Its

pri mary purpose is to promote standards for data communications throughout the industry,

thereby making it easier for buyers to create their own optimal solutions even though

that strategy might lead them to buy from several different vendors.

Out of sync: This phrase is used to descr ðibe a sound track run ning either ahead of

or behind the picture.

Output devices: This general computer term refers to devices that draw, print,

photograph, or otherwise display the information generated by a computer.

Outtake: In film, this is a scene rejected by the director.

Packet: From the world of data communications, this term refers to a way of organizing

data for transmission in which the target data (the actual information that the user is

concerned with sending) is placed between header and trailer information. These headers and trailers identify key attributes of the enclosed, or "packetized" data, including the address of the packet's destination and its proper se quence relative to any other pa Cckets it must be re-combined with at the destination.

Packet switching: With respect to data communications, this form of transmission is favored for its flexibility when compared against its most common rival, circuit switching. Packet switching works by breaking data down into small chunks called packets. Be cause these packets contain addressing and sequencing information, they make it possible to break large files into relatively small units that can be routed across the network over different pathways de pending upon the ever-changing and shifting availability of band width. Thus, packet switching accommodates peak loads in one part of the network by re-routing packets over alternate pathways, or com binations of paths. Owing to the presence of seque ncing information in the packets, some packets can even arrive at the âir destination be fore their predecessors, because the intelligence of a packet switch ing system will simply re-sequence the packets into their original order before turning the data over for processing at that destination. Be cause of this flexibility, packet switching is a very popular way of handling data communications. However, when it comes to transmit ting the extremely large and time-sensitive files associated with digi tal video, packet switching is often untenable because the processing overhead and network irregularities associated with routing and re assembling the packets can cause disruptions in the video stream.

Paint systems: This is the generic name for computer art sys tems that produce bit-mapped graphic images. They generally are pixel-oriented, and the artist uses them to create pictures by setting pixels to specific color values. Most paint systems are driven by

äsome form or combination of pointing device (e.g., mouse, graphics tab let), and

provide, at a minimum, functions for changing brush size and shape, changing and merging

the colors provided by the systems standard palette, and cutting, pasting, and merging

one bit map with others. Paint systems are often held in contrast to draw sstems, which

are designed to manipulate structured graphics (also called vectorized graphics), which

are mathematically represented objects such as lines, boxes, circles, etc.
PAL: Stands for pha se alternating line and is the TV signal encoding counterpart to the

North American NTSC (National Television Stan dards Committee) standard. PAL is used in

Great Britain, most of Europe, Africa, Australia, South America, and China.
Palette: With reference to graphical user interface (GUI) design, a palette is a

collection of small symbols, usually enclosed in rectangl   es, which offers the user a

quick, visually cued method for switching between a host of related functions. The

symbols used to represent the various functions can be icons, patterns, characters, or

drawings that stand for their respective operations. This term is also used in its more

traditional sense with paint systems to refer to the particular mix of colors that are

available to the computer artists as they create a piece of computer art.
Pan: Short for panorama, this term refers both to a shot where the camera sweeps across a

given area, thereby giving the audience a panoramic view of the film subject; and to a

shot where, in contrast to a zoom, the camera pulls away from its subject, thereby

placing that subject in its larger social or natural context. As a form of cinematic

language, the pan is often used at the beginning or end of a major film segment to place

the subject against the larger backdrop of its setting. Increasingly, both fo   irms of

panning are becoming a part of desktop video systems, which means, of course, that they

can be achieved with regard to a particular visual subject by merely issuing a single

command.

Parallel processing: Perhaps the next generation in computer design, parallel processing refers to a form of processing where more than one processor is devoted to executing the same program simul taneously, or in parallel. Based on a half-century history of comput ing, we have come to think of the CPUÐthe brains of the computerÐas a single, serial processing device. Although this single

device has undergone a steady increase in size and speed, it is still a serial processor, which means it can only execute one instruction at a time. Rather than focusing on the throughput capacity of a serial pro cessor, advocates of parallel processing insist that a wiser direction for many applications is that of having many small processors work in parallel. With the huge file sizes and codec   processing require ments of digitized media, parallel processing seems ideally suited for many of the computing tasks associated with multimedia. In fact, many of today's chip developers are hard at work creating the next genera tion of chips for the multimedia era, and many of their efforts are focused at creating "on-chip parallelism," where groups of small pro cessors team up to do such inherently parallel tasks as decompressing a screen's pixel map of incoming

digital video.
Parallel protocols: This term describes the emerging standard for multimedia networking in which two network protocols co-exist on the same physical network. Historically speaking, there have al ways been the contention protocols, which handle the bursty traffic associated with traditional alphanumeric da   ta. More recently, and with the appearance of mixed media data types, there are the stream man agement protocols now associated with the large, continuously flow ing streams of data necessary to play

compressed digital video or other high-bandwidth audiovisual data types.
Parallel transmission: This term is used to refer to a mode of data transfer in which all eight bits of a byte are transmitted simulta neously over parallel communication lines

(such as the ribbon cable found inside many computers). This form of transmission is

typically held in contrast to serial transmission, where data are communicated over a

single communication line one bit at a time.

Parse: From the realm of so Dftware engineering, this term refers to the very common

practice of scanning a list or sequential file of un certain length, one character or

element at a time, to determine its contents. Thus, for example, the common word

processor accessories known as spell checkers typically work by parsing the text files

cre ated by users in an effort to seek out misspelled words.

Party-line games: This is a projected form of interactive game that will be played over a

network by two or more players.

PASTM: Stands for Performance Animation System, which is an object-oriented software

toolkit developed by SimGraphics that en ables developers to create real time

character-animation applications. It is a prototype authoring tool for creating digital

puppet applica tions.

Pass-through video: This term refers to a way of presenting video o yn a computer in

which the video signal is not handled by (or integrated with) the computers graphics

subsystem, but rather is sim ply passed through to the computer's monitor in its original

analog format. Pass-through video is the simplest form of computer-related video

technology.

Patch: With respect to wave table synthesis, which is the highest quality technology now

associated with MIDI (musical instrument digital interface) synthesizers, this term

refers to one of the individual sound recordings that occupy the synthesizer's table of

sounds. Most patches represent recordings of musical instruments, but, owing to the 1

28-patch size of the MPC (multimedia personal computer) stan dard, most wave tables

include noninstrumental sounds such as ap plause, gun shots, and such esoterica as the

"space voice" sound. The group of sounds that go into making up a particular wave tabl

åe are often referred to as that player's patch set.

Pattern recognition: This term refers to the recognition of shapes and patterns by

machine systems. As computing becomes in creasingly visual, this form of machine

intelligence will continue to take on a correspondingly heightened importance.

Ultimately, the com puter may be able to recognize individual faces, and thus be able to

recognize people by sight.

PBX: Stands for private branch exchange, a relatively high-end piece of communications

hardware designed to manage large numbers of telephonic connections, usually between the

denizens of a single of fice building and the rest of the world. This term has gained

renewed popularity, because the device that it describes is being used as an analogy for

data communications hardware that is now coming to market for use by cable operators to

offer movies-on-demand ser vices (hence, video PBX ø) to their residential clientele.

PCITM: This term stands for Peripheral Component Interconnect and represents an open

standard for local bus developed by Intel. Like other local bus technologies, PCI has

been developed to help elirnl nate the inevitable bottlenecks that occur on traditional

ISA bus per sonal computers when they attempt to move mixed media data typeS between the

computer and its peripherals.

PCX: This venerable graphics file format is a bitmap, or rasterfile format that was

originally the native format of the PC Paintbrush graphics development program.

Paintbrush is a program now owned by Microsoft, and it is still offered as a utility

program to all who purchase a license to MS-DOS or MS WindowsÐa fact which, of course,

accounts for its widespread use. Owing to both its age and its position in the mainstream

of desktop computing, the PCX format has been revised numerous times over the years Ñ

to keep pace with the continual enhancement of PC displays.

PDA: Stands for personal digital assistant and represents a broad class of handheld

devices that many critics believe represent the next logical progression of the personal

computing revolution. These de vices will rely heavily on wireless forms of transmission, and will certainly grow to increasing levels of multimedia capability as they evolve. The Apple Newton is one of the early examples of a PDA. They provide a form of data communications that is free from the spatial constraints of the computer or the telephone, enabling users to carry on data processing activities anywhere they happen to be.

Pen plotter: This is a type of electronic drawing, or "plotting," device that works by moving a robotic pen carriage over a recording surface (paper, for example). There are basic types of pen plotter: flatbed and drum.

Perceptual asymptotes: A term coined by the + French film theorist Andre Bazin, it refers to the process by which various media continue to improve and refine themselves in terms of the amount of information they deliver until they reach a point at which they exceed the human capacity to process that particular type of information, at which point there is no further need to improve the technology. The classic modern example of a perceptual asymptote has to do with CD audio, which, at a sampling rate of 44 MHz, has refined itself to the point that exceeds the capacity of the human ear to discern any fur ther enhancements. Long since gone, Bazin was a true visionary, fore seeing the general tendency for all media to continuously add capability.

Perfect sound: This term was coined in the world of audio engi neering to describe manufactured sound that cannot be distinguished from real sound, or copies of an original that cannot be distinguished from that original.

Performance animation: An outgrowth of res   μearch efforts in virtal reality, this term refers to a form of animation wherein the performance of the animated character is tied directly to the real time movements of an actual human. The technique relies upon human performers outfitted with special motion-tracking devices used to drive all of the animated character's movements and expressions, includ ing all of their mouth movements.

Performance support system: Though it has not quite earned the status of an acronym (PSS) yet, this term is gaining ground as a concept for how to electronically structure an organization's in formation and training resources. A PSS is a computer based system that provides on-thejob access to integrated information, advice, and learning experiences, thus improving worker productivity. Owing to their expansive goals, PSSs have numerous components, and, in fact, are starting to spawn their own vocabulary: they include advisory systems, hypermedia information bases, and libraries of tutorials and other Ù indexed learning experiences. The central dream of PSS is to offer embedded, or just-in-time training, giving workers just what they need, nothing more than they need, and all of this at precisely the moment they need it.

Performance tracking: From the world of educational soft ware, this term represents a concept that scales up from simple an swer analysis (the learner answered a questioned correctly, or not) all the way to complex systems that track performance over long periods of time and across broad spans of curricula. In most cases, perfor mance tracking is achieving by simply recording the learner's re sponses to various questions, and then by subjecting the accumulation of those responses (even if only to one question) to some form of analysis. With gaming software, tracking is a bit more in direct than it is in instructional situations, but basically operates by assessing, and then recording how well the user is responding to the game's central challenge. In many respects, the high end of performance tracking is akin to creating a database of someone's school transcripts and test results. The difference, though, is that by converting this, or any far reaching span of performance data, into a machine -readable format, it makes it possible for an instructional designer to build sophisti cated instructional systems that perform such tasks as strand man agement (where specific content, and styles of

presentation for treating that content, are matched to the user's diagnosed needs). This,

in turn, helps the designer deliver on the long-sought promise of individual
ized instruction courseware that analyzes learner need and prescribes instructional

sequences that are specifically suited to meet that need. In large measure, performance

tracking must be considered one of the frontiers of interactive multimedia and

instructional technology because it represents the vanguard of software engineering

efforts that seek to understand in considerable detail th   e needs of specific users.
Persistence: A term used frequently in the domain of object oriented programming, it

refers to the ability of objects to persist through multiple sessions; for example, if

data created during the run ning of a program does not last (persist) after the program

session is terminated, then that data does not possess the characteristic of per

sistence. In contrast, data that does survive between sessions is per sistent.
Persistence of vision: From the realm of human perception, this term refers to the

illusion of smooth, continuous motion that people experience when viewing animation or

video that is created when the sequence of frames is played back rapidly enough, and the

differ ences between individual images is small enough.
Pe   Ærsonal newspaper: Like personal television, this concept was developed at the Media

Lab, courtesy of its founder, Nicholas Negroponte. Now a popular concept for the next

interface paradigm (beyond the desktop metaphor, that is), the personal newspaper ex

ploits the familiarity of the newspaper to present information in head line-and-column

format that has been tailored to the individual's needs. As now conceived, the tailoring

will be done by agents, software programs that self-navigate the information superhighway

in search of information items that meet the needs and preferences of the indi vidual. In

its full-blown futureÐif that ever comes to pas   sÐthe con tents of the personal

newspaper will be multimedia, with the actual delivery medium for any given piece of

information being determined by which one is best suited for that particular piece. Thus, for an essay written by, say, TomWolfe, the delivery medium would be plain old text; for an item that reports some sort of natural disaster, any video footage that is available would naturally be employed, and would be shown in the type of window now used by the traditional newspa per for still images (aka, photos).

Personal television: A concept invented at the Media Lab, this is a future version of the television projected to operate by cull ing from public media sources just those items that are of personal interest to the viewer. The device will be programmed with än an individual's information and entertainment needs and preferences. It will possess a soft copy of one's media profile. This information will be used to scan the mass of public media sources to construct an individual's personal viewing menu.

Phase modulation: Is modulation in which the phase of an otherwise continuous carrier signal is modified (shifte d) based on the data value to be transmitted.

Phong shading: This is one of the high-end forms of polygon shading associated with computer generated graphics. Use of this tech nique can create extremely realistic computer images.

Phosphors: These are a class of substances that give off light when acted on either by radiation or by certain chemicals. The terrn is also used to describe the picture elements in most televisions, which use this technology for creating the visible picture that we see on our TV sets.

Photosensor: This device is capable of converting light energy to electrical energy. A common use of photosensors is to serve as the conversion mechanism that linksfiber optic transmission to comput ing devices.

Phototexturing: From the world of computer graphics, this so phisticated graphics technique is used extensively in DTM (digital terrain modeling) and works by draping real photos and satellite im agery over polgonal terrain data. It is heavily used for adding real ism to simulations that incorporate a substantial amount of terrain scenery.

Physics approximate simulation: Is a form of computer simulation wherein models of the

real world are created from a li brary of algorithms based on Newtonian Physics. The term

was coined by Marvin Minsky, considered one of the fathers of artificial intelli gence

and a visionary with respect to the future of technology.
Pick up: From the world of audio engineering, this term refers to one of the most common

and simplest of   w recording devices, an elec tromagnet that captures acoustic

vibrations and converts them to elec trical signals.
PICT: This is a standard bit-mapped graphic file format for theApPIe Macintosh.
Picturephone: Most communications experts believe that this term represents the next

phase in remote, point-to-point, human com munications. Early prototypes are appearing

that transmit quasi-video (very small screen sizes at very low frame rates).
Picture planes: In seeking to understand how multimedia ap plications manipulate the

screen, it is important to realize that most programs make use of a set of picture

planes, arranged one behind the other. Today's standard is four planes: At the frontmost

position is the cursor plane, a small area of up to 16 x 16 pixels that holds the cur

rent position of the cursor. Behind the cursor are two image planes, known, respectively,

as thefr   óontplane and back plane. These are the two most active and important planes,

are used for executing most DVE (digital video effects), particularly the large subclass

of digital effects known as two-plane effects. At the backmost, behind these two center

planes, is the lowermost plane, typically referred to as the backdrop, which usually

holds items such as screen background colors.
Pinna: This anatomical term refers to the soft, shell-like mass of skin that surrounds

the ear. Psychoacoustic research in the area of HRTF (head-related transfer functions)

has determined that the pinna plays a major role in the listener's perception of the

direction from which sounds are emanating. Consequently, efforts to digitally en code and

create 3-D sound have begun to take stock of this role, often referred to as the "pinna

effect."

PIP: Stands for picture-in-picture, a term that represents the migra tion of software

windows con   cepts from the realm of personal com puting to the world of television.

Simply put, PIP is the appearance on a television screen of more than one channel at a

time, a feat made possible by the creation of an on-screen window that overlays a por

tion of the current channel and plays host within its confines to a second channel.

Pistol grips: This is a new form of input device being employed in prototypical

interactive movie theaters whereby the interactive mov iegoer can vote on such issues as

plot outcome.

Pits and lans: For better or worse, the evolution of optical tech nology has ensured that

these two terms are bound together for all time. They describe the way in which binary

(digita information is encoded onto the surfaces of optical storage media. Simply, pits

are microscopic holes that are etched into the surface of an optical plat ter, while lans

are areas that remain flat because they are not so etched. These two surfaces r

ñepresent the binary data of the digital world be cause when a laser beam is shone off of

a pit it bounces back as a different reflectance value than when that same laser beam is

shone off of the flat surface that is a lan.

Pixel: This term was first coined to describe the smallest unit of a video screen and is

a contraction of the phrase "picture element With respect to video screens, the term

refers to the small dots which, when taken altogether, make up the visual image that

appears on the screen. The term's use has been recently expanded to describe the smallest

elements of any system that represents data in the form of 2-D arrays of visual

information (e.g., fax machines, copiers, laser printers). The term is typically used to

describe the resolution or im age quality of such devices (e.g., 480 x 640 pixels for

full VGA moni tors).

Pixel hold: From the world of DVE (digital video effects), this term refers to one   Üof

two types of effect that are known together as mosaic effects. Pixel hold works by

extending the color and tone (chrominance and luminance) from one pixel to its neighbors

in a process that continues until the screen appears to break up into a gath ering of

extremely coarse and hazy blocks.
Pixellation: One of the primary artifacts of digital forms of video, pixellation is the

mosaic-like effect obtained by zooming in on por tions of a bit-mapped image.
Pixel pusher: This is the insider term for a computer graphics artist.
Pixel repeat: From the world of DVE (digital video effects), this term refers to one of

two types of effect that are known together as mosaic effects. Pixel repeat works by

zooming in on a portion of the screen, but without providing the additional detail needed

to keep the on-screen image well focused. Thus, as the target portion of the screen

continues to be enlarged, the image its   elf appears to be getting coarser, or more out

of focus.
Pixel thinning: Is a technique for compressing an imageÐ thereby reducin g its bandwidth

requirementsÐ by systematically discarding certain classes of pixel.
Platform: Also referred to as "Delivery Platform," this term means the combination of

hardware and software components that are as sembled to deliver some sort of multimedia

application. Because the
industry is still so young, single devices that integrate all of the de vices in a way

that is transparent to the user have yet to appear. Thus, for most multimedia

applications it is still necessary to build a plat form by assembling components, such as

high resolution monitors, joysticks, and CD-ROM players. In time, most industry experts

be lieve that one or more single-device, integrated solutions will emerge. In fact, most

believe that the interactive television (ITV) will be just such a device. When the ITV

appears, we may no longer have   °to bother with this term.
Platform strategy: Owing to the volatility in the multimedia hardware and software

markets, most sane developers of multimedia applications undertake to devise a platform

strategy very early in their design process. This strategy will specify the platform, or

range of platforms, that the planned product will be able to run on.

Plug and play: High on the lexical scale of wish fulfillment, this term refers to the

notion that getting a PC peripheral to operate as advertised should demand no more effort

than that required to pull the device out of its box and plug it into the computer. As

most PC users would attest, this is hardly the case. Compatibility problems riddle the PC

industry, and often the most difficult part of acq Æuiring a new peripheralÐ say, a

laser printer, a CD-ROM player, or a scan nerÐ is just getting the thing to work in the

first place. To achieve the dream of plug-and-play, PC hardware and peripheral de vices

must be automatically configured by the operating system. The Macintosh environment has

typically been credited with doing a bet ter job of this than the PC (MS-DOS), a tendency

which owes to the stronger enforcement of software and interface standards that Apple can

enforce because it controls the manufacture of both the hardware and the operating

system. The lack of plug-and-play as an industry characteristic will be a nagging

obstacle to the Fevolution of the multi media market.

Plug in module: Often, well-constructed, or just plain popular software packages attract

further development from third party soft ware developers, who seize the opportunity to

enrich the target pack age by building some set of functions that that program is

missing. For example, a paint system that is well received and popular might, for some

unknown reason, be missing a good library of fi11 patterns (e.g., radial fills, gradient

fills, etc.). A smart third party software developer might take advantage of this

opportunity by filling that gap with a good library of fills, even before the original

software manu facturer does. When this occurs, the gap-filling piece of software is often

referred to as a "plug-in module," indicating that the customer can simply plug the

expanded functionality   ~ into the existing package without worrying about any

compatibility problems.
P LV: Stands for production-level video and refers to one of two stan dard video file

formats that comprise Intel's DVI (Digital Video Inter active) technology. PLV is a

high-quality format that relies upon an asymmetrical, interframe codec that, like the

MPEG (Motion Picture Experts Group) standard, demands a time-consuming and expensive

encoding process. PLV stands in contrast to RTV (real-time video) the inexpensive,

intraframe portion of the DVI codec canon.
Pointer: A widely used programming technique, a pointer is a state ment within a computer

program that "points" to the location of an other statement. Pointers are employed

abundantly in such data structures as VTOCs (volume tables of contents), where they are

used to point to the starting addresses of the files located on a particular storage d

Áevice. In hypermedia programs, the hyperlinks that connect one portion of the document

to another are, essentially, pointersÐ they point from the origin of the hyperlink to its

destination.
Pointing device: This computer input device enables the user to directly manipulate

objects on the screen. The mouse has been the standard graphical user interface (GUI)

pointing device, but trackball, graphic pen, and laser gun are all additional examples of

this increas ingly popular and important method of interacting with the computer.
Polhemus TrackerTM: This is one of the first, and still most popular, forms of magnetic

positioning systems developed for use with virtual reality (VR) systems. Created by

Polhemus Navigation Sciences of Colchester, Vermont, this device uses a form of magnetic

position sensing to enable virtual reality products to track the move ment and position

of VR users (cybernauts) as they move about within their virtual w   Îorlds.
Polygons: With reference to computer graphics, especially those at the high end where

virtual reality devices and CAD (computer aided design) applications dwell, this term

refers to a 2-D image segment manipulated in various ways (through shading, for example)

to make up images of 3-D objects. For example, a 3-D cube is made up of six flat squares.

Each one of these squares is a polygon. Obviously, the more polygons a particular image

uses, the more realistic it looks However, as is typical with the cost-benefit downside

of most com
puting applications, the more polygons one uses, the longer it takes to create the image.
Polyphony: With regard to MIDI (musical instrument digital in terface) synthesis (the

dominant sound technology of the MPC [mul timedia personal computer] standard), this term

refers to the number of individual notes that a particular player is capable of playing

si multaneously. Often referred to as the number of voices (e.g., 24 voice polyp   Þ

hony), the larger the polyphony, obviously, the richer the sound.
Portability: Used frequently in the field of software engineering, this term refers to a

desirable feature of software systems wherewith the system can be easily migrated, or

"ported," from one platform to another. This feature is desirable because it eliminates

or reduces the considerable expense associated with re-programming products to run on

every popular platform in the market. The widely acclaimed move to object-oriented

programming is at least partly motivated by this programming discipline's ability to

accommodate the feature of port ability.
Position tracking: Refers to a family of technologies being de veloped under the banner

of virtual reality (VR) to keep track of the positions and orientations of users as they

interact with the VR sys tem. These technologies include techniques that make use of

mechani cal, ultrasonic, magnetic, optical, and/or image extraction sensors.
Postchannel world: This term descr   úibes the belief that in the near-future our TV

networks will be comprised of so many chan nelsÐ will be capable of carrying so much video

bandwidthÐ that the concept of an individual TV broadcast channel will become obso lete.

Rather than being subject to the constraints of a viewing sched ule prescribed for them

by distant network executives, the viewing public will be afforded the luxury of viewing

whatever they want, whenever they want it.
Post production: In the traditional world of film and video pro duction, this term refers

to that phase of the product development cycle that covers all of the manipulation of the

video after it has been produced or shot. Thus, this large segment of the development

cycle covers all of the editing and the addition of all special audio and video effects

(for example, DVE [digital video effects] such as the fades and dissolves that appear

between, and link scenes). It is a common say áing in the film industry that all of the

filmmaking activity that occurs in advance of post-production is as nothing more than the

making of raw clay, and that the real artistic shaping of the film oc curs during that

post-production phase. Up until now, the post-pro duction phase of filmmaking has

required the use of relatively expensive facilities and equipment, usually located in

what are called "post-houses." The current flood of all-digital, desktop video produc

tion tools is all but threatening to cannibalize the post-production in dustry by making

the most sophisticated forms of editing and DVE available to artists at a fraction of the

costs associated with traditional analog facilities.
PostScriptTM: A page-description language that serves much the same role for documents

that MIDI (musical instrument digital inter face) serves for music. PostScript was

developed by Adobe Systems and has now become the def òacto standard for page

description lan guages. The value that it brings to the market is that it is a type of

display list placed in a certain format that PostScript-compatible print ers, regardless

of brand, can read. By instructing the printer through code where to place its ink, a

printer can recreate any image, and any font without having the font loaded into memory.
Post symbolic communications: This phrase, originated by virtual reality visionary Jaron

Lanier, describes a near-future form of communication in which the maturation of the

various technolo gies surrounding virtual reality will make it possible for communi

cating parties to share ideas with one another, not so much by talking about the world,

but rather by manipulating objects in a shared virtual world. Lanier also refers to this

form of communication as "reality conversations."
POTS: Stands for plain old telephone service, still the   backbone of the modern

communications system.
POV: Stands for point of view, a term that describes the vantage point from which an act

of communication is witnessed or perceived. Thus, in a film, POV typically refers to the

positioning of the camera relative to the subjects being filmed. With literature, POV may

mean much the same thing as it does with regard to film; that is, the physi cal vantage

point from where the reader should imagine seeing a scene But the term may also refer to

a more abstract notion, such as a par ticular political point of view. However, when used

as its acronym the term usually refers to the physical vantage point for viewing a scene

or situation. POV has always been one of the fundamental ar
tistic considerations in building a piece of video or film. This lofty status should not

changeÐin fact, it may actually grow in promi nenceÐas we enter the era of interactive

forms of entertainment.
PowerPCTM: This term refers   to a multi-vendor family of desktop computing products

introduced in 1994. Based upon a RISC (reduced instruction set computing) processor

designed by IBM and fabricated by Motorola, and on an operating system developed by

Apple, the PowerPC is intended to provide significant competition against the long

domination of the personal computer market by machines based on the Intel 80 x 86

processors. Because the RISC architecture has been responsible in the early nineties for

some of the more powerful graphics workstations, the PowerPC's primary allure is its

facilita tion of multimedia applications.
Prediction: In the world of video codecs, this term refers to a form of motion

compensation in which aframe is constructed during decompression from the difference

information between the Ï original frame (determined during the compression process)

and the preced ing key frame.

Preference tracking: A close cousin to performance track ing, this concept drives

software engineering efforts to create pro grams that understand the emotional

preferences of the user. Examples of this might include programs that monitor preferences

for style of TV programming (e.g., westerns vs. whodunits, violent vs. nonvio lent

programming), purchasing preferences, social styles, etc. The pur pose for tracking

preference is, of course, to then use that data to match system resources to the needs of

the user. In the emergent phe nomenon of home interactive media, preference tracking will

serve as an enabling technology used to ihelp deliver on the promise of per sonal

televisionÐ smart TV that knows the user's likes and dislikes and uses that information to

build individualized evenings of enter tainment.

Pre-production: In the world of film and video, this term refers to that part of the

development phase that lies in between the comple tion of the scripts and the

commencement of the video shoot (also called production). Once a script is approved for

production, the de velopment team must first perform a number of preparatory func tions

before launching into the very expensive process of shooting the field footage. They

must, for example, break out the scripts, iden tifying the characters, the props, the

sets, and the locations. Then, if locations are to be involved in the shoot, they must

scout for the best site(s). Als o, they must conduct casting sessions, select the cast,

and perf øorm a large number of tasks associated with estimating and con trolling the

budget. En toto, these preparatory activities are referred to as "pre-production."

Because most multimedia budgets are still quite constrained when compared against those

that are available for the typical film project, much of the video placed in multimedia

titles is actually stock footage, rather than originally produced video. This course of

action eliminates the labor intensive and costly activities required by the

pre-production and production phases.

Problembased learning: From the realm of instructional de sign, this term describes an

emerging school of thought that says that people learn best, not by deliberately studying

educational materials, but by applying concepts and skills to the task of solving

specific problems. This premise has major consequences for how the com puter is employed

as a teaching tool. The dominant, ear Äly model of computer based instruction has been

the study, or drill and practice, model. During the late eighties and early nineties,

schools spent con siderable funds on integrated learning systems, which are dominated by

the drill and practice model of instruction. The reliance on this model reflects, not so

much a deep-seated belief that the study model of instruction is the secret to effective

pedagogy, but rather a capitu lation to the relatively easy nature of programming drill

and practice progr ams, which amounts to little more than programming a succes sion of

multiple choice style questions. Advocates of the problem based approach to learning

oppose the extensive use of integrated learning systems and are promoting a move to

problem-solving, game oriented programs that go much further in terms of engaging the

learner. Educational software is likely to move in this direction in the near fu °ture,

and away from the drill and practice paradigm.

Procedural knowledge: From the world of artificial intelli gence, this is the form of

machine knowledge responsible for model ing the sequence and nature of task completion.

This form of machine knowledge draws heavily upon, but is independent from, declarative

knowledge.

Proclamation 66: Considered a landmark case in the history of educational technology,

this legislative act by the state of Texas has made it possible for Texas school

districts to purchase instructiona multimedia products with funds that hitherto were

limited to the ac
quisition of standard textbooks. To many, this act represents a break through in thinking

about what constitutes a "textbook."
Production: In the world of film and video, this term refers to that most exciting of

phases in the development process during which the director says "lights, camera,

action." It is the phase that lies be tw   een pre-production and post-production, and

it is the penultimate act of film creation in which the actors and crew are assembled,

and the original field footage is shot.
Production chart: With reference to the production of a film/ video/animation, this is a

form that shows the status of every scene in the picture during the various stages of

production.
Progressive scanning: The standard form of scanning for today's television is termed

interlaced scanning, which means that it takes two complete passes of a TV's CRT (cathode

ray tube) electron gun to paint a single image on the screen. When a single screen image

of NTSC (National Television Standards Committee)-quality TV is transmitted, it is

actually transmitted in two separate frames, each one containing ev   õery other line of

the 525 scan lines that make up a television image. Thus, one frame will contain all odd

scan lines (1, 3, 5, etc.), while the verj next frame contains the even lines (2, 4, 6,

etc.). This interlaced method is motivated by the need to conserve bandwidth. Progressive

scanning is the more natural, but much more bandwidth-intensive technique whereby one

frame equals one screen image. It is called progressive scanning because each scan line

is fol lowed, not by its next odd or even cohort, but rather by its next, and closest

relative. Thus, scan line 1 is followed by scan line 2, which is followed by scan line 3,

etc. One of the competitors for the HDTV (high definition television) standard is recommending a progress live scanning method of transmission. This form of scanning eliminates many of the typical artifacts of normal TV broadcasts, such as inter line flicker and certain distortions associated with rapidly moving objects. The penalty, of course, is that with progressive scanning, a transmitted image in the video stream requires twice as much band width as is required by an interlaced image.

Project Jedi: This is a project being undertaken by Lucasfilm with the goal of changing the way that movies get made. The primary intent of the project is to convert from a process that, historically, has relied entirely upon analog technologies, to a process that relies en tirely on digital technologies. It is believed that the outcome of such a conversion will make possible unprecedented levels of ability to ma nipulate the visual image for artistic purposes.

Prototype community: e The costs of software development tends to be high. So too are the costs of creating high-quality media When you combine the twoÐwhich is exactly what you do when you build interactive multimediaÐ the costs can be very high. Thus, it behooves multimedia application and hypermedia application de velopers to create early prototypes of their programs, and to test them on at least one representative sample of their target market. This is no easy chore, because it involves organizing a willing and qualified community of users (viewers, gamers, or whatever). When such a community is organized, the organization who did the organizing tends to view them as a considerable asset and seeks to use them for exten sive testing, perhaps of more than one product or system. The term "prototype community" is now being used to describe this commu nity of users upon which prot otypes are tested.

Psychoacoustics: From the increasingly prevalent world of 3 D audio, this term refers to an academic discipline that concerns itself with the human perception and interpretation

of sound. Most of the recent advances in the digital encoding of HRTF (head-related trans

fer functions) have grown out of research in this field.

Public domain: Any item of electronic content (media or soft ware) that is free of any

copyright, trademark or patent restrictions is said to be "public domain." In the coming

age of multimedia, where so much of our information will be assembled from myriad, and

pre viously unrelated sources (e.g., from stock footage, clipmedia, etc.), the need and

demand for sources of public domain content will be intense.

Public switched telephone network: Also commonly referred to by its acronym, PSTN, this

term refers to the massive tele phone infrastructure to which everyone has common access

rights. W Îhen someone wants to send information over a channel that is not private,

they must access and use the PSTN. Thus, if someone is us ing a L AN (local area

network), or a direct private line, they are not using the PSTN. But in almost every

other conceivable case in which communications is occurring between geographically

separate enti ties, they are making use of the public switched telephone network.

Pulse code modulation (PCM): PCM is done by sampling a waveform at a constant rate

(sampling rate) of thousands of timeS

per second to convert analog audio to digital audio. The minimum standard MPC (multimedia

personal computer) samples sound at 11,025Hz with 8 bits per sample, and plays back

waveform audio at 22,050Hz with 8 bits per sample. The sampling rate needs to be double

the highest frequency of the sampled sound to produce the "Nyquest" frequency sound

standard.

Purging: In traditional data processing, this term refers to the very necessary process

whereby fi Þles that have outlived their usefulness are removedÐare purgedÐfrom the

system's storage devices. Purg ing can be accomplished through either manual or automated

proce dures. Most automated procedures base their decision to purge a particular file or

piece on information on the criterion of lack of use. In other words, if a file has not

been accessed for a pre-determined period of time, it is judged by the system to no

longer be of use, and it is therefore eliminated from the system. In the era of

multimedia, where file sizes are going to mushroom in order to handle the mixed media

data types, the need to purge files in a logical and consistent way is apt to grow in

importance.

Px64: This is a popular videoconferencing standard developed by the CC17T (Consultative

Committee on International Telephone and Telegraph). It is primarily a codec

(compression-decompression) stan dard, and facilitates the transmission of audio and

video data over copper or fiber channels.

QHY: Stands for qua Ûntized high-resolution Y, a term that refers to a technique that

elaborates on the DYUV (delta luminance color differ ence) compression scheme. QHY works

by enhancing the luminance (or Y) signals of the image and interpolating it between the

chromi nance and luminance values already stored as a DYW image. Wher ever luminance

varies greatly between two DYUV pixel values, QHY interpolates a correct value to achieve

the effect of a sharper image.

Quantization: In the process of ADC (analog-to-digital conver sion), quantization is the

step that immediately follows sampling and is responsible for providing digital media

with the binary-encoded numeric values that capture some or most of the properties of the

original sensory signal.

Quasi video: As computing makes the painful transition from the alphanumeric forms of

data to the higher bandwidth versions of dataÐ audio, image, and especially videoÐit is

being forced to render these presentational media in a compromised format. With regard t

¦ o video, which has the highest bandwidth of the three, there have been three basic

avenues of compromise. The first has to do with screenh scre geogra phy. Since all forms

of digitized visuals are translated into a pixel format, and since each pixel represents

some amount of memory re quirementÐ the basic element of size, insofar as the computer is

con cernedÐ the size and corresponding memory requirement of a piece of digital video is

directly proportional to the amount of screen space it is projected on. Thus, many

digital video applications are limited to a certain size window, so as to control the

overall amount of computer data that must be moved through the system to create the

motion pic ture. The second area of compromise has to do with resolution, i.e., with the

number of pixels that must be represented to display a given image. Obviously, the lower

the resolution, the smaller the amount of data that must be employed to represent the

image. Thus, lowering t he resolution is another way of lowering the memory and

processing requirements associated with displaying video. Finally, the third fac
tor of compromise has to do with how many frames per second (fps) are used to represent

the motion picture. For television, the standard is 30 fps. In the first half of the

'90s, however, most makers of video hardware and software still find this frame rate to

be a bit daunting. As a result, many "video files" are stored and played back at lower

frame rates, the most common hovering in the 10-15 fps range. Taken together, these three

compromises represent what many in the multi media industry are referring to as the

"quasi-video" of computing. It is important to note that, with time and the inexorable

advance of hardware and software, the c ¥ompromises of quasi-video will likely go away

(and with it, the term).
Queue: In the computer world, this term refers to a group of items waiting to be acted

upon by the computer. The arrangement of items determines the processing priority.
QuickDrawTM: Introduced with the initial Apple Msh in 1984, this is Apple's library of

software tools for developing static graphics. It made the PICT file format an industry

standard for graph ics files.
QuickRingTM: The local bus standard for Apple Macintosh, it is capable of moving up to

350 MBps, making it one of the fastest local bus standards in the industry.

QuickTimeTM: Introduced in 1991, this is Apple's library of sys tem software tools fo

Mr creating time-based dataÐaudio, animation, and motion picture. At the heart of

QuickTime, as with any motion enabling software, is a codec (responsible for data

compression-de compression), and so it seems inevitable that QuickTime will be compared

against DVI (Digital Video Interactive), MPEG (Motion Picture Experts Group), and other

codecs. QuickTime has three ma jor components: The MovieToolbox, which makes it possible

to play, edit, and otherwise manipulate the time-based data; The Image Com pression

Manager, which is the high level interface to QuickTime's codec; and the Component

Manager, which is largely responsible for interfacing QuickTime resources to external

system resources.
Radial fill: From the world of computer paint systems, this terrn refers to a type of

fill in which a pattern is projected from a center outward   øin all directions.
Radio button: An interface element common to graphical user interfaces (GUIs) based on

the desktop metaphor, radio buttons are typically placed in groups of three or more.

Their principal distinc tion as a mode of selecting program functions is that they are

mutu ally exclusive: you can only select one of them. Their name derives from the obvious

metaphor with the dials on a radio.
RAID: Stands for redundant arrays of inexpensive disks and repre sents the latest

incarnation of magnetic disk storage. This new form is gathering wide appeal among

multimedia developers because it of fers much higher capacities than traditional magnetic

storage, and yet offers the far greater data transfer speeds that have always character

ized magnetic as compared to optical disc (e.g., CD-ROM). Through a process called file

striping, this form of storage also provides the desirable feature of redundancy, wher

¥ewith the failure of one disk in the array does not cause any loss of data because each

file is dupli cated on the other disks in the array.

Random access: Of longstanding importance as a central con cept in data processing, this term is often defined in terms of its oppo site: sequential access. With information that is stored on a sequential access device, access times are typically longer because one has to pass over everything that intervenes to access the desired inforrna tion. Tape storage is the classic example of a sequential access de vice. If you are at the end of a tapeÐ one of your VHS tapes, for exampleÐ and want to access something near the beginning, then you must rewind the tape, searching all the while, until you get all the way to the front of the tape to reach the information you want. In contrast, random access means that you can access any single piece of information as easily as any other piece of information, regardless of w where any of it is stored on the medium. Disk storage is considered
the classic example of a random access device. This random access capability is made possible by the use of directories, which enable read heads to find out the address of the desired information, and then move directly to that location.

Raster file: As opposed to a vectorfile, a raster file is an image file generated either by using a paint program or by scanning an im age. A raster file is stored in the form of a bit map. This is literally a "map," or two-dimensional array, of the display image containing the location of each pixel and its representative grayscale or color char acteristics. Raster images are noted for their brilliant colors and high resolution, but also for their unwieldy size and resistance to flexible manipulation (e.g., resizing). Vector files, in contrast, are generated by draw prog   hrams and are laid out on the basis of mathematical equa tions, or "vectors."

Raster image processor: Providing the bridge from elec tronic content (e.g., ASCII data) to image (e.g., bit map), this device transforms the encoded representation of a character into the desired pattern of pixel marks so that it may be laid down on paper.

The qual ity goal of a raster image processor is to take the encoded character and

transform it into a pixel pattern that captures that character's typefont, style, size,

and orientation as accurately as possible.

Raster to vector conversion: In the workaday world of mul timedia applications, there is

frequent need to convert image files from one format to another. Raster-to-vector

conversion is one of the most difficult of these conversions, demanding a great deal of

the conversion software. This process requires the software to » detect the presence of

geometric shapes in a bit-mapped image, and then con vert those shapes to vectorized or

mathematical representations. Typi cally, this is done with a trace function that

literally traces and redraws the image with mathematical vectors of the lines, shapes,

and objects that make up the image.

Ray tracing: This technique is used for creating realistic com puter images by tracing

rays from viewpoint to light source, which is, of course, the reverse of light rays. In

other words, this technique traces the path of light as it bounces off of reflective

surfaces. It cal culates both hidden surfaces and shading. However, it tends to be

CPU-intensive, requiring a relatively lengthy processing time for each image that is

generated. The high cost in terms of CPU cycles is, however, offset by the high value

that ray tracing provides to a graphical image. It is a technique that is used primarily

to give computer gener   ated images a very realistic and subtle sense of lighting.

RBOC: Stands for Regional Bell Operating Company, a type of cor porate entity that was

established as a result of the 1984 anti-trust suit that broke up the AT&T Bell System.

There are seven RBOCs, or "baby bells" as they are sometimes called: Ameritech, Bell

Atlantic, BellSouth, Nynex, Pacific Telesis, Southwestern Bell, and US West. The

legislation that broke up the system prohibits the RBOCs from providing video services

into their local market areas, but these re strictions are under severe legislative

scrutiny and may be lifted at almost any time. In any event, the RBOCs are busy at the

work of forming alliances with CA7V (cable) operators, and are expected to become major

providers of multimedia services as we enter the Age of Interactivity.
RDS: Stands for radio data system, an innovation recently imported from Europe to the

United States that offers interactive services to radio Ï listeners through an FM

subcarrier channel. Haled as the first major innovation in radio technology since the

introduction of the FM signal in 1961, RDS will offer services such as a small screen to

display printed information like the station's call letters, the name of a song and its

artist, traffic and weather bulletins, and possibly even advertising. Additional features

will include the ability to search the dial by format, rather than by station; a

hand-offfunction for cross country drivers that automatically switches to a stronger

station for a broadcast being aired nationally (e.g., National Public Radio); and, the

ability to automatically interrupt any station with an emergency announcement, such as a

weather warning.
Real time: This refers to an operating mode for computers under which data are received

and processed, and the results returned so fast, that the process appears instantaneous

to the user. Real-time modes are usually described in contrast to batc ¿h systems,

where data are accumulated over time, and then submitted for processing all at once,

often during late night hours when the real-time processing load placed on the computer

system has diminished. As more and more of the processing load moves to managing the user

interface in concert with the rise of multimedia applications, the pressure will grow on

hardware/software to provide systems that feature real-time perfor mance.
Rear projection: A form of projection system that has grown very popular in corporate

America, rear-projection provides for sig nificantly larger display areas than are

feasible with conventional video monitors. Rear-projection works by reflecting the video

image off of a mirror which stands behind a special screen onto which the image is cast.

The use of this type of system for marketing and other corporate presentations has done a

great deal to foster the speaker-support seg ment of the mult Ëimedia industry.
Recognizer: From the world of OCR (optical character recogni tion), this term refers to a

process that is the opposite of rasterizing. The recognizer takes thepixel image pattern

of a character on a docu ment, identifies the particular character that it represents,

and then assigns it the appropriate computer code. In the PC domain, a recognizer

converts a character stamped on a paper document into its appropriate ASCII code.
Red Book: This term refers to the original compact disc format standard established by

Philips and Sony for digital audio, also known as CD-DA (Compact DiscÐ Digital Audio).

When one buys a music CD at a retail center, a sure bet is that the disc has been pressed

in accordance with the Red Book standard.
Redlining level: In the world of digital audio, this term refers to the amplitude of the

loudest sound that a digital system is capable of expressing. For an audio engineer, the

trick is to keep all events in the sound track Ábeneath the redlining level of the

digital system that is being used.
Refresh rate: This is the rate at which the electron beam of an RGB (red, green, blue)

monitor scans the screen, thereby restoring (refreshing) the image. Most computer

displaysÐ and TVs under the NTSC (NationalTelevision Standards Committee) standardÐ

refresh the screen every l/60th of a second.
Remediation: From the field of learning theory, and more re cently, from instructional

design, this term refers to a teaching strat egy that seeks to address learning

deficiencies directly, rather than working on learning strengths. With the various forms

of computer based learning (e.g., CAI [computer aided instruction], CBT [com puter based

training], educational software, etc.), remediation is of ten used in direct response to

an incorrect answer to a question.

Render: One of the most CPU-intensive of all computer processes, rendering is the

penultimate phase in the cr   +eation of 3-D graphics and animation. Prior to rendering,

a graphics artist will create a 3-D model, which is, in essence, a wireframe

representation of the graphical ob ject (a chalice, for example). Once this model has all

of the shape and size attributes the artist wishes, the rendering process will be

launched This process involves removing all of the jagged edges and hidden surfaces,

followed by adding all of the object's shading attributes, such as texture and depth.

Rendering is becoming an increasingly sophisticated aspect of multimedia production, and,

along with the compression of motion pictures, represents one the strongest forces

pushing chip manufacturers to build faster processors.

Rendering engines: Are hardware/software systems powerful enough to generate

illusion-sustaining landscapes, buildings, etc. An example of a rendering engine would be

DTM (digital terrain model ing). The future of rendering engines is clear: they will play

a rol   6e as one of the key automata involved in the creation of realistic settings for

virtual reality and interactive fiction products.

Re recording: With regard to filmmaking, this term refers to one of the penultimate

phases of post-production, where the final sound track is "re-recorded" from its various

components, which were ei ther separated from one another at an earlier time so that they

might receive individualized attention (e.g., the various voice tracks in a dialogue), or

were recorded separately in the first place (e.g., the film's musical components). During

this final mix, many things are done to perfect the audio track, such as balancing

volumes, adjusting the pitch of the voices or sounds (treble/bass balance), and perhaps

adding some special effects (e.g., a telephone filter, which, obviously, makes a voice

sound as if it is being heard over a telephone). As with so many as pects of media

production, thi   s process has a great deal to benefit from the digitization process, because it leads to the ability to ana lyze, separate, and recombine sounds, all on the same platform, and all without the traditional concern for handling many different types of physical media. The maturation of such technologies as MIDI (mu sical instrument digital interface) and DSP (digital signal processing) ensures that the process of re-recording will soon be done entirely within the domain of a computerized system.

Resample: This process is undertaken to adjust the resolution of a digital image to match the capabilities of the current hardware plat form. Resampling down discardspixel information in an image. Con versely, resampling up adds pixel information through interpolation

Resolution: In its most general sense, this term refers to the fine ness of the detail represented by any form of mediaÐ audio, image, video, or even such exotic forms of media as tactile feedbac   k. The most common use of the term today occurs with regard to the images shown on a video or computer display, where they are measured as a number of discrete elements per areaÐ for example, pixels per square inch. The higher the number, the better the resolution and the higher the quality of the image.

Resolution independence: This term refers to a highly de sirable capability for computers to be able to output mediaÐ audio, image, videoÐ at any resolution, regardless even of the resolution at which the original media was captured ordigitized. This term is nearly synonymous with scalability.

Retinal imaging: One of the more futuristic of new media de vices being contemplated today, this technology represents the art of painting an image directly onto the retina of the eye. One stra   - tegy for doing this is for the computer to steer a low -powered laser beam around the retina, thereby activating rods and cones in the desired patterns and intensities.

Reverb: Short for "reverberation," this audio engineering term re fers to the natural

echo that accompanies almost every sound as it bounces off of natural objects in the listener's environment. Because sound recordings that lack reverb are perceived as thin and unnatural, much effort is made by audio engineers to add this dimension to their finished work.

RGB: Stands for red, green, blue and represents the most widely used representation of video images, wherein the constituent pixels are defined by their respective red, green, and blue c .olor components.

RIPTM: Stands for Remote Imaging Protocol, a standard for trans mitting computer generated, mixed media data types over the televi sion transmission infrastructure. It is created by TeleGrafix of Huntington Beach, California, and is intended to replace the longstanding NAPLPS (North American Presentation Level Protocol Standard) by making it possible for online services to transmit a much more media -rich form of content.

RLE: Stands for run length encoding and refers to a commonly used strategy for compressing data, especially data with black-and-white images, like those associated with paper documents. RLE works by counting the number of consecutive pixels that have the same visual valueÐsuch as occurs with the proportionally large white spaces in most documentsÐand then stores only   qthe location and "count" of these consecutive pixels. This is in contrast to bit -map images, which supply the numeric, or digitized, value of each and every pixel in the image. It is important to note, however, that many RLE algorithms start with bit maps as their primary source of input, and then "com press them down" by parsing, counting, and then saving all of the segments in the bit map that possess consecutive pixels with the same digital characteristics.

Rolling demo: From the world of multimedia applications, this type of hypermedia application is used almost exclusively in market ing situations, such as show or retail floor exhibits. With rolling demos, a sequence of screens/video segments is programmed to

flow from one screen/segment to another with little or no need for human inter vention.

These demos are typically used to display key product char acteristi Ács and features.

Their primary benefit is, of course, that they do not require the expensive services of a

salesperson, and so can be left unattended at shows or in stores. Most rolling demos

provide a feature that enables users to break out of the pre-programmed se quence, and

take direct control of the program's media assets.

Room tone: From the world of audio production for film and video, room tone represents

the natural sound of any location (e.g., the low buzz and china-clinking of a restaurant

crowd, the machine murmur of outside traffic). Room tone is used instead of blank film or

tape for spaces in between sound takes, because every location has a sound, whereas film

and tape do not. In the age of multimedia tech nology, an abundance of audio clip media

is becoming available to provide a libr ary of such sounds to video producers.

Rotoscope: In the world of feature animations, this is a machine made to project filmed

images f Ãrame by frame onto the surface of a drawing board. The image is traced onto

animation paper and used by the animator to achieve lifelike movement. In a sense,

rotoscoping is a form of data capture for animation.

Rough cut: From the world of filmmaking, this term refers to one of the first phases of

the post-production process wherein the direc tor/editor team put together their first

pass at building the finished movie. They do this by sequencing together an initial

selection of takes and shots from the production phase. Depending upon many factorsÐe.g.,

the skill of the director as reflected in his choices dur
ing productionÐthe rough cut will be either close, or rather distant from what the

finished film will look like. Many of the more sophis ticated electronic video editing

products, such as Adobe's Premiere, make it possible for film developers to prepare their

rough cuts en tirely in a digital format. This means that, rather than coping with the

Ð problems associated with a potentially large and cumbersome num ber of sequential access video tapes, the editing crew can work en tirely in random access or nonlinear mode. Of course, this also assumes the presence of some rather large storage devices, including a sizable volume of erasable media.

RTF: Stands for rich text format, a Microsoft file formatting stan dard that grew out of the Microsoft Windows software developer's kit. It was designed to enable software developers to create help files to accompany their software. Specifically, RTF enables developers to embed elements of document structure, such as table of contents, in dex entries, hyperlinks, etc. Many popular word processing packages now support the RTF standard.

RTOS: Stands for real-time operating system and refers to operat ing system(s), or OS components, that operate quickly and efficiently enough to manage direct user interaction. With the increasing move ment of computer applications int o the workaday world of noncomputer professionals, and with the addition of high bandwidth (media) data types, the demands placed on operating systems to man age high volumes of information in real time will continue to grow. CD-RTOS, the operating system of Philips' CD-I standard for home interactive media, provides a good example.

RTV: Stands for real-time video, and refers to one of the two stan dard file formats that make up Intel DVI (Digital Video Interactive) technology. RTV is an inexpensive, intraframe codec in which both compression and decompression can be executed on the fly and stands in contrast to PLV (production-level video), the more expensive, interframe portion of the DVI codec canon.

Rubberbanding: In this line-drawing technique, an "elastic" line is extended from one or more point(s) to wherever the screen cursor is located. This feature is used with many paint systems to enable an easy and flexible way for artists to re-shape objects.

Sample rate + converters: Because there are now so many forms and modes and standards

for digitizing the various media (au dio, image, video, etc.), there is often a need to convert a signal from one sampling rate to another. Sample rate converters perform this function, and therefore can be said to be part-in-parcel of a scalable architecture. The need for sample rate conversion commonly arises when transferring a digitized signal from one system to another. For example, an audio signal recorded at 48 kHz on a professional digital tape deck may have to be converted to 44.1 kHz for storage on a CD. Another obvious example has to do with digital telephone systems where, in order to carry the low-quality 8 kHz standard of the public switched telephone network, (PSTN) digital audio from almost any other digital source must be down-converted.

Sampling: The first step in any form of DSP (digital signal pro cessing), this process is responsible for converting   the continuous, analog forms of signal known in the real world of nature to the dis crete-time, binary forms of signal employed in the world of digital computing. In the process of ADC (analog-to-digital conversion), sam pling precedes the step known as quantization, whereby the discrete time signal obtained by sampling an analog signal is converted to a binary-encoded numerical value that captures some or most of the natural signal's properties.

Sampling rate: This refers to the number of times per second that digitizing circuitry measures an analog signal to produce a digi tal value. With regard to digitizing various sources of media, this criti cal variable is virtually synonymous with quality, because it expresses the resolution at whichADC (analog-to-digital conversion) takes place. The higher the sampling rate, the finer the quality of the digitized media.

Saturation: A technical characteristic of color, saturation refers to   } the purity of a color. Rich, intense colors are thus said to be highly saturated, while dull or diluted colors are characterized as not being very saturated.

For example, pink is a low-saturation red.

SBCELP: This acronym stands for an emerging standard in voice coding. The SB is short for

Lernout & Hauspie Speech Products of Belgium, the firm responsible for developing the coding technique; while the CELP stands for code -excited linear prediction, an acro nym that captures the essence of the technique's algorithmic makeup. SBCELP is routinely capable of creating voice compression ratios in the range of 30-to-1, and possesses a codec that requires about 12 MIPS (millions of instructions per second) of computational power for compressing the voice signal, and about 1.5 MIPS for decom pressing the same signal. Numerous low cost DSPs (digital signal processors) are now available t bhat can perform these codec tasks.

SCADA: Stands for system control and data acquisition and repre sents one of the emerging, large scale applications for multimedia technology. SCADA centers look like the War Room at the Pentagon. They feature large video displays and are connected to the world by abundantly equipped broadband communications facilities. Geo graphic Information Systems (GIS) that present real time sources of data on br ightly colored maps are perhaps the most common form of enabling technology used in conjunction with SCADA. Picture this: a fast food mogul stands before a GIS displaying real-time sales data and joyfully shrieks at the realization that there is a flurry of cheese burger sales in Delaware.

Sca labi I ity: A term of increasing importance in the world of com puters and multimedia, scalability refers to the ability of a give °n tech nology to scale up or down in capability in conjunction with the differing capabilities of the technologies which surround and support it. For example, when used with reference to the balkanized world of video codecs, this term refers to a computer's ability to optimally adapt a digital video stream to the data rate of the playback system it finds itself working on. If, on the one hand, the playback system has superior resolution (e.g., SVGA), then the codec should scale itself up so that the compressed image is decompressed to play at this

high quality resolution. If, on the other, the playback system has antiquated display

technology, the codec should decompress the image to play at the lower level of

resolution.

Scalable architecture: This term refers to any product de signed so that buyers can

upgrade their initially purchased items with out having to replace those items. This term

can be aptly applied to the Ñpersonal computer market, where it is possible to upgrade

ones initial purchase by, for example, adding internal memory chips, at taching new

peripheral devices, or even by replacing the machines motherboard. In contrast, the

television has, for the most part, failed to make scalability a part of its design: if a

family has a black-and white TV and now wants color, they must simply buy a new color

television set. This term is much in vogue now, because as the indus try contemplates the

inevitable merger of the television and the com puter, there is much hope that this new

deviceÐ the interactive television or snart TVÐ will feature a scalable architecture.

Looking ahead, this architecture is expected to make it possible for television owners to

do such things as add new disk storage so that they can download more programming or

simply add more flatbed screen cells so that they can watch a bigger screen.

Scan converter: A ï lso referred to by the longer phrase "video scan converter," this

device helps to convert video signals from one format to another, mediating format

differences primarily between the worlds of TV and computer video. Unfortunately, this

increas ingly intense interface between the analog world of traditional media production

and the digital world of computers is based upon a signifi cant technical difference in

the way the video signal is handled. For TV, the format has remained the same in the

United States since the NTSC (National Television Standards Committee) standard was set

for color television in the 1950s. In contrast, for computers, the stan dard seems to

change with every new release of every make and type of computer, which means, of course, almost daily. When converting an image from computer to television formats, for example, a scan converter must change the image from digital to a ª nalog, and from noninterlaced to interlaced, plus it must match the refresh rates be tween the two. So long as the analog and digital worlds co-exist in nervous parallel, the market for scan converters should remain a strong, but complex one. Bring on the teleputer.

Scan head: Is the part of a scanner that optically senses the text or graphic as it moves across the page.

Scan lines: These are the parallel lines across the video screen along which the scanning spot travels from left to right when project ing the video information that makes up the picture on the TV screen or monitor. NTSC (National Television Standards Committee) stan dard video systems produce 525 lines on a screen.

Scanner: This term refers to a data-capture device that creates a two-dimensional, bit-stream image of the object being scanned. Most commonly, scanners are used to digitize paper documents. The pri mary function of a scanner is to transl ÷ate paper documents into elec tronic pixel or bit-mapped images. Typically, the scanning process involves reflecting light off of the target object in such a way that it can be captured or converted to digital data. The subcomponent within a scanner responsible for converting the light to digital data is the CCD (charge coupled device).

Scientific visualization: This emerging field uses computer graphics to create visual models of physical processes and numerical data. Ranging from literal translations of nature, such as a visual, cross-sectional model of a volcanic eruption, to highly abstract ren derings, such as a color-coded, heat-mapped depiction of a stock port folio over the course of a trading session, scientific visualization is an approach or a process that makes it possible to distill huge amounts of numeric data into a single

image or a series of images over time in animations.

Scope and sequence: From the hallowed halls of academe, this term refers to a significant step in the design   + of any educational program. It has become quite popular with instructional designers, who use this step to lay out the scope of the content to be covered in a particular piece of educational software (courseware), and to specify the most desirable sequence(s) in which that content should be expe rienced by the learner.

Screen candy: This insider term refers to little visual rewards placed within an interactive program to dazzle the user.

Screen capture programs: This term describes a family of software utilities, commonly used by multimedia developers in par ticular, which are used to quickly capture the current contents of the computer screen. These programs typically work by creating a snap shot, or bit-map of the current contents of the screen, and can usually be enacted by some form of simple command, such as a two key stroke combination or command sequence.

Script-XTM: One of the mission-specified projects of Kaleida Labs (the joint v   Í enture between Apple and IBM), Script-X is a multimedia authoring language. It enables developers to create applications for multiple pla tforms. As envisioned, Script-X is to multimedia what Apple PostScript is to desktop publishing.

Scroll bar: From the world of the desktop graphical user interface (GUI), the scroll bar is a common interface element used to change locations within a document. Typically, the scroll bar is a rectangle having on each end an arrow in a square box indicating direction of movement within the document. Inside the scroll bar is a scroll box, which is the item that the user drags to move within the document

Scrolling: A common technique in computer user interface design whereby all the displayed information on the screen is moved at once, either vertically or horizontally.

Scrolling game: This is a somewhat pejorative term that has been used to label the dominant genre of video games in which the player-controlled protagonist is moved acro ¦ ss the screen from left to right, encountering a succession of obstacles as different

backgrounds scroll by.

SCSI: Stands for small computer standard interface and refers to a very important set of

standards that was established to control the way that peripheral devices of virtually

every kind (scanners, storage devices, printers, etc.) are connected to personal

computers. Pro nounced "scuzzy," this 8-bit, parallel standard makes it theoretically

possible for any device, such as a CD-ROM player, to attach to any personal computer,

provided of course that both have been equipped with a SCSI interface.

SECAM: Stands for Systeme Electronique Coleur Avec Memoire and is the counterpart to the

North American NTSC (National Televi sion Standards Committee) standard for encodingTV

signals. SECAM is used in France, Russia, and Eastern Europe, and makes use of 625 scan

lines and runs at 25 frames per second (77s).

Seek: This term is used most often in the digital   Èworld to refer to the positioning

of a read head on a mass storage device in the correct location to read a particular file

or a particular piece of information

Seek time: This term represents a performance measure used most commonly with disk

storage devices. It measures the time it takes for the disk read head to pick up from its

current location and move to its next. Obviously, seek time is controlled in large

measure by how close the data from one read is relative to the next read. Thus, seek time

as

an official performance measure is usually recorded as an average over several types of

read.

Segue: Industry jargon from the world of video production, this term is used to describe

the transition from one major theme, scene, etc., to the next.

Sensorama: This was one of the earliest prototypes of virtual reality. Developed as

prototype arcade game in the mid-1960s by Martin Heilig, it was one of the first examples

of a multisensory simu lation environment that   Î provided more than just visual input.

This prototype featured a binocular viewing optics system, 3-D binaural sound, simulated

vibration cues, wind simulation, and a chemical smell bank that generated simulated

smells borne into the user's face by the wind simulator. The premise of the game was a

first-person-view point motorcycle ride through New York city.
Sequence: Is a series of scenes that make up a definite episode in a story.
Sequencer: In the word of MIDI (musical instrument digital in terface) sound production,

this term refers to a program feature that enables a composer or sound engineer to move

musical and other sounds around, i.e., to rearrange them into the desired sequence. In

many respects, the sequencer is highly analogous to the cut-and-paste features found in

word proc essing programs and paint systems. Sequential access: Of longstanding importance

as a central concept in data processing, this term is often defined in terms of its

opposite: random   - access. With information stored on a sequential access device,

access times are typically longer than with a random access device. Tape storage is the

classic example of a sequential access device. If you are at the end of a tape and want

to access some thing near the beginning, then you must rewind the tape, searching until

you get to the front of the tape to reach the information wanted. In contrast, random

access means that you can access any single piece of information as easily as any other

piece of information, regardless of where any of it is stored on the medium. Disk storage

is considered the classic example of a random access device. This random access

capability is made possible by the use of directories, which enable read heads to find

out the address of the desired information, and then move directly to that location.
Server: A term usually associated with LAN (local area network) and database

technologies, a server is centralized repository o   yf shared database information. In a

typical LAN configuration, the server is the largest machine in the network, and

generally manages the net work (plays host to the network operating system), as well as

playing host to the network's largest collection of shared objects. Attached workstations

make requests to the server, which then downloads the requested information to those workstations.

Set top box: This term is fast becoming the center of one of the great technological debates of our time. While it is widely accepted that the computer will converge with the television in the long run, it is not at all certain which of these two venerable devices will win out in the near term. That is to say: we all know that the computer is becoming more like the TV, that it can now show TV-quality images, and that it can, in fact, be rigged with an expansion board that makes pass-throug êh video possible; and, we all know that the TV is being made smarter all the time, and that, in fact, there are boxes that we can attach to the TV which, in effect, provide it with most, if not all of the intelligence of a computer. These boxes are now being called "set top boxes." They actually have quite a history, going back at least to the beginning of the video game industry, when companies like Nintendo and Sega were placing CPUs in their game machines, but avoided calling those devices by any name that might suggest the presence of a computer out of fear that any computer-like device would cause a phobic reaction among their buyers. Nevertheless, these set top boxes have CPUs, and so have the essential ingredients of a com puter. Moreover, their technical make-up is advancing rapidly, and with products like the 3DO player, are approaching the power of a full-blown desktop computer. Th «us, we have a controversy: will the set top box become so powerful that it eliminates the need for a per sonal computer?, or, will the personal computer take on so many media capabilities that it will eliminate the need for a separate presenta tional device like the television?

SGML: Stands for standard generalized markup language and is the leading standard among tagging languages. It uses special character sequences called markup tags to embed

control information within streams of text data. These tags work by separating text to be

pro cessed in a specialized wayÐtext to be boldfaced, for example~ from the remainder of

the text stream. The specific rules for how to interpret the various markup tags

specified under SGML are set forth using DTDs (document type definitions). The greatest

weakness of SGML today is that it has no facilities for handling nontext data. Con
sequently, it is not presently suited for handling the mixe
d media data types of compound documents.
Shading: Is one of the fundamental techniques for creating highly realistic computer

generated graphics. Shading occurs when a light source is added to the visual environment

created by the computer. When this happens, areas that fall away from the light source

are shadowed, and areas closer to the light source are highlighted. The problem with

shading is that it tends to add significantly to the com putational load, thereby slowing

frame refresh rates significantly in most contemporary systems. Gourad and phong are two

techniques that represent the high end of shading.
Sheetfed scanner: This type of scanner has fixed sensors and light sources. The documents

are fed past the light sources like a fax machine. This type of scann   Eer is generally

used for high-volume ap plications, though there are now some small, personal-use models

available.
Shot: From the world of filmmaking, this term refers to the smallest logical unit of a

filmÐto the fundamental unit of filmmaking. A shot represents the span of time in a film

during which a single camera POV (point-of-view) is sustained. Obviously, shots vary

widely in duration. Though moving from one shot to another has typically been considered

an aesthetic decision to be governed entirely by the filmmaker's artistic goals, with the

advent of digital processes, it is increasingly a decision that has significant technical

and practical implications. The most powerful motion picture codecs (compres

sion-decompression programs) work on the principle of finding and eliminating redundancy

in successive frames of ya film. To the extent that a piece of film moves in a hurried

fashion, jumping quickly from one shot to the next, a codec will have a difficult time

achieving a high compression ratio becauseÐon averageÐthere will not be much redundancy

over the groups of frames that make up the film. In con trast, films with a lazy pace

(from the standpoint of how they are edited), featuring lots of extended shots where the

camera stays fo cused on the same objects for long periods of time, are ideal for achiev

ing high compression ratios because they will possess a great deal of visual redundancy

(also called temporal redundancy).

Shot list: From the world of filmmaking, this term refers to a list of the shots that

must be executed based on the blocking of the scene in the director's mind. As such, it

is one of the more important planning documents that goes into the making of films, scene

Ñby scene With the use of authoring systems that possess time-line interfaces, the

links between the shot list and the finished shots can be auto mated, thus making it

possible to automate at least the first phase of editing a picture together. This, of

course, assumes that the finished shots have all been digitized.

Shovelware: Some jaded jargon from the realm of hypermedia, this term refers to disks

loaded with so much poorly organized infor mation that the user, seeking to navigate that

information, is lost in an electronic maze.

Shuttle: From the analog world of tape, this term refers to use of the fastforward and

rewind features of a tape deck to search for some specific part of a video. While users

are locked into this sequential access search mode, the picture must be visible so that

they are able to have "visual hits." The pain and agony of shuttling is one of the

reasons why many feel that nonlinea; random acc ess, all-digital video is the wave of

the future.

Signal: In the world of digital media, signal refers to physical prop erties of sensory

information that change with time, especially those associated with the electromagnetic

spectrum. Thus, in speaking about DSP (digital signal processing), it is customary to

speak of the "voice signal" or the "video signal," etc.
Signal processing: This is a near-synonym to DSP (digital sig nal processing).
Signal reconstruction: This term is roughly synonymous with decompression in that it

describes the reconstruction of an analog signal from its digitally encoded, compressed

counterpart.
Silence function: Often available with digital audio produc tion systems, this function

eliminates all sources of ambient sound and other unintentional noise in an audio track

by enabling the audio editor to simply force all values in the selected passage to zero.
SIMNET: Short for simulated network, this program represen Äts the first serious effort

at creating a networked virtual reality simulation also referred to as cyberspace. SIMNET

is a networked virtual battle field funded by DARPA (Defense Advanced Research Projects

Agency), and developed at the Institute for Simulation and Training at the University of

Central Florida in Orlando. It enables geographl cally dispersed players to wage war with

one another on a simulated
and shared battlefield. It thus provides a prototype of the role of equitagonist. Each

standalone simulator is in the form of a tank and contains a copy of the world database,

includmg the terrain and the virtual representations of all of the other simulators in

the conflict.
Simulation: This term refers to an increasingly popular form of multimedia application,

used most often for providing educational experiences in the most realistic contexts

possible. Simulations are based on the same go sal oriented, highly interactive design

principles as video games, except they typically place the gaming challenge within some

real-world, job-relevant context. Flight simulators, simu lations of the stock market,

and war games are three fairly obvious examples of this highly sophisticated form of

multimedia.

Simultaneous interpretation telephone: Conceived by Koji Kobayashi, former head of

Japanese corporate giant NEC, this term refers to a telephone system that provides

real-time, machine generated translation between languages, thus making it possible for

individuals to conduct a free and normal conversation even though they do not understand

one another's language. Though this technology has yet to be achieved, it is commonly

thought of as one of the key enabling technologies of the global village.
Sine wave: Is a continuously varying, repeating signal character i Øzed by amplitude,

frequency, and phase; the sine wave is the primary mathematical symbol for analog

phenomena, which include, of course, analog media.
Sliders: From the world of interface design (not baseball), this term refers to a type of

on-screen control icon used to control functionsÐ like sound volume, for exampleÐthat

vary along a scale of values, rather than just being subject to an on-off determination,

which is a toggle switch.
Smart TV: One of the many emerging synonyms for interactive television, this term

underscores the necessity for televisions to take on machine-based, or processor-based

intelligence as they become interactive.
Smell o vision: This is industry slang for a loser technology. It refers back to an early

1960s attempt at virtual reality in which the authors tried to incorporate smell as a

form of output. Obviously, it did not work out.
SMPTE: Stands for Society for Motion Picture ñand Television En gineers, a

professional society that has been responsible for estab lishing a number of standards

for motion picture and television equipment.
Snap to grid: One of the many accuracy aids now used in com puter graphics programs, this

term refers to an underlying, and often transparent grid that works to force alignment of

objects at a microscale within a graphics development environment. Thus, for example,

this tool is often embedded in paint systems so as to force alignment of bullet points

and other forms of lettering that the artist would nor mally want to have a common

vertical or horizontal edge. Every once in while, this otherwise useful tool can get in

the way by forcing alignment where the artist wants rough edges. As with most software

features, though, the artist can typically circumvent this problem by simply turning off

the snap-to grid feature, or by making adjustments to the spacing betw «een elements of

the grid.
SNR: Stands for signal-to-noise ratio, which is a measure of quality for any form of

digital signal. For example, with regard to audio, where this ratio is most often used,

SNR refers to the clarity of sound in relationship to ambient noise.
Soft robot: A term coined in 1984 by Alan Kay, it refers to much the same software design

concept as does the term interface agent. A soft robot is a computer based agent that

represents a system made up of software routines. When given a goal (by a human user),

this sys tem is capable of carrying out the details of the appropriate computer

operations and of asking for, and receiving advice in human terms when it gets stuck.
SONET A CCIIT (Consultative Committee on International Tele phone and Telegraph) standard

that defines a number of levels of digital telephony service over fiber optic transmission

lines. SONET is often associated with the backbone of the Ameri èican communications net

work and ranges in carrying capacity from 1.544 megabits per sec ond (Mps) up to 2.4

gigabits per second (Gps).
Sound placement DSP: This technology permits audio pro ducers to position apparent sound

sources anywhere in space around prospective listeners: front, back, left, right, above,

below. Based on digital signal processing (DSP) technology, sound placement DSP is a

foundational technology for creating the 3-D, surround sound sys
tems critical to the success of many high-intensity amusement attractions.
Soundspace resolution: This term is used to describe how many sound source positions can

be simulated in a 3-D sound system.
Spatial: When used in conjunction with the world of video codecs, this term refers to

actions tha. are performed on an individualframe. In this sense, spatial is nearly

synonymous with the term intraframe. Spatial is often used in contrast ¢ to temporal,

which refers to codec actions that are taken over the span of two or more frames, and in

this sense, the contrast between spatial and temporal techniques is syn onymous with the

contrast between intraframe and interframe modes of compression.
Speckles: From the world of document and image scanning, this term refers to any dots or

gray patches found on scans, faxes, or cop ies. They represent a form of background

noise.
Specular light: Is directional light from a specific source that reflects directly off

the surface of an object without entering it. This form of light is a key concern of

advanced graphics programs which are seeking to create increasingly realistic visual

representations of the world.
Speech font: A projected future technology for multimedia, wherein one is able to use

sophisticated text-to-speech and speech synthesis technologies to shift between different

styles of computer ized speech (e.g., male/female, bas s/alto, etc.) with the same

ease and flexibility characteristic of changing fonts in today's word proces sors.

Imagine a day may soon come when you request that your com puter speak to you in the

voice of Humphrey Bogart or Lauren Bacall.
Spline: From the realm of 3-D animation and modeling, this term refers to one of the

fundamental elements upon which most commer cial animation packages are based. A spline

is a mathematical repre sentation of a curve. Spline -based graphics are, therefore,

pictures built from numerous mathematically defined curves.
Split bar: From the world of graphical user interface (GUI) de sign, this term refers to

the bar, or separation marker that splits one window from another. Thus, for example, if

a user has opened up two documents and has made both of them visible on the screen at the

same time, with one in each of two windows, respectively, the bar that separates those

two windows is called the "split bar."

Sprites À: From the realm of computer animation, a sprite is a small image, stored in libraries of such images, movable under program control. In many respects, sprites are the computer animator's ver sion of a subroutine library, representing reusable graphical elements. Sprite libraries normally range in content from character sets used in representing text on screen to sets of characters used in animating computer games.

Square: In the realm of DVE (digital video effects), this everyday word takes on the specific meaning of a two-plane effect where the image on the front plane becomes a square opening or closing, re vealing the image on the back plane.

Stand alone system: This term is used to describe a self-con tained computer system not connected to either a network or a larger computer.

Star topology: From the realm of computer networking, this is one of three dominant network topologies. The other two are ring and bus, and both of these © differ from "star" in that they connect all of the workstations on the network over a single transmission line. In con trast, star topology features a separate transmission line for every workstation, and all transmission lines emanate from the server. Star topology is on the ascendance because it is the only one of the three topologies well suited for handling the large, continuously flowing streams of data characteristic of multimedia applications.

Steadicam: From the world of filmmaking, this relatively recent invention is a device that makes it possible for the camera to make rock-solid, "steady" shots, even when mounted on something mov ing, such as a plane, a roller coaster, or even the shoulder of a person who is running. In many instances, the steadicam has been used to create for the film viewer the sense of being "in" the movie, of being, as it were, in the shoes of one of the characters. This ability to place the viewer in th Ëe action will have growing significance as filmmakers turn to interactive cinema as an artform. Thus, whether or not

the steadicam continues to be of practical use in our technological future, it should at

least be remembered for the technical goals it success fully achieved.

Step frame: This term refers to a feature of certain video ma nipulation devices, such as

frame accurate tape decks and laserdiscS, which permits the user to move backwards and

forwards in the video stream oneframe at a time.

Stereo pairs: These are pairs of overlapping images shot by cam eras from slightly

different vantage points for the purpose of creating stereoscopic, 3-D forms of visual

media.

Stereoscopic glasses: By rapidly displaying slightly offset images alternately in both

lenses, these early virtual reality devices create for their wearers a 3-D illusion. In

the future, these devices may become as light and unobtrusive as eyeglasses, with

increasing resolution and separation ac ßcuracy.

Stereoscopic vision: Is the sensing of a single 3-D image by binocular vision of two

perspective images generated from different vantage points.

Stock footage: In the world of filmmaking, this term refers to film footage that

represents commonly used scenes, or filler, such as trains, planes, or automobiles in

transit. These scenes can be acquired from companies that collect and sell such

categorized film segments as their core business. Stock footage houses provide filmmakers

with catalogs that provide an indexed listing of the contents of their librar ies. By

making use of these libraries, filmmakers can decrease the cost of making a particular

film by an amount commensurate with what it would cost to shoot the scenes they buy as

stock footage. Given the high costs of original film production, the savings from using

stock footage can be considerable. Many of these stock footage firms are now digitizing

their libraries, laying them down on CD, and thereby broadening t ¤their markets by a

considerable degree to include the growing number of desktop video producers. In the

emerging multimedia industry, these newly digitalized vendors of clip media are being

referred to as "content vendors." It is possible to visualize a day when commercially

successful films will be comprised entirely of stock footage, or clip media segmentsÐ

artfully stitched together.

Storage place:This term is used in the context of describing the storage feature of a

highly literate form of multimedia such as an art gallery kiosk. The term represents the

shift in perception of electronic storage from that of a physical or logical phenomenon

to that of a cultural phenomenon. Like the burial place of archaeological con cerns, it

is a relatively simple futuristic leap to imagine that our children's children will

remember their ancestors by storing their media representationsÐa video biography, for

exampleÐrather than, or in addition to, some form of their phys +ical remains.

Storage virtualization: This term refers to the ability to make storage devices appear as

if they have unlimited capacity. A network implemented concept, this is done by

transparently migrating inac tive files through a series of "migration steps" to servers

located (theoretically) anywhere across a network. The steps for implement ing storage

virtualization are controlled by network administrator defined rule s, which are

transparent to users.

Store and forward: This term describes a commonly offered data communications service,

wherein data messages (broadly de fined) containing address information about their

destinations are tem porarily stored, and then later transmitted on toward their

respective destinations. Voice mail and e-mail are two common types of store and forward

service.

Storyboard: A term co-opted into the interactive field from the world of film and video,

it refers to a piece of panel material on which is placed one or more   ösketches that

present the look and feel of a proposed screen or story sequence. Storyboarding has

become an in tegral part of the planning of any program that has a significant visual

component.

Story cube: This term is a play on the linear video design term storyboard, and it

represents a design presentation tool used by inter active designers to provide a high

level, graphical representation of the structural aspects of their programs.
Storymercials: Many analysts and industry pundits have won dered upon the problem that

will face advertisers when our prospec tive information superhighway makes all forms of

entertainment available on demand, potentially eliminating the one -minute adver tising

slot altogether, creating a fonn of TV in which all channels would be operated like the

contemporary premium (pay per view) cable channels such as Showtime or HBO. One idea that

has surfaced is that products wi   «ll become "embedded" in the entertainment, illus

trating their benefits by virtue of how they are used by a story's pro tagonists. The

term being offered to cover this idea is that of "storymercial."
STP: This term stands for shielded twisted-pair, an expensive, high end form of

transmission media used in networking data applications that require high levels of

capacity and reliability.
Strand management: From the realm of instructional tech nology and educational software,

this term refers to the body of de
sign principles that electronically organize and sequence the flow of educational

segments that students experience as they move through a program. In well-designed

programs, the strand management logic is governed by software routines that track and

assess performance and learning styles so as to match the learner's knowledge, skill

level, and learning preferences to appropriately designed educational se quences. When th

  is occurs, the educational software can be accu rately credited with obtaining the

long-sought dream of individualizing instruction. Though the concept of strand management

has been around for years, its implementation has been very difficult and expensive to

achieve. The biggest barrier has been the costs associated with creat ing a large and

rich enough library of educational segments so that the software can be truly responsive

to every learner's needs. Pro grams that possess strong elements of strand management are

com monly referred to as "adaptive learning systems. " They can adapt on the fly to

whatever problem or deficiency the learner exhibits. As a concept with wide

kansferability strand management has much to offer to producers of sophisticated video

« games and other types of interactive entertainment.
Streaming data: This refers to any data with a time component, such as digital audio and

video.
Stream management: From the world of computer network ing, this term is on the rise, as

it describes a type of service demanded of any network management system that would

manage the flow of the large, continuously flowing streams of data that characterize digi

tal video and other high-bandwidth sources of audiovisual data.
Stretch target: This term from the business management school of process innovation

refers to projects that enable the sponsoring organization to stretch their current

capabilities in a dramatic fashion. As o   6rganizations large and small begin to

implement such enterprise wide multimedia solutions as performance support systems, they

will, by definition, be setting stretch targets for themselves.
Structured graphics: This term refers to a way of describing an image using a set of

simple geometric primitives. These primitives (e.g., lines, arcs, rectangles, ellipses,

etc.) are the building blocks that construct the image. Structured graphics represent a

distinct approach to treating visual data and are often referred to as vector graphics

and contrasted with bit-mapped graphics. With structured graphics, the image is stored

and drawn as an array of pixels. Thus, every pixel in an entire image is given a value

that represents its visual characteris tics (brightness, color, etc.). When high levels

of image quality are   C sought (defined in terms of numbers of pixels and permissible

col ors), bit-mapped images can become large and difficult for a com puter system to store and transmit. Bit-mapped graphics store the image itself; structured graphics store a set of instructions for drawing the objects that comprise it. This system saves considerable storage, and it is the chief advantage of this approach. Structured graphics, how ever, usually require complex display software, which must contain a module that can interpret the structured graphics instructions and draw the appropriate objects.

Student model: From the realm of intelligent CAI (computer aided instruction), a student model is a software component that records and maintains an information base on such learner character istics as preferred learning mode and current level of skill [mastery. A well-designed student model contains common student errors and mis conceptions compiled by classroom teachers and cognitive scientists. The overall goal of the student model is to make interactive forms of training more responsive to the individual needs of the student.

Stylus: This pencil-shaped graphical input device is used with a data tablet to enter data and commands into some form of graphics software package.

Subcarrier: This term is used with reference to radio and televi sion broadcasting to describe small portions of a given station's broad cast channel not used for radio or television signals, respectively. As we enter the age of interactive radio and television, this hitherto un used resource is now being viewed as a potential carrier of data sig nals; i.e., as a narrowband path along which users can interact with the broa Ödcasting source to express such items as station content or format preference.

Submarining: This term refers to an artifact common to LCD screens in which the cursor disappears briefly during a rapid move. The problem is caused by the relatively slow response times of pixels in an LCD screen.

SUI: Stands for sound user interface and refers to an 1/0 (input/ output) interface specialized for processing voice and other forms of audio. SUIs will become common

components on DSP-equipped MPCs (digital signal processing equipped multimedia personal

computers).

Superscalar: From the realm of computer processor design, this term refers to a feature

present in many of the latest processors, in cluding the Pentium line of microchips from

Intel, in which two or more arithmetic operations are executed at the same time.

Superscalar chips tend to have very high performance with respect to floating point math,

which is   µparticularly important for graphics processing.

Surrogate travel: This is one of the first applications of interac tive video and virtual

reality to have rightfully earned the status of a multimedia genre. Simply put, surrogate

travel programs are designed to create the illusion that users can move through

geographically re mote areas as if they were there. Common subtypes are the moviemap,

wherein users can travel the streets and byways of remote territories, and the

walkthrough, wherein users can navigate the rooms and hall ways of simulated buildings.

SVGA: The acronym for super video graphics array, it refers to a high resolution RGB

(red, green, blue) color monitor designed to sup port a PC Super Video Graphics display

driver card. An SVGA moni tor supports 256 colors in its highest graphics mode (800

horizontal pixels x 600 vertical pixels). This standard is set by VESA (Video Electronics

Standards Association).

S-VHS: Stands for super-VHS, a high-quality extension of the VH õS tape format for home

video creation. This higher quality format pro vides for clearer images and high-fidelity

stereo audio. Low cost stan dards like S-VHS advance the mission of lowering the barriers

to entry into the realm of professional video productionÐand, by virtue of a quick leap

of faith, into the realm of interactive multimedia cre ation as well.

S-video: Offering a higher quality signal that composite video, but a lower quality than

component video, this mid-level format divides the signal into two channels: luminance

and chrominance. It is also referred to as Y/C, where Y stands for luminance, and the C

for chromi nance.

Sword of Damocles: Credited with being the first ever head mounted display, this device

was created in 1968 by virtual realit pioneer Ivan Sutherland, while he was a student at

Harvard Univer sity. This device got its name because it was hung from the ceiling by a

large and ominous-looking arm that served as a mechanical posi tion tracking device.

S Ïymmetric multiprocessing: A term of growing significance in the computer industry,

it refers to a type of operating system that works in a multiprocessing environment such

that it allocates code to run on any free processor in the multiprocessor computer. Thus,

it views all of the processors as being equivalent, non-specialized re sources for

performing the processing requirements of the system. Asymmetric multiprocessing systems,

in contrast, typically contain specialized processors not equally adept at performing all

functions, and therefore contribute in varying fashion to the tasks at hand An asymmetric

system, for example, might have a processor specialized in handling audio data and would

not make use of this audio proces sor unless the application had audio content. Also

referred to by the acronym SMP, symmetric multiprocessing systems are generally per

ceived to provide better overall throughput and greater availability than do asymmetric

systems.

Sync: Short f ëor synchronize, this term refers to the need to create a precise sense

of unison between picture and sound elements in a video sequence.

Synthespians: Are computer-generated actors, especially promi nent in animated forms of

interactive fiction, who may perform the roles of interface agents.

System emulation titles: A genre of interactive, CD-ROM titles that seek to engage users

in environments that simulate certain real world economic and/or physical systems.

SimCity by Maxis, which engages users in a game where they, in effect, manage and build a

simulated city, is considered the exemplar, or core example, of this genre.

Tactile acuity: Is a measure of the resolution of a tactile feed back device, such as VPL

Research's DataGlove.

Tactile feedback: One of the new frontiers of man-machine communication, this form of "touch and feel" feedback is beginning to emerge from virtual reality re bsearch labs. It has to do with deliver ing feedback in a form perceived in a meaningful way by the human haptic system. The DataGlove and DataSuit developed by VPL Re search are two early attempts at creating the tactile interface.

Tagging language: This is a general term for languages that make use of markup tags to impart complex formatting characteris tics to text documents. They are essential to programs, such as desk top publishing systems, specialized in creating highly formatted documents. SGML (standard generalized markup language) is perhaps the best known example of a tagging language. Another example is HTML (hypertext markup language).

Tape autoloader: This emergent form of near-line storage makes use of robotic arms to move tapes between a storage area and a unit that reads from, and writes to, the magnetic tape cassettes. This type of alt pernative storage is gaining popularity, because it accommodates some of the enormous storage requirements of large-scale multime dia applications, such as VOD (video on demand).

Targa lile format: Also commonly referred to by the three-char acter identifier "TGA," this term refers to file format standard for bit mapped images that dates back to 1984. The format was established for using the Targa video board by Truevision, one of the first spe cialized PC expansion boards designed for enhancing the computer's ability to handle visual data.

Taxels: An obvious analog to the pixels of the visual display world, this term is a contraction for tactile display elements. Taxels are the fundamental units of tactile feedback and are used in various virtual reality devices, such as the DataGlove, to deliver "touch and feel" or haptic sensations to the user.

TDMA: Stands for t Øme division multiple access, one of two emerg ing standards for digital wireless communications. TDMA is mod eled after a popular method of data

communications known as "multiplexing," whereby a single communication channel serves the

transmission of several messages by time-dividing the message stream so that users take

their turn in sharing the channel. The accepted anal ogy is that TDMA places everyone in

the same room, but allows them to only speak one at a time and only in short bursts.

Because it repre sents a new form of transmission capacity, TDMAÐalong with its sister

technology, CDMA (code division multiple access)Ðis thought to be part of the solution to

the emerging bandwidth crisis that is part in-parcel of the coming age of multimedia.
Tear off menu: From the world of interface design, this term refers to a menu that can

be removed from the menu bar and moved around the screen like a floating wi Ãndow. What

makes it useful is that it remains fully extended, even after it has been detached, so

the user doesn't have to pop it down every time a selection is needed. This feature is

extremely popular with graphic artists when they are work ing with paint programs,

because it enables them to, for example, move a color palette close to the object they

are colorizing. In a more general sense, the tear-off menu is intriguing as an interface

design element because it suggests a mode of interactivity in which objects carry with

them, wherever they go, their own user-selectable options.
Teleconferencing: The audio precursor to vide oconferencing, this term refers to a form of

communication in which the enabling technologies of POTS (plain old telephone service)

are exploited to allow three or more parties to engage in the same voice conversation.
Telemetry: This refers to the control of machine processes from remote locations. With

the emergence of audio a ¦ nd visual recognition systems, this multimedia technology

will play an increasing role in the remote control of all types of machines and

processes.
Telephony: This umbrella term is used to describe the totality of technologies associated

with the telephone.
Telepresence: A birthplace of many virtual reality (VR) prod ucts and concepts, these

applications enable users to operate a VR interface to simulate and enhance their virtual

presence in a remotet real-world location. The primary purpose of the technology is to en

able remotely situated operators to receive enough sensory feedback to feel like they are

really at the location where they are able to do
different kinds of tasks. One of the first attempts at developing a telepresence visual

system was done by the Philco Corporation in 1958. With this system, operators could see

an image from a remote camera on a CRT mounted on their head in front of their eyes, and

could control the camera's viewpoint by   moving their head. A con temporary real-world

example would be the use of telepresence tech nology to manipulate a deep-sea probe

(perhaps to upgrade or repair a trans-oceanic cable).
Teleputer: George Gilder uses this term for the device he predicts will come to serve the

function of interactive television. He prefers this word because it better captures the

sense that this new communi cations device will embody the convergence of the television,

the telephone, and the computer.
Telerobotics: One of the key components of telepresence, this term refers to the remote

manipulation of robotic devices. Though useful in its own right, telerobotics can also be

viewed as an engine of multimedia applications, because by fulfilling the goals of

specific telerobotic projects, researchers oft Í en stumble across technological

serendipities that have much to offer to the manufacture of virtual reality devices. One

of the reasons for this is that some of the most interesting elements of telerobotics can

be used to experience the world in ways for which humans are not equipped. For example,

though human sight is not equipped to handle the infrared portion of the elec tromagnetic

spectrum, researchers are capable of creating robotic sen sors that can see infrared, and

from that source, create a representation (e.g., a color -enhanced, partially transparent

overlay) that can bring the representation within our visible spectrum.

TeleTact GloveTM: This virtual reality device was developed at the NationalAdvanced R

[obotics Research Center in conjunction with Airmuscle Ltd., both of which are located in

the United Kingdom. This glove device is used in tandem with the DAG (data acquisition

glove), developed by the same principles. The TeleTact is essentially a virtual

reality,forcefeedback output device. When users wear this glove, it is capable of making

their hands feel as though they are grasping any number of real world objects. The

capability to do this results from a process where the DAG records digitized patterns of

force feedbackÐeach pattern associated with grasping a particular object under given

circumstancesÐ and where the TeleTact then be comes responsible for re-creating this force

pattern in a process roughly analogous to the DAC (digital-to-analog conversion) that

occurs with digital audio devices.

Teletext: One of the earliest attempts at pro   yviding multimedia ser vices to the

residential (consumer) market, teletext works by trans mitting textual information over

the same transmission channels that serve television. Largely considered a failed,

"bleeding edge" experi ment, teletext has been relegated in recent years to supplying

public service types of information.

Template matching: From the realm of OCR (optical charac ter recognition), this term

refers to one of the most commonly used techniques for recognizing the characters that

lie on the original, scanned document. It works by comparing a character with a stored

template of the same character. Its primary weakness is that the sys tem can only possess

a library of templates with a finite number of font shapes, sizes, and styles. When there

is a match, the system will generate the ASCII code for the character. When no match is

found, the character must be sub   í mitted to manual recognition. This tech nique of

template matching is often compared with feature extrac tion, a more powerful, but more

expensive alternative for implementing character recognition.

Temporal redundancy: This term is frequently heard in codec technology circles, where it is used to describe the tendency for large amounts of information to be repeated from one frame to the next in motion picture sequences. This tendency is what makes possible a class of compression technologies, interframe codecs, that dramati cally reduce the amount of visual information required to represent a particular motion sequence by capturing just those elements that change from one frame to the next.

Terabyte: This next level of digital storage capacity may cause eyebrows to raise, but only in degrees of diminishing astonishment. Once thought obtainable, or practical for that matter, only by the very largest organizations, é a terabyte of information represents 1,000 gigabytes (or a million, million bytes). As organizations undertake more and more multimedia -oriented projects, such as the mammoth backfile conversion projects to transfer all of their paper documents into image data, the use of terabyte-size storage systems will become increasingly common. In today's market, most systems possessing this level of storage capacity come in the form of optical juke boxes

Tertiary memory: This terrn is used to describe low -speed, high volume memory, such as optical juke box, tape, and other forms of off-line and near-line mass storage.

Text search and retrieval: This term refers to the core of software competencies that have emerged from the field of software engineering over the years to define the manner in which items of information are sought for and found from within our culture's mass of textual document ̧s (e.g., magazines, newspapers, etc.). This is a very important frontier for the entire inf ormation industry, because how we learn to organize, and then find textual items, will establish the scientific bases for how we organize and search for other forms of information. In general, an information retrieval system may be thought of as a form of structured memory where items are stored and then tagged or indexed for later retrieval. With text, most of which comes in the form of poorly

organized documents (i.e., documents that were not composed with search and retrieval in mind), the longest standing method for organizing the contents for searchability has been that of appending to the document a header record, or summary file, and then filling that d Èata structure with keywords that describe the con tents. Thus, a header record appended to the contents of this book would undoubtedly contain entries such as "multimedia," "interac tive," and the like. Using this method, at least some portion of the document is structured for search and retrieval; and, in any event, the presenc e of the header record obviates the need to search the entire document, which can be an extremely CPU-intensive and costly un dertaking. Of course, the crux of indexing is whether or not the index entries successfully represent the contents. The issue is further com plicated when we recognize that different groups and constituencies (lawyers versus college professors, for example) will defin ge what is important in a particular document in entirely different ways. Suffice it to say that as we move into an era where it becomes increasingly important that other forms of media are effectively indexed, as is al ready becoming the case with clip media and stockfootage libraries, the role of indexes and keywords will become one of the focal points of research for the information age.

Text to speech conversion: This emerging medium of the MPC (multimedia personal computer) relies upon DSP (digital signal processing) technology to process ASCII text, generate a phonetic transcription, and then produce synthetic speech. In other words, with this technology, the computer becomes able to "read" any document stored in the industry-standard ASCII format. This technology has been available for some time in such products as IBM's Primary Edi tor Plus, a word pr uocessor for children, which, among other things, is capable of reading back anything that the user has typed. Most exist ing

systems provide rather crude, and obviously mechanical, inter pretations of human speech.

But as voice synthesizers become more lifelike, computers will increasingly communicate

by speaking.

Texture mapping: A common feature inpaint systems, this terrn refers to the mapping of

digitized surface textures (e.g., a brick pat tern) onto a surface.

3 D animation: From the high end of computer graphics, this term refers to a form of

animation that relies upon the on-screen move ment and interaction of 3-D objects. From a

production standpoint, the creation of 3-D animation presents many thorny problems; the

most significant of which is that it is both CPU- and memory-inten sive, and it is

therefore quite expensive and time-consuming.

3 D digitizing: Thi Âs emergent, sophisticated form of data capture works to capture

(digitize) the x, y, and z coordinates of a real object, thus creating a 3-D

representation of that object which might be used later for creating, for example, a

holographic image. The fundamen tal unit of information captured by 3-D digitizing is

often referred to as a voxel, the 3-D version of a pixel.

3-D sound: This term refers to sound systems that produce con vincingly directional,

360-degree spatial motion and support acous tics. The implementation of 3-D sound usually

involves stereo earphones that make use of DSP (digital signal-processing) to deliver

complementary audio signals that reconstitute sonic volume and motion.

Thresholding: From the world of document and image scanning, this term refers to a

process used to create clean images from dirty, faded originals. The user sets a limit of

contrastÐ a thresholdÐ be neath which the pixel will be reproduced as white   and above

which it will be reproduced as black.

Thumbnails: This term refers to the image-based icons that are rapidly taking their place

in the design and implementation of graphi cal user interfaces (GUI). The term was

originally coined as way of describing their average, postage-stamp size, which is also

about the size of a human thumbnail. This size is justified because it is large

enough to make the visual contents discernible to the human eye, but small enough to

conserve screen geography and memory consump tion so that first generation MPCs

(multimedia personal computers) can make liberal use of them. The most common example of

a thumb nail is a postage -stamp sized image of the f1rst frame in a video se quence,

which is used to both represent and launch (by clicking on it, of course) that video

sequence.
TIFF: Stands for tagged image file format, an industry standard for image files,

originally developed by Aldus Corporation. This stan da +rd uses tags (i.e., labels) to

define the structure of graphics images captured by digital scanners for processing.
Timbrality: With respect to MIDI (musical instrument digital in terface) synthesizersÐ

perhaps the key audio technology of the MPC (multimedia personal computer) standardÐ this

term refers to the number of different instruments that a given MIDI device can play

simultaneously. Obviously, the greater the number of simultaneous instruments, the more

resonant the sound.
Timbre: Pronounced "tam-bur," this term refers to one of the key components in a musical

sound. Typically distinguished from pitch and loudness, timbre establishes the

distinguishing quality of a musi cal sound. With regard to many of the emerging and

sophisticated digital audio production tools, timbre is an element that is typically

isolated so that it can be more directly manipulated by the composer or audio engineer.

MIDI (musical instrument digital interface) com position t Òools are particularly adept

at manipulating timbre.
Time code: This term refers to a code embedded in a video se quence so as to facilitate

editing and synchronization. Each frame in the video is given a time offset (or address)

from the beginning of the sequence, thus enabling editors to specify precise entry and

exit points from which to start and end scenes, respectively. In the soon-to-be extinct

realm of analog video, time codes are actually burned into a spare track on the videotape

(see BITC), where they remain until the penultimate stages of post-production. In the

rising realm of digital video, time codes will be just another digital element in the

video data stream and will be responsible for enabling random access and the databasing

of video content.
Time line metaphor: This term refers to the most commonly used interface design for media

integrators and other computer pre sentation systems. These interfaces use a columnar,

almost spread sheet-like structure, with the Ôcolumns calibrated in terms of time

slots. The rows represent the various media sources (audio-voice clips, music, image,

video sequences, etc.). By using this specialized, time based, tabular structure, the

time-line metaphor makes it easy for mul timedia applicatiorl developers to synchronize a

wide variety of media types by controlling their appearance, their activities, and their

disap pearance with reference to a shared timeline.
Time stamp: Is information added to a message, record, or other unit of data indicating

the time at which it was processed by the system.
Title depth: This is a descriptive term that connotes one very important aspect of a

CD-ROM title's quality: namely, its depth of content, which can be largely discerned from

how many times the user is inclined to use it. A "shallow title" would be one that users

discard after using only once or a few times and would therefore be characterized as

having very little depth. In contrast, a title with depth will ha +ve, generally

speaking, many layers of content and will inspire its users to re-use the program over

and over again. Because it pos sesses a strong multiplay quality, The 7th Guest by Virgin

Games is said to have excellent title depth.
Titling: Refers to the process of laying down text overtop of a video signal. Now an

integral function in most desktop video systems, stan dard applications of titling

include placing video text for company logos on advertising pieces, and producing titles

and screen credits for movies and TV broadcasts.

T1 line: A digital telephone line—commonly used for distance learn ing, among other things

—the Tl line is on copper wire and transfers digital information at the comparatively

high rate of 1.544 megabits per second.

Torque: In the field of animation, this term refers to the twisting of parts of the body

in contrast to each other. It is believed that by pay ing close attention to such

relational aspects of body motion, an imators are better able to create life quality

in their productions.

Touch screen: A popular form of effecting human-computer in teraction, especially with

IVD (interactive video disc) applications7 this technology makes it possible for users to

interact with computer programs by simply touching designated hot spots on the screen.

Touch screens work under much the same principle as the mouse input de
vice, except that, rather than clicking on the desired hot spot, the user simply touches

it with a finger.

Track: With regard to the storage of digital information, a track is a linear, spiral, or

circular path on which information is placed. This term is equally applicable to magnetic

and optical forms of storage. This term is also used in the film/video community to refer

to any single component of a finished video, such as the sound track.

Track analysis: In film and video production, this krefers to an examination of a

sound track by the editor to determine exactly where various sounds occur.

Trackball: From the world of computer input devices, this device uses a ball that is free

to move around within a fixed mounting. As the user rotates the ball, receptors inside

the fixed mounting record the movement and translate it into on-screen cursor movements.

Transfer rate: In computing, this general term refers to the rate at which information is

moved between any two devices, particularly from storage into RAM. Currently, an

important transfer rate is that between CD-ROM and internal memory, because it represents

a bottle neck, making it difficult for producers of interactive programs to cre ate many

of the effects taken for granted in the arena of traditional, analog video productions.
Transmission media: See Cabling.
Transponder: This device is u psed in satellites to receive a data communications

signal at one frequency and retransmit the signal at a different signal.
Treatment: A term derived from the world of film and TV, it re fers to a general or high

level description of a proposed program, an outline of sorts. It is generally used as the

first step in the business planning process to interest potential clients, programmers,

publish ers, etc.
Trucking: In film and video production, this term refers to the movement of the camera

toward or away from the scene. "Trucking in" means that the camera is being moved closer.

"Trucking back" means that the camera is being moved further back. These terms are

near-synonyms for panning and zooming.
TrueTypelM: Developed by Apple Computer, this widely used stan dard defines a set of

outline-based typefaces that are used to create display and printer fonts.
TSR: Thi s software acronym stands for terminate-and-stay-resident, and it is used to

describe programs that load themselves into memory with the intent of staying there. TSRs

are typically represented by software utilities, such as screen capture programs, which

develop ers, in particular, like to have at their disposal.
Turing Test: This refers to the now famous test described by Alan Turing in his justly

famous 1950 article "Computing Machinery and Intelligence," wherein he proposed that the

only way for a computer to prove itself to be truly intelligent (in the human sense) was

if it could respond to the questions asked by a human interviewer in such a way that the

answers would be indistinguishable from those that one would expect to receive from a

human. In other words, a com puter may finally be deemed intelligent whenÐ and only whenÐ

it can carry on a normal conversation with a human being.As we progress further and

further in °to the recesses of the age of multimedia, the ability for interface agents

to pass the Turing Test may become a key industry success factor.

Tutorial: Borrowed from the world of academe, this term is used by instructional

designers to refer to a form of multimedia applica tion that seeks to pull learners

through a highly constricted sequence of interactive experiences designed to convey a

narrowly defined set of learning objectives. Software tutorials and drill and practice

matll programs are two fairly obvious examples of this type of educational software.

TV tuner boards: This category of board product enables the user to receive broadcast

video and display it in a window on the PC monitor. This type of board simplifies the

process of using the c   ×om puter to view video segments because it causes the video

stream to bypass the PC's internal graphics subsystem, playing it directly from its

analog source (e.g., directly from a VCR).

TWAIN: This term refers to an emerging interface protocol that seeks to standardize the

way various image capture devices, such as scan ners andframe grabbers, are accessed by

application software. As an example, any scanner that is TWAIN compliant can be directly

ac cessed from within software that support TWAIN devices. Not to be confused with Mark

Twain, the nineteenth century American writer

Twitch and shoot fantasy: An obviously derogatory term, this phrase describes the

:dominant genre in the first generation of video games that focuses on violent themes and

the user's ability to

respond quickly to various forms of animated threat by merely blast ing those threats to

smithereens (or its electronic equivalent).

lvo plane effects: From the realm of DVE (digital video ef fects), this term refers to a

broad family of effects used primarily to transfer from one screen to its successor.

Fades and dissolves are com mon types of this effect. Two-plane effects are so-called

because they operate on two visual planes, with the image held on the uppermost, or front

plane, being replaced by the image held on the lower, or back plane.

Ultrasonic position sensing: This is an emerging form of position tracking being used in virtual reality research. Basically, the technology works by placing so ame form of ultrasound emitter on an object (such as a human being) that is to move around within a virtual world. As the object moves, ultrasound sensors (microphones) keep track of its position by sampling the location of the transmitter.

Underlay: In the world of animation, this terms refers to a section of the background that is mounted on the cel. Adopting an object oriented approach to animation, underlays, like other constituent ele ments of the animated world, can be stored in libraries for continual re-use.

Undo: An important graphical user interface (GUI) application menu choice in most quality applications, it permits the user to reverse the most recently performed user action. Utilization of this option fulfills the maxim: "to err is human, to forgive divine."

Usability: In the world of computer programming, this refers to that quality of an application which makes the software easy for é the user to understand, learn, and use. By building in online reference and procedural information (ideally hypermedia in the realm of the information designer), and by building in online training information (ideally CBT [computer based training] and interactive multimedia in the realm of the instructional designer), into the design of a graphi cal user interface (GUI) design, the corporate application develop ment team can achieve a depth of usability that fulfills the goal of making the application easy for the user to understand, learn, and use. As with software applications, so too are multimedia and hypermedia applications better if usability is built into their inteace design.

Usability evaluation lab: In the early '80s, IBM Corporation began focusing its efforts on small systems development as well as developing complementary business application software to run on these pla ^tforms. In an effort to improve the usability of the software interface

design, as well as the design of the supporting training and documentation materials, IBM
devoted its efforts to building usabil ity labs, not to test for software bugs or
hardware human factors glitches, as had been previously done, but to evaluate how easy it
was for a new user to understand, learn, and use the business applications. A team
inAtlanta, Georgia, composed of M. Mehal, R.Autry, P. Smith, Dr. J. Morgan, and Dr. D.
Leonard developed the IBM Atlanta Us ability Lab, as well as a usability lab evaluation
process for planning, designing, running, analyzing, and reporting evaluation results.
From that seed, IBM and its business application customers began to think about and
evaluate software from a usability perspective. Through another IBM Atlanta effort, the
Multiples M Åarketing Program, IBM disseminated to its hardware and software customers
the knowledge, expertise, and process for conducting usability lab evaluations world
wide. As a result, many companies now have usability labs in which end users, sitting in
a control room, perform various tasks with the software in development, are observed by
developers in an observa tion room and are filmed, interviewed, surveyed, and essentially
brought into the development process solely to improve the usability of the software and
its supporting materials. Quantitative data ex tracted includes tasks performed
successfully, task performance time, number of errors, and error recovery time.
Qualitative data extracted includes (through observations, w ritten surveys, and
interviews) evalu ation subject preferences, problems, solutions, and overall emotional
responses to the software. Hopefully, the usability lab evaluation p   ro cess will also
be employed for the development of hypermedia appli cations and multimedia applications.
User interface: A term that has gradually taken on great impor tance for multimedia
applications, user interface refers to the point of contact between a human user and the
contents of a computer system. Traditionally, this term was used to denote the devices

through which a user would communicate with the computer, e.g., the keyboard, the joystick, etc. As the computer has become more knowledge-oriented and media-oriented, and as these devices have become more sophis ticated (e.g., with the use of tactile feedback devices, such as the DataGlove and DataSuit), the role of the user interface and its design will continue to grow and expand in significance.

UTP: Stands for unshielded twisted-pair, a term that refers to the least expensive, lowest capacity form of transmission media used in the transmission of data. Formed by twisting pairs o f copper wiresÐtypically in groups of fourÐUTP is just one step above telephone cable. By twisting the copper wires, this technology reduces some of the electrical interference that can occur from proximity to motors, computers, etc. Owing to its low cost, UTP is a very popular medium for networking computers and is often cited as a difficult-to-hit, but desirable target for implementing networkedmultimedia applications.

Variable length records: This refers to a way of organizing a database such that the sizes of records containing the data need not be uniform. With the move to media-based forms of data (to audio, im age, and video databases) the need for variable-length records will grow. One of the carryovers from the alphanumeric -only days now being adapted f Xor this use is the so-called memofield. With a memo field, only the address of the record is stored in a fixed-length format. The content of the field is open-ended, and in fact, may be stored on a separate device from the one that holds its address.

VBI: Stands for vertical blanking interval, which is the black bar in between frames of a television broadcast. The limited bandwidth ca pacity of VBI has been used in recent times to carry the small amounts of control information associated with early attempts at interactive forms of television. Information transmitted through VBI is limited to text, simple graphics, and information for positioning on-screen objects. In the 1980s,

teletext services offered news and other infor mation through a VBI signal on broadcast

television.
VDU: Stands for visual display unit, a very gene ral term that refer hs to the

now-diverse universe of video displays (e.g., LCDs, CRTs, etc.).
Vector: This term is used in the realm of computer graphics to refer to the mathematical

representation of a geometric object con tained within a computer image. Vectors are

typically used to repre sent objects such as circles, arcs, and lines. Their use in this

context reflects an effort to create an abstract representation of digitized im ages,

thereby reducing the storage space required to handle visual forms of data.
Vector file: As opposed to raster, or bit-map files, vector files are made up of

mathematical equationsÐalso referred to as "vectors"Ð that provide an easily manipulated

representation of an image. Raster files, in contrast, are typically large, because they

are comprised of a bit map that possesses a value (or set of values) for every pixel in

the image. Though they a íre more readily manipulated, vector files typi cally do not

possess the high image quality found in most raster files
Vector-to raster conversion: In the everyday world of mul timedia applications, where

there is a veritable explosion of paint and image manipulation software tools, there is

frequent need to con vert files from one format to another. Vector-to-raster conversion

is one of the easiest conversion processes to perform. This sort of trans lation

effectively snaps a picture of a vector file and organizes it into a bit map.
Vertical correlation: Also referred to as "vertical redundancy," and closely related to

the concept of horizontal correlation, this term refers to an element of redundancy

present in most sources of visual information. If, for example, two pixels located next

to one another in the vertical plane of a picture have the same visual characteristics

(i.e., the same color and brightness), th £en they may be said to possess vertical

correlation. This form of redundancy, like all other forms of visual redundancy, is

important to the process of video compression. If a whole vertical string of pixels have

the same visual characteris tics (in a background depicting the sky, for example) then

they may be compressed down to a simple mathematical formula that expresses the shared

visual characteristics only once, but then also lists the num ber of consecutive pixels

possessing those characteristics (a compres sion technique known as RLE [run length

encoding]).

VESA: This is the acronym for one of the multimedia industry's leading standard setting

associations. It stands for Video Electronic Standards Association, and it is represented

by a set of software and hardware manufacturers with a common concern for establishing

stan dards for graphic and video display adapter cards.

VESA VL BUSTM: The VESA stands ⦙ for Video Electronics Stan dards Association, and the

term refers to an emerging standard for overcoming the bottlenecks associated with

handling video on tradi tional PCs. The VESA VL Bus, which is featured on a number of

video adapter cards, is a 32-bit bus capable of operating as fast as a CPU's memory

access speeds. This standard is designed to enable faster operating speeds of video

display and hard disk subsystems at affordable prices.

VFWTM: Stands for Video for Windows, Microsoft's package of sys tem and authoring software

for integrating video files into Microsoh Windows.

VGA: An acronym that stands for video graphics array, it refers to the medium to high

resolution RGB (red, green, blue) color monitor designed to support a PC Video Graphics

display driver card. VGA is a display standard that was originally developed by IBM in

1987 for its PS/2 line of computers and supports 16 colors in its highest graph ics mode

(640 horizontal ° pixels x 480 vertical pixels).

VGA -to-NTSC boards: This class of board product takes the signal from a PC's graphics

adapter and converts it to a composite signal (e.g., SuperVHS) so that it can be recorded

onto an analog medium such as a videocassette. Some of these products also offer

genlocking and overlay capabilities, making it possible for the user to combine PC

graphics with the video before it is sent to the tape.

Video: Is a system of recording and transmitting visual information by converting moving

or still images into electrical signals. These signals can be broadcast through

high-frequency carrier waves or sent through cables on a closed-circuit.

Video adapter card: A family of expansion cards designed to enhance the PC's ability to

û manipulate video, these cards work by offloading many of the video processing functions

from the CPU to the card itself.

Video bandwidth: One of the key components in measuring the tractability of a multimedia

application (i.e., the ability to process the amount of information at an acceptable

rate), video bandwidth is a measure of the size of a digitized video data stream. There

are four major elements that go into determining video bandwidth: 1) the as pect ratio of

the picture; 2) the scanning method (interlaced versus progressive, with the latter

requiring twice as much bandwidth as the former); 3) the picture's repetition rate (i.e.,

theframe rate)   I, which is usually expressed as frames-per-second, such as the 30 fps

of NTSC (National Television Standards Committee) television; and, 4) the number of scan

lines in each frame (which is the dominant compo nent in determining the picture's

resolution).

Video christmas card: This metaphoric term represents one of those future exemplars of

how we may use the high bandwidth networks of the future to communicate with one another

at holiday events or whenever. An example is when Dave in 2001: A Space Odyssey by Stanly

Kubrick receives a visual birthday greeting from his parents while he is on board the

space ship headed toward one of Jupiter's moons.

Video dial tone: A concept associated with the picturephone, the video dial tone is

functionally analogous to the telephone dial tone in that it provides the individual user

with some ƒ sort of visual pattern which signifies that bandwidth has been made

available for purposes of placing a video phone call.

Video dictionary: A subclass of hypernedia applications, this term refers to programs

that feature the alphabetically organized col lection of information items, primarily in

the form of video clips.

Video digitizer: Typically, this refers to a board level product that accepts analog

video input from standard video sources, such as VCRs, videocameras, laserdiscs, and

cable TV, and displays it on the monitor screen, converting the signal into a binary

(digital) file on cue. Some of these products display the video signal in its native

interlaced format, where the screen is painted in two passes. Other boards offer a frame

into memory before displaying it as a noninterlaced image, which offers the advantage of

less flicker and more clarity.

Videodisc: Like the old format war that was fought b + etween Betamax and VHS over who

would be king (the standard, that is) in the VCR industry, the videodisc standard is

often compared against CD-ROM as an alternative for delivering interactive forms of

media. The videodisc standard is la rger than CD-ROM (about the size of an LP album) and

is double-sided, and its data rate and rotational speed are higher. However, it has one

serious drawback that seems destined to cause it to go the way of Betamax. Though its

control information is stored in digital format, its program informationÐ the images and

other mediaÐ is stored in analog format. Thus, its primary forrn of storage is at odds

with the digital format of computers.

Videodisc levels: Videodisc has traditionally been divided into five levels of

technology/interactivity, ranging from the modest inter action of switching the machine

on and off, up through the sophisti cated branching and presentation strategies allowed

by integrated systems of Ï CPU and disc player. Those layers are: Level Zero: Lin ear

play of videodisc; i.e., those designed to play only videodisc ver sions of movies. Level

One: A player with still/freeze frame, picture stop, frame and chapter stop

addressability, and dual-channel audií, but with no programmable memory. All functions

are initiated by manual inputs from the player's keypad. Picture stop and chapter stop

codes are put on the disc during mastering. Level Two: A player vi
on-board, programmable memory. The player's memory is pro grammed from information

contained in audio channel two of a Level Two encoded videodisc, or is programmed

manually from the player's keypad. Inputs are made from the keypad. Level Three: Any

video disc player controlled by an external computer. This is the level that

characterizes the preponderance of programs termed IVD (interactive videodisc) programs.

Level Four: A videodisc-and-computer system in which the videodisc is used to store

computer-readable µ digital data as well as analog video and sound information. The

videodisc player functions as an optical storage drive to the computer, as well as the

source of analog picture and sound.
Video fax: This term is nearly synonymous with movies-on demand, a term that refers to an

emerging service, whereby consum ers access movies of their own choice from a central

database of films. The term video fax describes the technical process that controls how

users make use of movies-on-demand services. After accessing the database of movies, and

making a selection, the consumer waits a short period of time, while the digital form of

the film is downloaded from the central database to their own interactive television

playback unit. Thus, envisioned in this fashion, movies-on-demand may work much like the

ubiquitous document fax does today: The entire con tents of the document (movie) are

transmitted and received before the user begins to consume any part of it.
Video PBX: Nearly synonymous wit Ćh video server, this term re fers to communications

hardware that serves as the intermediary be tween residential consumers and databases of

video product. It is called a PBX (private branch exchange), because it operates much

like a telephonic PBX in making large numbers of point-to-point connec tions. In most cases, equipment worthy of this term is relatively high end (e.g., mainframe) computing hardware owned and operated by the cable companies.

Video server: This term refers to a specialized portion of a LAN (local area network) set aside to handle the unique demands of pro viding sources of digital video to LAN clients in much the same way as traditional LAN servers provide data and application services to those same clients. A video server must cope with the unique chal lenges associated with the large, continuously flowing streams of data necessary to play compressed digital video or other high bandwidth audiovisual data types. These multimedia technology data types are Âtime-dependent, and thus, in addition to requiring a continuous (un interrupted) connection between client and server, possess several key differences to the traditional sources of data that move over LANs These traditional sources are characterized by relatively small file sizes, and thus, possess the need for only momentary and intermittent dominance of the network channel capacity. As a consequence, most traditional LAN protocols are contention-based and are designed to handle a bursty flow of traffic over a shared transmission line on the network, where only one client-server or workstation-to-workstation connection is being accommodated at any given moment. Typically, these data conversations are so brief, that the individual users are unaware that their requests are being handled out of a queue. In con trast, multimedia technology connections demand relatively long and continuous ones, and so are not well suited to the traditiona ¢l network protocols. Instead, most video servers demand dedicated, point-to point connections with each of their clients, an arrangement referred to as a star topology. Additionally, because the transmission resource (the wire connecting server to client, for example) is not normally a shared resource, the network

protocols for networked video are not normally based upon contention schemes, but rather

rely on conver sational protocols more typical of telephony.
Videot: This is slang for a video game junkie.
Video teleconferencing, videoconferencing: One of the earliest and largest markets for

multimedia, this application es sentially applies the technologies associated with

picturephone to group situations. Despite the relatively high cost of transmitting video

in real time, video teleconferencing is viewed as being affordable when used to hold high

priority, corporate-style meetings where face to-face contact is seen as a critical

element i   in the communications. Several standards have cropped up to encode the

quasi-video signals that are typically used in video teleconferencing, the most notable

being the H.261 standard.
Videowall: Seen frequently at large trade shows, videowalls are large assemblages of

monitors stacked together to form a single dis play area. Typically, they are controlled

by a computer, which does the work of taking a single image and splitting it up so that

the picture can be spread across all of the monitors.
View: In the simplest sense, the term "view" refers to what is seenÐ that is, what is

visible to the userÐ within a window on a graphical
user interface (GUI)-based personal computer. But this term means much more. It is one of

those tip-of-the-iceberg terms. Put simply, it is one of the most important and central

concepts in all of multime dia. Moving on to one of its still-simple, but abstract

meanings, a "view" is one way of seeing a particular set of data. Critical to th   &e

concept of a view is that there are many different ways of looking at the same set of

data. Thus, for a simple table of numerical dataÐ representing, say, sales figures listed

by salespersonÐ one can take a view of that data which is the table itself, or, one can

take a view that represents the same data in the form of a bar graph, or maybe a pie

chart. One might also take that data and write a narrative around it, describing how the

various salespeople are doing, based solely on the sales figures contained in the table.

   The point is, there are many different ways to "view" the same information. As one addresses more complex datasets, where it is only possible to consider portions or summaries of the data at any one moment, then the concept of view takes on another dimension; that of scalin μg up or down relative to the object being considered. Thus, as one scales up, the view takes in a wider scope, but contains less de tail. As one zooms in, the scope narrows, but the detail is increased. In a sense, the notion of "view" takes stock of the perceptual limita tions of the human mind relative to the volume of information that can be considered at any moment in time. And this notion of present ing digestible views, within the context of a "view -generating sys tem" that can switch flexibly and quickly between many different views, is a core concept, a sort of gestalt that drives the entire enter prise of human interface design, GUI, and usability.

viewer polling: This is one of the prototypical forms of interactivity that n is already being experimented with in anticipation of the coming of interactive television. As the term implies, viewer polling works by actively soliciting the opinions and attitudes of view ers. In today's technology context, viewer polling is conducted by using the telephone as the means by which viewers communicate their opinions back to the broadcasting source. Obviously, this is a con temporary kludge that uses two separate technologies. As envisioned for true interactive television, though, future forms of viewer polling will involve the user's direct interaction with the TV (by clicking on an on-screen icon, for example) which, in turn, will communicate back to the broadcasting source via some form of data backchannel.

Viewport: A term for programmers, it refers to a rectangular por tion of the screen onto which the window and its contents are mapped.

VIM àS: Stands for visually induced motion sickness, a unique form of motion sickness

that is a result of some of the more powerful vir tual reality entertainment

environments. Almost exactly the opposite in cause from normal motion sickness, VIMS

occurs when there is a compelling sensation of self-motion without any corresponding vis

ceral cues. Research shows that this form of nausea tends to occur during a user's

initial exposure to a particular simulation, especially in cases where there are many

motion cues.

Virtual communities: This term describes subsets of Marshall McLuhan's global village,

groups of geographically dispersed people who communicate with such intensity that they

form what could be properly called communities. Obviously, these communities will make

heavy use of multimedia technology, as the capacity of our public networks expand to

accommodate the higher bandwidths assoc ©iated with moving mixed media data types

between remote locations.

Virtual mall: This term refers to one of the emerging visions for how interactive

shopping will be presented as an interface paradigm once mass deployment of an

all-digital, national information infra structure occurs. Under this interface paradigm,

the at-home shopper will fly through an electronic version of a mall, using the input

device to steer and stop as the salivary glands of shopping dictate.

Virtual memory: This term represents one of the older software design technologies and

perhaps the first use of the word "virtual" in the computer world. Virtual memory is a

fairly sophisticated tech nique used in computer systems as follows. First, an

application is divided up into discrete chunks. In most cases, these chunks are regu lar

in size and are called pages. When an application is running, it typically uses only a

few pages of the program in a given time frame. T Èhese active chunks are referred to

as the working set of pages. Since only a few pages are being used at any one time, a

large program can waste a great deal of memory in a system with inactive pages that may

never be used at all. To ensure the efficient use of memory, a computer can be programmed

to load only the working set of pages into memory and still be able to run the

application, even though much of its code is absent from memory. If the application

requires a page not currently in memory (for example, when branching to a dif ferent part

of the program that lies outside of the code represented by
the current working set), a page fault is generated by the computer hardware. At this

point, the computer chooses a page not being used, swaps it out to hard disk, reads in

the required page, and then contin ues executing the application. This process is totally

transparent to both developers and users alike. Thus, since no "out of memory" er ror

ever confronts eit &her of these two groups, even though they may be working with

extremely large program files, the computer appears to have a limitless supply of memory.

This apparent extension of ca pability beyond what is real is what has given rise to the

use of the term "virtual." In the era of multimedia technology, where an explo sion of

file sizes of all sorts will be upon us, expect virtual memory to be one of the more

important forms of virtual for quite some time.
Virtual reality (VR): VR is primarily a real-time graphics and animation technology that

immerses users into alternate worlds, ones that are intended to seem as real as the real

world of nature. Through a combination of sensing and interface devices, and software, VR

systems provide direct interaction with computer generated models. In its pu Írest

form, virtual reality is a computer generated, surrogate environment that allows users to

experience the full sensory/tactile feedback of a place in space and time different from

the one in which the user really is. Thus, virtual reality relies on many of same illu

sionary forces so critical to our various narrative traditions (e.g., the novel and the

movie). Recently, there has been such an expansion in the uses and technologies

associated with VR, that there are now all sorts of VR systems, ranging from

environmental VR to full immer sion VR to many different forms of partial VR. Taken as a

whole, virtual reality should be viewed as the leading edge of interactive multimedia

technologyÐpotentially the most sop   Whisticated, demand ing, and engaging medium of the

information age.
Virtual surreality: A term coined by the philosopher Daniel Dennett in his 1991 work,

Consciousness Explained. Dennett joins a widening group skeptical of the various meanings

implied in the term virtual reality. According to Dennett, the experiences one has while

garbed in the paraphernalia of VR systems are at best something a user might imagine as

real for only a short span.
Virtual VCR: This term was coined by those in the know about interactive television.

Basically, it is a synonym to movies-on-demand, a term that describes one of the early

interactive TV services, whereby the consumer ordars a iovie brom a large menu of

choices. The actual movies are stored on a large video server(hkcapad kn pha bacihipias

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kpad ap JASA#s Aies Rasearch Canper, involves paking popkgraphical `apa ceneraped brom

satellites ajd space prkbas po creape 3-D iodels of portions of planet surfaces from

arkund the solar system. The sys tem will phen make it possible for users to fly over

iountains and down into valleys kn, bor example, the Martian surface. As better rendering

engines, and mo cre accurate data become available, the sys tem is planned for

scalability, such that one day people may be able to simulate flight through

photorealistic versions of planetary sur faces.
Visual workbench: This term refers to a human-factors engi neering application for

virtual reality, shereby physical environments are modele d/simulated for purposes of

conceptual trial-and-error. A contemporary example is provided by the University of

Washington's Human Interface Technology (HIT) lab. HIT has developed a simu lation of a

new runway for SEATAC airport, complete with simulated sound, so that stakeholders can

test out the impact of various design strategies.
VOD: Stands for video on demand and is nearly synonymous with movies-on-demand. Many

industry critics see true VOD as still lying somewhere out there in the near, but as yet

unobtainable future. Its im ¡ mediate predecessor, NVOD (near video on demand), will

make use of the rapidly growing bandwidth of the cable TV infrastructure to supply users

with so many starting times for a particular film that wait times will never exceed a

very short duration, say 10 minutes at the most. It's like a bus schedule where the buses

are running with very high frequency. VOD will follow on the footheels of NVOD and not

only allow viewers to pick out a program and choose just when they want to use it, but

will also enable them to start, stop, and pause
each program without affecting any of the other programs available to, or being viewed by

others.
Voice: This everyday word has recently moved into the world of digital audio, where it

has taken on the meaning of an independent channel in a multichannel, digital audio

production. Thus, you may find it written in one of the trade journals that the sounds

produced by a particular musical instrume Ênt, say a horn, make up one of the voices in

a 24-voice production.

Voice annotation: A concept associated with hypermedia ap plications and the compound document, it refers to the practice of annotating reference documents with voice messages. Obviously, voice annotation is one application of voice digitization.
Voice coding: Refers to methods of digitally encoding and com pressing voice signals optimized to the spectral patterns characteris tic of voice. Techniques like SBCELP, developed by Lernout & Haupsie Speech Products of Belgium, are making 30-to-1 compres sion ratios for voice signals possible. Such medium-specific special ization in algorithm development is a reflection of the growing maturity of multimedia technology.
Voice grade: A term used to describe the relatively low quality audio signal that typifies dial-up telephonic communications. Voice grade has a relatively modest bandwidth of 3,000 Hz.
Voice mail: Though not usually thought of as such, - this store and forward service is a precursor to the compound document, which may become one of the dominant forms of multimedia technology. Be cause they store messages in an audio format, and are typically con trolled by computers, voice mail systems are clearly multimedia technology.
Voice recognition: A long sought-after goal of the computer intelligentsia, voice recognition is a form of user input whereby the computer is able to respond in a meaningful fashion to human speech. This form of input has long been held back by the lack of a thorough understanding of human speech, a scientific deficiency that has made it impossible for programmers to create the algorithmic foundations, often referred to as natural language processing, required by comput ers so that they might be able to "understand" normal, conversational speech. Today's voice recognition systems are confined to the use of fairly limited vocabularies. Most systems can only recognize vocabu ðlaries under a thousand words. These systems are based on a technol ogy whereby the words spoken by a human are first digitized, and then submitted to a lookup function,

which attempts to match the digitized instances of human speech against a table of stored

speech patterns. It is expected that as our scientific knowledge of human speech

progresses, the vocabularies supported by voice recognition systems will expand apace,

ultimately reaching the long-awaited dream of continuous speech recognition.
Voomies: These are virtual realit movies designed to be experi enced in a 3-D movie

theater. According to industry rumor, the first voomies may be exploratory virtual

realities, where audience mem bers can move through the virtual settings (environments)

and watch the action of the dramatic characters from whatever perspective they choose.
Voxel: This volume element can be thought of as the 3-D equiva lent of a pixel. It is

used, for example, to describe the spatia l display elements in a 3-D visualization

system.
VRAM: Stands for video random access memory and is pronounced vee-ram. It is a special

type of memory used with high-end, high performance accelerator boards to speed up the

processing of visual (display) information in personal computers. Its most distinguishing

characteristic, and the thing that separates it from standard dynamic RAM, is that it

allows the computer to write new information to a memory location, even while the old

information is being read.
VTOC: Stands for volume table of contents. This is a critical por tion of any form of

data storage disk because it includes the disk (or volume) name, copyright information,

pointers to datablocks, sequence numbers in a multivolume set, and version numbers.
WAIS: This acronym stands for wide -area information service, and it refers to a program

that is used for searching the In |ternet for con tent that has been appropriately

indexed.
Walkthrough: This is a subtype of the surrogate travel genre, wherein one is able to

navigate the hallways and rooms of remote, or even nonexistent, buildings. Walkthroughs

rely heavily on CAD-based (computer aided design-based) libraries of algorithms,

wherewith ar chitectural building designs are used to create rooms and hallways on the

fly as users exercise their software-encoded, navigational free dom to move about within

the simulated building. Common applica tions include human-factors engineering and real

estate marketing.
WAN: Stands for wide area network, a term which refers to com puter networks that are not

limited to a geographic area within a range of 10 km, as are LANs (local area networks).

WANs often use com mon carrier facilities.
Water cooler syndrome: For the sociologist of media, this term refers to t ühe tendency

for people to talk the next day about what they watched on TV the night before. In the

age multimedia, what will people talk about the morning after?
WAV: This is the file extension for the standard adopted by Micro soft and IBM for

multimedia sound applications. WAV files contain pulse code modulation (PCM) waveform

audio data.
Wavelet image compression: A sophisticated variant of DCT (discrete cosine transform)

this is one of the frontier compres sion technologies; it is now receiving a considerable

research and development effort.
Wave table synthesis: One of two primary forms of MIDI (musical instrument digital

interface) synthesis (the other being FM synthesis), wave table is generally considered

to be the superior of the two. It uses a store (or table) of digitally recorde`

ijsprqment samples, and phen blends those sampled sounds together on the basis of the

seque Çhce of MIDI commands it receives to create the pro grammed music or sound

effects. The table of sounds, kr patches, as they are sometimes called, are usually

stored in ROM. Wave table players have ROM sizes that range in size from 1 to 6

megabytes, sith the obvious quality advantage going to the larger pables, shich hold

correspondingly more, longer, kr more intricate instrument samples. For playback, wave

table players are measured in terms kf pwo quahity bactors: 1) how many instruments they

can phay simulta neously, a beature cahled pimbrality; and, 2) how many different notes

they can play at the same time, a feature called polyphony.
Whiteboard: Ahsk referred to as "alectronic shitebkard," phis `avice is kne kf tha key

anabling pechnklogies kf dkcument conferencing. After pwo remote qsers astablish a

desktop-to-desktop connection, the session software presents a shiteboard sind ñow that

bkth participants are permitted po view and manipulate.With the typical implementation of

this concept, bit maps of the whiteboard are being transmitted back and forth over the

network as each participant makes changes to the contents. Most implementations also

enable either par ticipant to save snapshots of the whiteboard for future reference.
White Book: Developed by Philips and JVC in 1993, this stan dard enables the storage of

MPEG (Motion Picture Experts Group) video on CD-ROM.
Wide shot: From the world of filmmaking, this term refers to a shot that provides a broad

view of all or a large part of the action in a scene.
Windows: From the world of graphical user interfaces (GUls), this widely used term refers

to independent regions created on the computer screen to segregate different functions

and/or forms of in formation. Windows are made possible by the growth in bit-mapped

displays, and, in turn, make + it possible for several applications to dis play results

on the same screen simultaneously. Thus, windows rep resent two basic graphical user

interface design and human interface design principles: 1) people desire to, and are

capable of working on more than one task at a time; and, 2) to maintain cognitive order

dur ing such multitasking activities, it is advisable to create a visible way of

segregating, or compartmentalizing one task from another. The most ubiquitous windows

graphical user interface application is the operating system by Microsoft, otherwise

known as Microsoft Windows.
WindowsTM: Microsoft's graphical user interface (GUI) extension to their MS-DOS operating

system, now an industry standard, it rep resents their implementation of the desktop

metaphor interface that flowed from the early-eighties, pioneering work of the Xerox PARC

research group on graphical user interfaces.

Wipe: From the world of DVE (digital video effects), this is a tran sitional effect

wherein one scene supersedes another by wiping it off the screen. As with the other

transitional effects, the more sophisti cated paint programs and authoring systems now

supply entire li braries of wipes, e.g., from side-to-side, top-to-bottom, etc.

Wireframe: In graphics, this is a 3-D outline image displayed as a series of connected

line segments, including all of the hidden lines.

Wireless: This term refers to the emerging return to the radio air waves for transmission

bandwidth. Technologies such as TDMA (time division multiple access) and CDMA (code

division multiple access) are being heralded as providing a substantial portion of the

band width required to feed the voracious appetite of interactive multime dia services.

If wireless does prove to À be as rich a source of bandwidth as experts are predicting,

our TV set-tops will be visited once again by devices that are the futuristic equivalent

of the rabbit ears that the baby boomers grew up with. Of course, these modern

technologies are distinguished from their forebears by being based on digital, rather

than analog encoding of the transmitted information. Wireless tech nologies will also

enable the widespread use of PDAs (personal digi tal assistants), the handheld

communications/computing devices that are now in their earliest forms.

Working plane: With respect to high-end visual modeling sys tems, this term refers to a

visual reference system, a grid laid down on the screen 0 at the outset of a given

development pr oject. This grid, or working plane, offers a spatial reference model to

which items can be positioned, a feature also referred to as a snap-to grid. It is also

very useful for scaling, wherein the feature is employed for sizing visual objects to fit

a given context.

World building software: This emergent term is used by prac titioners of virtual reality

to describe the authoring tools that they use to create simulated portions of the world.

WORM: Stands for write once, read many and refers to a standard form of compact disc technology that permits users to write their own data to CD, albeit only once. In effect, WORM technology turns the CD mastering process over to the users, which is in contrast to the standard way of doing things with respect to CD-ROM, where, ühis torically, the mastering has been done at specialized facilities that employ expensive equipment. Though far less expensive than these capital intensive facilities, WORM drives have remained beyond the financial reach of most desktops, and have typically been bought only by those organizations who have a high volume of CD mastering they must perform. As with almost every other form of digital tech nology, though, this expense factor is subject to change, as WORM drives are becoming increasingly affordable. Most contemporary WORMs permit multisession recording, which means that you can not reuse the same disc geography, but you can take more than one session to make use of the entire geography of the disc. The Kodak Photo CD consumer technology is multisession, which makes it pos sible, for example, for families to make use of small chunks of a single CD as they grow their photo li ¢braries over time, thus keeping the overall expense of the technology under check.

WYSIWYG: Stands for "what you see is what you get" and is pro nounced "wizeewig." This term dates back to the earliest attempts to upgrade the graphical capabilities of personal computers so that users could get a realistic view of what their output would look like once it was committed to hard copy. For example, owing to the limited graphi cal capabilities of computer monitors, early word processing programs were unable to display any of the special formatting characteristics that the word processing software permitted, such as bold facing and underlining. To see these effects, early PC users had

to wait until they printed the document. Obviously, they were often surprised (with "sur

prise" being a pejorative term in this context) with what they wound up getting. As the

graphical capabilities of computers began to im prove, the word processing programs were

ab   le to display these ef fects on the screen, thereby initiating the phrase "what you

see is what you get," and, with it, this endearing acronym.
Xanadu Project: Launched in the mid-sixties by Ted NelsonÐ the man also credited with

coining the term hypertextÐ this project has been responsible for conducting breakthrough

research on the impact of the computer on the textual creation enterprise. The obvi ous

allusion that gave birth to this project's name is the magical place of creative

imagination described in the nineteenth century poem, Kubla Khan, by Samuel Taylor

Coleridge, in which seemingly dis cordant images are intermixed to create an

other-worldly realm of "A Sunny Pleasure Dome with Caves of Ice!" One of the key concepts

to emerge from this project is that of intermixing and ma   tching portions of text from

various sources to form composite works. Of obvious applicability to hypertext systems,

Nelson has used the term "xanalogical storage" to refer to the shared document space that

re sults from such intermixing of textual works. In 1988 the Xanadu Project was taken

over by Autodesk, the C alifornia software maker most famous for its AutoCad and other

visual processing tools.
Xerox PARC: The acronym stands for PaloAlto Research Center. Established in 1971, this

now-famous R&D facility was responsible for developing some of the earliest prototypes

for the personal com puter. However, what has earned this center a rightful place in the

creation myth of multimedia was its central role in devising so   cme of the earliest

concepts and standards for the design of graphical user interfaces (GUI), the fruits of

which were brought to market in the form of the Apple Macintosh and Microsoft Windows

desktop user interfaces. PARC was also largely responsible for developing the Smalltalk

programming language, the high level language commonly given the credit for launching the

object-oriented paradigm in soft ware design. Of its more recent research projects, the

most notewor thy to the continued progress of multimedia technology appears to be the

Information Theater. This project is aimed at enhancing text re trieval technologies and

at breeding a new form of presentation tech nology referred to as infornation

visualizers.

Y/C: More commonly referred to as S-video, this video type pro vides a quality of signal

that lies between composite and component video. The ° Y stands for luminance, the C

for chrominance, which represent the two channels into which the form of video signal is

broken.

Yellow Book: Is the Philips/Sony technical specifications refer ence for the physical

structure and data layout of CD-ROM discs. These specifications are based on the Red

Book's description for audio CDs, also known as CD-DA. The Yellow Book standard has two

modes: mode 1 is the basic specification based on CD-DA; and mode 2, also known as CD

ROM-XAÐ the XA standing for ex tended architectureÐ which involves the interleaving of

audio and graphic data, critical to enabling the synchronization of audio and visual

components.

YUV: This is the industry standard way of transmitting and storing video information.

Under this method, the RGB (red, green, blue) data for each pixel is converted to a

format that uses one channel (Y) to represent the luminance, or overall intensity of that

pixel, and two cha ennels (W) to represent the chrominance, or color. The advantage of

this technique is that it makes it possible to reduce the overall data volume required

for a video image by lowering the W resolution relative to that of Y, which, in turn,

takes advantage of the universally accepted principle that the human eye is less

sensitive to color than it is to brightness.
Zoom: In video and photography, this term refers to the facility to enlarge (zoom in on)

or reduce (zoom out from) an area of an image. As a piece of the accepted cinematic

nomenclature, the term zoom more precisely describes the enlargement of the film subject

relative to its context or setting, in contrast to the term parl, which means to pull

away from the subject.
Postscript

   Failing tofetch me atfrst keep encouraged,
   Missing me one place search another,
   I stop somewhere waitin   bgfor you.
     Ð Walt Whitman, poet of Leaves of Grass

ANNOTATED
Bl BLIOGRAPHY

In concert with the overall increase in interest regarding multi media, we have witnessed

a spate of written material over the   past half-decade that hits in and around the

subject. Books on multimedia, interactive multimedia, virtual reality, and cyberspace are

beginning to appear at an accelerated rate and now threaten to take up entire stacks in

libraries and bookstores across the country. New magazines and trade journals entirely

devoted to the subject have appeared in the last few years, and many longstanding

publications in related areas have begun to re-orient their content so that they are now

invading the same conceptual turf. As if in a magnanimous ges ture to its own

cannibalizing forcesÐ to its own executioner, if you willÐ the print and publishing indust

 vry is certainly doing its part to inform the public about the coming of multimedia.

Additionally, while it might be gratuitously facile to say that the intellectual

foundations for multimedia start with Plato, or thereabouts, it would be accurate to say

the serious people have been giving seri ous thought to the various forms that new media

might take for at least the majority of this century. This vein of genetic thought leads,

in particular, to the likes of Vannevar Bush, Marshall McLuhan, and Ted Nelson.   The

entries in this book owe something to all of these sources, recent and otherwise. In this

annotated bibliography, we attempt to give the reader some form of shoehorn into this now

burgeoning bundle of source materials. We have broken the bibliography into two sec

tions, one devoted to books and articles drawn from scholarly peri odicals, the other to

trade jo   üurnals and magazines. In dealing with the latter, we have decided to treat

the magazines as a whole, even though it should not be concluded from this that their

individual feature ar ticles are not as valuable as they might be. In fact, one of the

happier trends in the industry right now is the appearance of some very high quality

trades, to whichÐit should be pointed outÐthe authors have culled from and synthesized

information to build the content for many of the entries of this book.   We make no

claim of being comprehensive, or even of being close to comprehensive. Rather, we merely

hope that this bibliogra phy is somehow representative, and that it can lead the reader

through a systematic swath of the mounting literature on multimedia.

Books and Scholarly Articles

It,t lt

Allen, Thomas B. War Games. New York: Berkley Books, 1987.
Though thi   Äs book does not make a single mention of multimedia, it is of note to the

interactive community because it covers a subject that is of mounting importance to the

future of media. The author points out that at, or near, the pinnacle of all of the

branches of America's armed forces there is a penultimate form of training that is called

"war games." These games, of course, strive to create as much of the complexity of the

real world as possible, and so are perhaps more accurately referred to as simulations.

But, then again, the difficulty we have in naming this highest form of military train ing

may be a further reflection of the underlying instability and change that is

part-in-parcel of the emerging age of multimedia. For the sake of fostering worthwhile

reflection, this book is worth a read.

Ambron, Sueann, and Kristina Hooper. Editors. Interactive Multimedia: Visions of

Multimedia for Developers ×, Educators, & Information Provid ers. Redmond, WA:

Microsoft Press, 1988. This work is the third in a trilogy of readers published by

Microsoft Press in conjunction with Apple Computer to pronounce the com ing of

multimedia. Of the three, this book does the best job of deal ing with issues of

interactive design and content development. The Foreword by John Sculley and articles by

Stephen Weyer and Sueann Ambron are particularly noteworthy.

Aukstakalnis, Steve, and David Blatner. Silicon Mirage: TheArt and Sci ence of Virtual

Reality. Berkeley, CA: Peachpit Press, 1992. This is a very competent survey of the

enabling technologies and applications that are making virtual reality the cutting edge

of mul timedia. It does a fine job of explaining the scientific principles that are

making the creation of such new and immersive technolo gies as force feedback possible.

It also lays out an industry-by industry survey o »f the current applications of

virtual reality. Put simply, the book does its part to establish the legitamacy of VR.

Benedikt, Michael. Editor. Cyberspace: First Steps. Cambridge, MA: MIT Press, 1992. An

excellent reader on the emerging subdiscipline of virtual reality known as "cyberspace,"

this book does more than any other in the industry thus far to explore the philosophical

implications of new media. In particular, articles by the editor and by Michael Heim lay

out some of the dimensions of the deep structure of cyberspace. For those with an

academic orientation, this book represents a good vehicle for placing the cutting edge of

multimedia technologies in perspective.

Brand, Stewart. The Media Lab: Inventing the Future at MIT. New York: Viking, 1987. When

neophytes ask what book they should read to get their bear ings with respect to

multimedia, this is the one that we almost al ways recommen   d. It is a pleasureable,

anecdotal read. But it also examines with considerable clarity the roots of new media

think ing, if for no other reason but that it explores the background of Nicholas

Negroponte, the founder of the Media Lab, and one of the industry's true visionaries.

What is most heartening about this book is that, while all of the projects it describes

were intended by virtue of the Lab's mission statement to conjure communications tech

nologies 30 years out, several of them are actually starting to be implemented today. In

particular, Negroponte's concept of "per sonal television" would appear to be just around

the corner and will likely arriveÐ full blown, virtually as conceivedÐ about a de cade

ahead of schedule. Written by the author of The Whole Earth Catalog, this book is both

fun and informative.

Bush, Vannevar. "As We May Think."Atlantic Monthly. (July,1945), pp.
 101-08. Any bibliography that purports to cover the multimedia ind   ðustry is obliged

to include this entry. This article is typically credited with being the first to

articulate "hypertext." It would probably be a bit more accurate to say that it is the

first description of the implica tions of hypertext, even though it predates the first

use of that term by roughly two decades. Bush bemoaned the antiquated state of our

library information systems (if you could have called them that in the 1940s), and

foresaw a day when all of the contents of all of the world's print-based information

would be inter-connected by associational links. Researchers and browsers, alike, would

be able to traverse this structured labyrinth of information by simply fol lowing these

links, either on the bases of their immediate research needs, or their current

intellectual whims. Bush called this future haven of interlinked literature the Memex. As

concepts go, . . . long live the Memex.

Gardner, Howard. Frames of Mind: A T11eory of Multiple Intelligen ces New York: Basic

Books, 1983. Like a number of other entries in this bibliography, this one may seem a bit

tangential. However, learning theory is one of the core competencies of one of the core

applications of multimedia. Howard Gardner's contribution to learning theory has been

considerable, and we could have included almost any of his works here. This one, though,

ranks among his most memorable and should be re quired reading for anyone who wishes to

practice the emerging profession of instructional design.

Greenfield, Patricia Marks. Mind and Media. The Effects of Television Video Games and

Computers. Cambridge, MA: Harvard University Press, 1984. Though this book predates most

of the speculation over the coming of multimedia, it does a great deal to both anticipate

it and light its way. Greenfield offers an excellent survey of the literature and re

search that occurred during the sixties and seventies pertaining to the comparative value

of d ifferent learning media. She is absolutely prescient in her assessment of

potential instructional benefits of the video game genre, and, as a case in point, lights

the way in 1984 to the recent emergence of edutainment titles.

Holsinger, Erik. How Multimedia Works. Illustrated by Nevin Burger. Emeryville, CA:

Ziff-Davis Press, 1994. This is the best exemplar of books that most successfully employ

graphics and text to explain computer hardware and software tech nology. It succinctly

and clearly defines and illustrates "how multi media works" and is part of the Ziff-Davis

"How It Works" series. Hats off to author, illustrator, and editorial staff for bringing

an understandable view of multimedia to the masses.

Jacobson, Linda. Editor. Cyberarts: Exploring Art and Technology. San Francisco: Miller

Freeman, 1992. This interesting reader ranges across a broad range of topics that are

currently impacting the multimedia industry. The book is pa Àr ticularly useful in its

coverage of the many categories of software that impinge on the interactive multimedia

authoring process. Of particular note are entries that cover MIDI/MSC and the low cost

all-digital alternatives to high-end professional video that are now entering the market

at a rapid pace. This book also contains a gem from Ted Nelson, who takes about ten rich

pages to describe the current status of his life-quest Xanadu Project.

Kearsley, Greg P., Editor. Artificial Intelligence & Instruction: Applica tions and

Methods. Reading, MA: Addison-Wesley, 1987. Heavy sledding, as they say, this is a

worthwhile read for those who have an interest in the many academic projects launched dur

ing the seventies and eighties to explore the pedagogical potential of machine

intelligence.

Khoshafian, Setrag, A. Brad Baker, Razmik Abnous, and Kevin Shep herd. Intelligent Of

fices: Object-Oriented, Multi-Media Information Man agement in C   ®lient/Server

Architectures. New York: John Wiley & Sons, 1992. This is one in a series of very sound

books published by John Wiley to explore the promising new conceptual areas in computer

sci ence. This book provides a synthesis of object-oriented software design, the

integration of media into traditional applications, the design of graphical user

interfaces, and the deployment of opera tionaVcomputing resources over distributed,

client-server architec tures. For those interested in the technological foundations of

mul timediaÐ the enabling technologiesÐ this is an excellent survey.

Lambert, Steve, and Suzanne Ropiequet. Editors. CD ROM: The New Papyrus. Redmond, WA:

Microsoft Press, 1986. This is the first in a trilogy of readers published by Microsoft

Press in conjunction with Apple Computer to pronounce the coming of multimedia; as you

would expect, this title does the best of the three to frame the overall context of th

ℰ emerging multimedia in dustry. The Foreword by Bill Gates does much to illustrate how

much he was in tune with the graphicaVmedia orientation of com puting, even before he was

able to successfully implement his Win dows graphical user interface in the

Intel-dominated PC world.

Laurel, Brenda. Editor. The Art of Human-Computer Interface Design. Reading, MA:

Addison-Wesley, 1990. Of all the multimedia readers that have appeared over the past five

years or so, this is probably the most representative of the industry's true range of

interests. It is also distinguished by the general qual ity of its contributorsÐ just

about every industry thought leader has an entry in this volume. Perhaps the most

noteworthy article is the editor's treatment of the exciting and complex concept of

"inter face agents."

Leebaert, Derek. Editor. Technology 2001: The Future of Computing and Communications.

Cambridge, MA: The MIT Press, 1991.

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Though this reader gives only scant treatment of multimedia, per se, it does an excellent

job of speculating on the technical agenda of the industry's major enabling technologies:

computer architec tures, office automation, tele- and data communications, etc.

Lieberman, Debra A. "Learning to Learn Revisited: Computers and the Development of

Self-Directed Learning Skills." Journal of Research on Computing in Education. Vol. 23

(Spring, 1991), pp. 391-95. This scholarly article does a good job of relating the

leading trends in learning theory to the use of instructional technology in school

programs. Though there is a tendency in our country to be highly critical of our primary

and secondary schools, this article is indica tive of some of the cutting edge thinking

that is going on with re gard to the application of educational software.
McLuhan, Marshall. Understanding Media: The Extensions of Man.   + New York: Mentor,

1964. McLuhan had a unique ability to identify the large historical arcs associated with

media. And now that the forces of change have accelerated the forward evolution of media,

McLuhan is being quoted with increasing frequency, particularly from the point of view

represented in this book.
Mast, Gerald. Film, Cinema, Movie: A Theory of Experience. Chicago: University of Chicago

Press, 1983. As we labor to contemplate the future of media, it will no doubt be prudent

for us to understand where we have been. Gerald Mast is one of the best film theorists

going, and this is probably his most msightful discussion of the film mediumÐ the medium,

I think we all agree, to which the interactive arts will owe the most.
Nelson, Theodore Holm. "The Hypertext." Proceedings of the World Documentation

Federation. (1965). The first use of the term "hypertext" appears in this article, and,

in effect, stands as the virtual starting gate fo   + r one of the most fecund

intellectual careers in what is now being called multimedia.
Papert, Seymour. Mindstorms: Children, Computers, and Powerful Ideas New York: Basic

Books, 1980. One of the earliest works to examine the use of computers in edu cation,

this book is notable for a number of reasons. It details the LOGO language, a high-level

language developed explicitly for use by children for the sake of exploring math and

science con cepts. It covers a number of issues in instructional design which, if
anything, are even more pertinent today than they were when they were written. Most

notably, though, it captures the essence of Seymour Papert, a man who has been at the

forefront of the entire computer revolution by virtue of his association with the MIT

Arti ficial Intelligence Lab and of his ability to contribute to and articu late the

thinking that has taken place therein.

Parsaye, Kamran, Mark Chignell, Setrag Khoshafian, and Harry Wong. Intel Êligent

Data bases: Object-Oriented, Deductive, Hypermedia Technolo gies. New York: John Wiley &

Sons, 1989. One in a series of books published by John Wiley, it explores some of the

emerging concepts in computer science. This book does an excellent job of exploring the

key issues in software engineering, particularly those having to do with object-oriented

programming and hypermedia design, both of which impact very heavily on the enterprise of

multimedia. It possesses one of the industry's most intelligent discussions of Ted

Nelson's Xanadu Project and does an excellent job of analyzing the issues associated with

designing and building knowledgebases.

Resnick, Lauren B., and L.E. Klopfer. "Toward Rethinking the Curricu lum." In Toward

Rethinking the Curriculum. L.B. Resnick and L.E. Klopfer, editors. Arlington, VA:

Association for Supervision and Cur riculum Development, 1987. This article is one of

many possible entries for Ms. Resnick, per haps the leading Amer iican thinker in the

field of educational re form. Throughout her canon of work, one finds a steady theme:

curriculum needs to move away from the industrial-age traditions of drill-and-practice,

emphasis on specific content, and other forms of regimentation, and in the direction of

pedagogies that stimulate higher-order thinking, problem solving, and the acquisition of

pro cess knowledge. These pedagogies are much more difficult than their traditional

forbears to encoded interactive multimedia pro grams . . . but so be it.

Robbe-Grillet, Alain. For a New Novel: Essays on Fiction. New York: Grove Press, 1965.

For anyone who sees the production of interactive forms of art as a mission against which

are stacked incalculable odds, these essays from Robbe-Grillet will prove comforting, if

not insightful. Though his fictional works were never widely accepted in his own time,

Robbe-Grillet stands as probably the most inventive practitioner of the narrative arts

in our cent °ury. These essays articulate the rebel lious, iconoclastic vision that is

so abundantly present in his nov els. Had he "bloomed" during the 1990s, we have no doubt

that Robbe-Grillet would be devoted to interactivity and the cyberarts.
Ropiequet, Suzanne. Editor. CD ROM: Optical Publishing. Redmond, WA: Microsoft Press,

1987. The second in a trilogy of readers published by Microsoft Press in conjunction with

Apple Computer to pronounce the coming of multimedia, this one has the stongest

orientation of the three to ward the engineering issues associated with CD-ROM

technology.
Schneiderman, Ben. Designing the User Interface: Strategies for Effec

tiveHuman-ComputerInteraction. Reading, MA:Addison-Wesley,1986. This work serves as a de

facto standard in the area of interface design, a discipline which possesses

near-complete overlap with the field of interactive multimedia design. Schneiderman's

text is particularly insight Çful in its treatment of the concept of "direct

manipulation."
White, Mary Alice. What Curriculum for the InformationAge ? Hillsdale, NJ: Lawrence

ErlbaumAssociates, 1987. This is an excellent treatment of educational concepts that

should deeply concern everyone in the multimedia industry.

Magazines and lade Journals

Bte. Published by McGraw-Hill. One Phoenix Mill Lane, Peterborough, NH 03458. From its

inception, Byte established itself as the most credible tech nical read in the small

systems (desktop) world. For those in the multimedia industry responsible for following

technical trends, this is the key journal. In recent years, with the rise of multimedia,

Bte has become exceptional at following relevant technical trends in computer

architectures and software engineering.

CD-ROM Professional. Published by Pemberton Press, Inc.407 Kingston Avenue, St. Paul, MN

55117-2424. This cmagazine has gained a high level of credibility with multime dia

content developers. Appropriate to its name, the magazine fo cuses on technical and

marketing issues having to do with CD ROM as a delivery medium for multimedia content.

CD-ROM World. Published by Mecklermedia, 11 Ferry Lane West, Westport, CT 06880. Though

this magazine covers much of the same ground as the other multimedia trades, it does seem

to be developing a specialization in one area: the review of CD-ROM titles. In an

industry that is crying for standards of criticism, this orientation is a welcome one.

Computer Graphics World. Published by PennWell Publishing Company, 10 Tara Boulevard,

Suite 500, Nashua, NH 03062-2801. Increasingly, this magazine is becoming a must-read for

those in volved in the authoring of multimedia content. From a tradition he tavily

focused on specialized computer graphics programs, CGW has transitioned into the center

of the multimedia industry by re orienting its feature articles that deal with the

cutting edge of authoring technologies. The magazine is particularly strong in the field

of nonlinear, all digital software tools; a hotbed of activity that is leading Hollywood

in the direction of a collision with Sili con Valley perhaps a year or two ahead of the

schedule set by the San Andreas fault.

Desktop Video World. Published by TechMedia Publishing, Inc. 80 Elm Street, Peterborough,

NH 03458. A relative newcomer, this trade journal focuses on issues surround ing the use

of digital media on desktop machines, primarily the PC, Mac, and Amiga platforms.

Morph's Outpost (on the Digital Frontier). Published by Morph's Out post, Inc. P.O. Box

578, Orinda, CA 94563. Appropriately, this tabloid- Ystyle publication is one of the

most un usual trade journals in the industry. Its content profiles NewMedia fairly

closely, though it possesses a somewhat stronger orientation to content creation and

interviews. This publication may validate the long-held suspicion about the screws and

bolts rattling free in California.
Macworld. Published by Macworld Communications, Inc. 501 Second Street, San Francisco, CA

94107. Inasmuch as the Macintosh has continued its two to three year lead over the PC

platform with respect to media capabilities, this maga zine finds itself in the center of

the multimedia industry almost by default. Though its product range is narrow, this is an

excellent magazine for following developments in multimedia, particularly with respect to

the many authoring tools that have become

frontrunners   " through their historical tie to the Macintosh platform Macworld also

does an excellent job of illustrating basic computer concepts for the neophytes,

possessing perhaps the best art depart ment in the trade magazine industry.
Multimedia Today. Published by IBM Multimedia Solutions, 4111 Northside Parkway, HO4L1,

Atlanta, GA 30327. This publication raises the concept of consultative selling to an art,

using a trade journal to showcase and explore IBM's multimedia product offerings. The

magazine is particularly strong on case stud ies, and each issue provides an extensive,

detailed catalog of IBM business partner multimedia products, including sections on

courseware and production tools.
Multimedia World. Published by PC World Communications, Inc., 501 Second Street, #600,

San Francisco, CA   - 94107. Brought to us by the same people who publish PC World, this

maga zine is positioned in the same approximate niche as NewMedia. Its contentÐto use the

term du jourÐis not of the same consistency or quality.
NewMedia Magazine. Published by Hypermedia Communications, Inc. 901 Mariner's Island

Boulevard, Suite 365, San Mateo, CA 94404. In many respects, this magazine has become the

Byte of multime dia. Its lead features are uniformly strong and strike at the key is sues

facing the industry. Their annual Multimedia Buyer's Guide represents a substantial

contribution to the industry, not just be cause it helps organize the information about

who is selling what, but also because the editors have taken the effort to have it also

help categor Íize the exploding media phenomena that are multimedia.

PC Magazine. Published by Ziff-Davis Publishing Company, One Park Avenue, New York, NY

10016. A stalwart of the PC industry, this magazine has its fair share of multimedia

articles, in parallel with the overall industry trends in that direction.

Upside. Published by the Upside Publishing Company, 1159-B Triton Drive, Foster City, CA

94404. This magazine has a well-executed focus on technology issues as they relate

specifically to investment. Though the topics range pri marily in the direction of

general computing and telecommunica

tions, it is an excellent source for those in the investment banking business, or for

those who are Íinvestors in the stock market.

Videomaker. Published by Videomaker, Inc. P. O. Box 4591, Chico, CA 95927. As media

production equipment becomes increasingly digital, maga zines such as these become as

excellent source for those members of the multimedia development team who are responsible

for pro ducing the clay.

Virtual Reality World. Published by Mecklermedia, 11 Ferry Lane West, Westport, CT 06880.

A sign of the times, this publication brings a sober approach to virtual reality. Though

some of its entries tend to evangelize a bit, most attack their futuristic subject matter

from an appropriate, even scholarly perspective. Refreshingly, many of the articles come

with detailed footnotes and bibliographies.