

VIEWPOINT

On the Road to an All Digital World

Searching for Compelling Applications Along the InfoRoute

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In the last five to seven years, consultant reports, hot new conferences, and magazine articles have fueled the PC industry's fascination for topics such as the latest multimedia products; the imminent merger of the computer, cable TV, and telecommunications industries; and the forthcoming explosion of high-end computer games. In its constant search for the next high-volume markets for microprocessor-based products, the industry has been very tolerant of lagging sales and of the confusion associated with new product categories and emerging markets. Numerous startups have received financing and shipped early products. We certainly can point to successes like sound cards, CD-ROM drives, QuickTime software, Sega, and Super Nintendo, but also to companies like 3DO that have only promised success.

The basis of our interest in this new All Digital World is rational. After all, it seems quite certain that an All Digital World will create such a change in our use of information that, like the PC, it will dramatically change the way we work and play. This change will create a burst of new products, resulting in explosive growth for several existing markets or, even better, the emergence of several yet-unforeseen large markets. But despite these great possibilities, there is a frustrating lack of consensus on user requirements and on the role of the various technologies.

This confusion should not be too surprising. The technologies used are relatively well understood: we know that their cost will come down significantly, so the only real issues deal with product trade-offs and customer acceptance, which we all know is very hard to achieve and to anticipate. In our rush to embrace new products, we continue to forget that their markets are typically much slower to emerge than originally hoped, and that the ultimate compelling advantages of new product categories are usually not recognized when these products are first introduced.

Instead of trying to cover all relevant markets, I will focus on four main themes for the All Digital World: interactive multimedia; the digital convergence of the computer, cable, and telephone industries; entertainment versus information; and the Information Superhighway.

The interactive multimedia market provides a good example of applications that did not evolve as expected. The much-touted digital convergence is, for the time

being, nothing more than wishful headlines, at best several years ahead of its time. The critical importance of games and entertainment in the PC industry has been reestablished. And finally, personal access to information is the compelling reason that I do not dismiss the incredible Internet mania as just another fad. This article concludes with a review of the lessons learned in the past few years and my projection of the winning trends for the vendors of microprocessor-based products.

Interactive Multimedia

Of all the promised digital markets, interactive multimedia was the first to burst on the scene. The vibrant desktop publishing market was very influential on early expectations for the multimedia market. As color monitors, image display and manipulation, sound playback, and postage-stamp video became affordable, it seemed logical that users would want to add interactive video and sound to PCs saddled with black-and-white WYSIWYG text. Bit-mapped displays and laser printers had been the enablers for the compelling application of desktop publishing, making everyone their own publisher. Now video and sound could enable a new multimedia market in search of a compelling application.

Given the limitations of most PCs at the time, or even today, a PC playing a sound file from a floppy disk cannot compete, in sound quality or price, with high-fidelity stereo equipment playing Mahler's Ninth Symphony. Similarly, a few seconds of video in a window the size of a postage stamp does not compare with a VCR playing 180 minutes of *The Longest Day*.

New markets for snippets of sound and video were required. The most obvious application for sound clips was to enhance the effects in computer games. But this application, which is probably the reason that most PCs are now equipped with sound cards, helped an existing market by enhancing existing products; it did not create a new market. We wanted to find new markets!

Because PCs could use only snippets of sound and video, we convinced ourselves that "interactive documents," in which one could attach these snippets to some hypertext structure, were a large new market. By clicking on a keyword or button, a sound or video snippet would be played. Since users were free to click or not, they could interact with the media and participate in a totally new form of communication requiring a PC: interactive multimedia. What a large market it was going to be! Following the example of desktop publishing,

perhaps everyone would become an interactive multimedia publisher and user.

The major problem with the interactive market is that there is no consensus on the definition of interactivity. Depending on the content of this rich media—made of text, sound, and video—we want different interactions for a game, an encyclopedia, or an atlas. Depending on the target audience—kids, students, or adults—we probably want to organize the material differently.

Interactivity is at the core of games. But beyond the current fad for hypertext multimedia documents, I continue to wonder how large a market for information these electronic documents will represent over existing documents. Leaving these doubts aside, it is now clear that creating multimedia documents is very hard, time-consuming, and impractical for most people except for professionals. We should have known this, as we all have many stacks of unorganized family photos and unedited camcorder tapes at home.

So the expected large market for interactive multimedia publishing turned out to be a much smaller market for authoring tools and an emerging publishing market for CD-ROM titles. In the same way that we do not have bit-mapped-display conferences and magazines, maybe we should not have multimedia conferences and magazines. It is obvious today that the large new markets projected for multimedia products are the existing markets for information publishing and games plus the new market for multimedia accessories.

Merger of the Titans

Communications is hot again in the computing business. The deregulated telephone giants are getting more competitive, especially as the intelligence and microprocessor content of their products are increasing. Recent consolidations are sweeping the less-regulated cable TV industry, and banner headlines trumpet the convergence of the computer, cable TV, and telecommunications industries.

In the All Digital World, bandwidth is important for distributing image and video; each industry brings a different piece of the puzzle. The telcos, equipped with their reliable fiber network, provide the basic transport layer, while the cable industry owns the last coaxial mile to your home. In the meantime, the computer industry, armed with interactive knowledge and Newton-like products, is ready to invade the telecommunications industry. (I kid you not! Newton may not be a success, but at least its PR was superb.) Add to this environment exploding cellular networks, HDTV, and thorny regulatory issues, and we clearly have legitimate reasons to pay attention to the digital convergence of these three industries.

The realignment of the turf in each of these industries creates natural confusion and great opportunities for new product categories and emerging markets. Given

Digital MegaFlops

Many of the products described today as the symbols of this emerging Digital World seem to arise from the ashes of highly visible failures from another era. The oldest one is the AT&T Videophone, introduced well before the PC, that used analog technology and a coaxial connection to the central office to provide a service very similar to what is now being claimed by the vendors of desktop videoconferencing. The next example is Videotext, a TV-based information service with dedicated protocols to the home, very similar to what is now provided by Prodigy and other on-line providers.

The home PC market, symbolized by the PC Jr. from IBM, is the next example of the wrong product category: a low-cost PC with limited and awkward features “tailored” for the home. It was replaced several years later by game consoles and only now by full-fledged business PCs cheap enough to be used in the home.

CD-ROM digital books run the risk of being the next failed category if the industry does not respond quickly to the criticisms mentioned in a recent *Wall Street Journal* article: they are simply too hard to install and too slow to use. PDAs with only a pen-based interface have taken a fall, dragged down by inadequate handwriting recognition software; they may never recover.

the titans involved, small undercapitalized startups may have a hard time competing for these new opportunities. But the fact that these three giants are lusting for each others' markets does not a new market make. Once again, we have enabling technologies or competitive environment changes in search of a compelling application that will justify investing in new products.

At various conferences, some companies have taken the stand that industrial applications, such as desktop teleconferencing, will emerge first (the opinion of computer companies for the most part), while others believe that home broadcast entertainment applications will emerge first (the view of most cable companies or telcos). I am convinced that this merger of the titans deals only with the cable providers and the telcos. The computer industry may provide enabling technologies—such as microprocessors, compression chips, or ATM switches—but it will have to wait for the cable and the telephone companies to provide the transportation infrastructure, and these companies are currently more focused on the broadcast entertainment application.

No convergence will really take place until a significant number of homes are served by broadband services, and we should not expect this until 1997. Given the significant regulatory issues raised by such networks, I would not be surprised if it was delayed until 2000. Both telephone and cable companies are adopting each other's strengths and building a fiber network with

coax to the home. This, I believe, is excellent for an All Digital World but promises to increase the deregulation battles between these titans.

Looking for Winning Home Applications

What will be the compelling applications? There is much talk of 500-channel cable, movies on demand, home shopping everywhere. More channels are likely, but 500 seems more of a PR statement than anything else. Movies on demand may be a reasonable service, but with 10 minutes between start times (i.e., an average wait of 5 minutes), only 90 channels are needed to broadcast the ten most-requested movies. High-speed connection to information services through the cable channels may be an important service (perhaps a 56-kbps channel to the Internet for every home!). Most logical applications are being tried in test markets, but it will take some time before winning applications will emerge.

We do not have to believe the awful and silly MCI Information Superhighway ads with Anna Paquin saying, "It won't connect here and there, because there will be no more there." The reason all these telecommunications giants are installing fiber and broadband to the home is not because they had a vision of 500 multimedia channels. Wiring of homes is strictly a maintenance cost-saving strategy of replacing existing equipment with fiber. In the current vacuum of compelling applications, it is significant that a broadband infrastructure will be available in any case, as we would not want to be dependent for this service on another market destined to collapse later, like the Videotext market did (see sidebar). The question seems more to be, "when will it arrive and with what type of regulatory constraints?"

I expect the role of the computer industry to be restricted to the design of microprocessor-based enabling products. Currently, most of the attention is focused on the set-top boxes necessary to provide these new services. HP, Silicon Graphics, and other computer vendors are participating in trials. Set-top boxes contain a microprocessor, memory, an MPEG decoder, and an interface to a monitor—much like a PC with compression.

Will the set-top box be the computer for the TV? Or will the PC become the interactive TV of the future? The arguments go as follows: TVs are ancient, low-resolution devices in need of a technology overhaul. PCs now have more resolution and provide the interactivity needed for these new services. Pushed to the extreme, these arguments result in a PC on the Internet being the TV of the future. On the other side, much is made of the fact that TV sets are an advertiser tool viewed from a distance in a "home theater." A PC, on the other hand, is viewed from a few inches and has no advertisements (what a relief!), and thus will not compete with the future TV.

I tend to side with the view that the TV of the future may have many components similar to those in PCs and

will have as much resolution. But because the intended use is different (home theater versus close-range interaction), the initial overlap will be small.

A key question that impacts the introduction of advanced set-top boxes is who will purchase them: users, cable providers, or entertainment providers? The answer may have more impact on the initial services and features of the box than many other factors, since millions of users times a few hundred dollars per box gets quickly into the billion dollar range!

Compression Is a Clear Winner

In all of this confusion, there is a clear winner: compression. In less than four years, compression has become a necessary element of multimedia sound and video, future cable TV plans, CD-ROM encoding, the Internet, and HDTV. MPEG-2 dominates video hardware compression plans. There will be a few more standards for software-based compression (for example, lossless compression for data, others for video and sound) and finally, standards for voice-only compression. Much to our benefit, this standardization process is actually very fast. Indeo and other close-but-nonstandard solutions may not survive.

Entertainment vs. Information

In the previous analysis, my focus was on broadcast entertainment: one source and many recipients at the same time. Personal entertainment devices, like games or CD-ROM electronic books, are different because they are used typically by only one recipient.

In an attempt to describe this All Digital World better, there have been suggestions that we should divide applications between those targeted at the home (i.e., entertainment) and those aimed at business (i.e., information). Unlike the rarely mentioned Videotext, whose failure does not seem to have left much of a lasting impression, the early home-computer fiascoes still resonate in the computer industry and may have been the first road kill of the Information Superhighway (before we even knew it existed). Mention the home and most computer companies, until recently, have tried to change the subject to business applications. But as desktop publishing made its greatest impact on the graphics industry, and multimedia authoring tools permanently changed video production, the computer industry, encouraged by the success of PC games, is reconsidering the importance of entertainment applications.

The impact of shaded 3D graphics on movie special effects need not be repeated here. But there has always been a paradox in the use of technology in the arts: compelling art touches our emotions, and the tools to achieve this personal connection with the artist are somewhat irrelevant, although they may help a lot in conveying his or her vision.

Peter Gabriel's interactive CD-ROM is hot because its music is very good. We are touched by Pedro Meyer's CD-ROM *I Photograph to Remember* not because it uses multimedia sound and images but because the story of the last years of his parents' lives is so compelling. On the other hand, the Spark Concert at the recent Digital World conference was absolutely awful, because 30 high-end workstations transforming sound and video in real time only made bad artistry worse. As one astute observer said, "We will have sales of multimedia-based entertainment and supporting hardware only if the entertainment is compelling."

Which brings us back to 3DO, Rocket Science, and other highly visible attempts to use sophisticated computer-based products for the next generation of 32-bit games. Both combine venture-capital backing with a Hollywood mogul style, taking lots of risks and using lots of money. 3DO is licensing a new platform and Rocket Science is a game developer. Both are betting that their unique approaches to the game market are correct and, more important, that their timing is right.

Once CD-ROM, hardware compression, and 32-bit RISC performance are used, the quality of the game experience will be so much better than today's games that users will flock to these high-end systems. These companies are faced with the same dilemma that faced Gavilan or Momenta: it was not sufficient for them to predict correctly the importance of laptop computers; everything was in the timing and the implementation. Hot new startups like 3DO and Rocket Science will not survive because of their technology alone; they need hot game titles to justify the purchases by their customers.

If there is a lesson from all of this, it is that games were the application that sold most PC multimedia components. Once in place, these components then enabled emerging business and information applications such as rich-media databases and desktop teleconferencing. In fact, I expect that the existing personal entertainment market (i.e., games), with its relentless need for 3D shaded realism, will be a very strong force behind increasing the processing power and bandwidth available on the "Game Desk."

It was only 15 years ago that the first ports of UNIX to a personal computer were made on a Z80. Now that processor sells for about one dollar and is used in washing machines. We can only dream about how much power will be on the Game Desk in a few years. Cray performance will reach the home within five years!

Riding the InfoRoute

Starting a year ago, we have been thrust upon the Information Superhighway, quickly renamed the National Information Infrastructure or the Infobahn (if you believe *Mondo*, *Wired*, and other technopunk magazines). But I guess I have the right, in this world of ob-

tuse technology, to rebel against the cult of the nerd persona and the excess of metaphors behind the Infobahn: road warriors, road kills, highway lanes leading nowhere. I prefer to use the already proposed InfoRoute name, taking advantage of an existing networking term.

From dirt roads to sky lanes, it is easy to see that this metaphor will provide no common understanding of this road and where it leads. As the interactive multimedia market did with the CD-ROM market, this projected new market will in a few years turn into a much simpler reality and product set.

But there is something more to the frantic level of interest in the Internet—or Mosaic, or commercial Internet applications—beyond a mere warm welcome for new applications or markets. I believe that, with the increasingly PC-literate public, the easy access to information symbolized by the Internet is a compelling story. Markets emerge for new products that provide a compelling advantage for users. That was the case for the PC and its driving applications: word processing, desktop publishing, spreadsheets, accounting packages, and databases. In a world where all forms of communication, from instant 24-hour TV news to advertisements, are used to achieve societal and commercial goals, access to information is a significant form of control and power.

This relationship between information access and empowerment in our jobs or lives is what makes Internet mania an important phenomenon, not an amusing fad. It is somewhat irrelevant whether we use the Internet itself or an equivalent InfoRoute. Technology will deliver high bandwidth at low cost. Easy access to information is the compelling reason that some InfoRoute applications may explode into large new markets. In a world overwhelmed with too much noise and irrelevant information, the ultimate way of responding to user needs is to provide methods for easy discovery, easy access, and easy use of relevant information.

The applications have yet to be designed, but with the communication technology available and a significant customer need ready to be fulfilled, I have very high expectations for the InfoRoute of an All Digital World: information access for all. But if the ease of discovery, access, and use, the pricing, or the quality of the information do not fulfill customers' control and power needs better than existing solutions, we will see another home PC market bite the asphalt: a logical concept but a flawed set of products. At this early stage of development, I believe there is only a 50/50 chance that this market will reach its projected very large size.

Hindsight: A Powerful Tool

Four years of hindsight make it easier to learn the lessons from the multimedia segment of this All Digital World. The industry correctly sensed that the availability of sound cards, color displays, and video playback

would result in significant application growth. These enablers were the engines behind the growth of applications like games and digital books (CD-ROMs). They impacted these applications greatly, creating new product categories but not new markets per se. Digital books, such as CD-ROM encyclopedias, will become a vibrant new product category only if they provide a compelling advantage over their hard-cover counterparts. Digital books will coexist with paper books, not replace them.

The second lesson from the unreached multimedia market is that vendors of enabling technologies—color displays, sound cards, CD-ROM drives—did rather well. They were helped by the hyped projections of growth but succeeded because they focused on the early practical applications, such as games. The size of the authoring tool market is a far cry from the initial projection that everyone would be their own multimedia publisher; if this had been the only new market, the growth of sound cards and CD-ROMs would have been dramatically smaller. Note that these multimedia accessory markets have fierce competition and all the known challenges associated with accessory markets, including the later inclusion of the accessory on the motherboard or in the base PC configuration.

The losers were the multimedia application vendors that projected faster and wider acceptance of products wrongly targeted to you and me instead of the professional tool user. This is an interesting reversal of what had happened in the computer-aided publishing market, where the early vendors of professional tools were overrun by the vendors of desktop publishing tools for a broad range of consumers.

Finally, the most interesting conclusion is that games, not any business application, drove the need to buy multimedia PCs. If there is a business reason for multimedia, it is the better human interface that hopefully can be derived from it. But such an interface, while improving existing applications, does not create a new market. Only now can we talk about the impact of multimedia PCs on the already existing and specialized teleconferencing market. Low-cost digital cameras will accelerate the emergence of a large desktop conferencing market, complete with electronic white-boards. The videophone may finally become what it was projected to be in the 1970s.

The Coming Applications

Despite their fights, the cable and telephone industries will manage to establish a transport structure for the broadcast entertainment of tomorrow. For application developers attempting to introduce new services, one need only point to Videotext and the early Prodigy business problems to see that these are not businesses for the faint of heart. The existing cable entertainment providers are really in control of this market. In the most

likely scenario, no new and compelling form of broadcast entertainment will emerge from this confusion. Thus, these existing providers will stay in control, growth will be steady, and the speed of growth will depend on the rate of new broadband connections.

I believe that the early home-computer fiascoes are now forgotten, and we have rediscovered this market in the form of Nintendo-like products, soon to be 32-bit and CD-ROM based. The battles to define the Game Desk are, not surprisingly, reminiscent of the early Hollywood studio days. We can identify the game hardware providers (Sega, Nintendo, 3DO, Panasonic), the title creators (Rocket Science, Electronic Arts), and the studios/producers (Crystal Dynamics). As was the case with Hollywood, multiple roles are common, and roles will change as the industry matures. But one thing will stay the same: with high hopes for incredible returns, enormous amounts of money will be poured into highly visible “box office” failures as well as successes.

The PC won the battle for providing computing services by providing personal access to computing; the losers were time-shared mainframes. Personal access made fax boards worthwhile a few years ago, despite the existence of cheaper standalone fax machines. Personal access makes my palmtop the best phone book I ever had: I don't have to boot the computer to get a phone number, and it is always with me.

Personal access to information for all of us is the large new market that could explode, but only if we deliver its projected compelling advantages in practice. After all, information services like Lexis and Dialog have existed for years. The real promises are in the ease of discovery, ease of access, ease of use, and low cost. We certainly are willing to pay for services. But the greatest value of Mosaic may be that it is free and provides access to information on an Internet where the costs are often not directly charged to the user.

Despite its fairly crude interface, for several years Minitel has been very successful in France by providing easy access to information. It has more than 5 million connections and even more users (15 to 20 million) in a country of 60 million people. Minitel terminals are free. Fees for using the services (typically around 8¢ per minute) are charged on the user's telephone bill by the state telephone company, which splits the revenues with the service providers. Still, many information services are free. Despite its lack of support for voice or image, this simple pricing structure and the right set of services—from telephone directory, airline and train schedules, and mail ordering of goods and tickets to risqué bulletin boards—are behind its success.

The Winners

Technology enablers like sound cards, modems with voice capabilities, digital cameras, and video accelera-

tors have done well because they allow the computer to communicate better with us. Logitech, very perceptively, uses the word SenseWare to describe these accessories that enhance the human interaction. These devices will thrive, provide significant advantages to some applications (like games), create new product categories (such as electronic books and desktop conferencing), and even help fuel new markets.

Compression technology, both hardware and software, is the next winner. Bandwidth and storage are always limited, and our perceptual capabilities accommodate the loss of information often associated with them.

High-density storage technology (like CD-ROM) will thrive. Even with compression, several digital books are at the limit of the CD's current 600M capacity. I believe that we will soon need media with capacity in the 3–5G range (four to eight times more).

Multimedia PCs are another winner. They provide the SenseWare accessories, computational power, compression, bandwidth, and storage increasingly needed for advanced interfaces and rich media. High-end games are the next winners. Increasingly realistic simulation is needed, consuming all available megaflops.

Finally, networking products are the main layers of the "TelecomWare" needed for easy access to information. We currently are witnessing a battle of proposed standards against older ones: 100-Mbps Ethernet and ATM vs. existing Ethernet and FDDI; frame relay vs. ISDN. Speed, at least, is the winner here.

Many Killer Applications Needed

If we all had a broad, shared understanding of these markets, their customers, and the role of technology, there most likely would be few new opportunities and slow growth. Marketing and technology specialists like me love to project future product opportunities, large emerging markets, and new channels of distribution. But given this "beneficial" confusion, it is increasingly difficult to find our way around.

I think this difficult stage in the rise of an All Digi-

tal World (an All Difficult World!) results from the continued neglect of four important principles:

- There will not be one product or one market but instead many variants of existing product categories.
- There will not be one killer application.
- Enabling technologies must provide compelling advantages to their supported applications.
- Any application must be compelling to survive.

Technology in an earlier era exploded the number of ways to be transported. Despite the view of the 1930s "Buck Rogers" cartoon, we do not have only one type of vehicle for all our transportation needs, so why would we have one market for all our information needs? Similarly, there will never be only one network for information, or one type of interactive book, or one sales channel. In looking for answers, we may have unrealistically asked for one gigantic killer application to define the All Digital World market. In reality, there will be not one but many killer applications, all based on high-end multimedia PCs, set-top boxes, and Game Desks. The applications for this All Digital World will be as different as the moped and the jumbo jet.

To the microprocessor industry, this is good news, since microprocessors and PC accessories will be used in an increasing number of markets, each requiring some specific and compelling reason why a digital solution is better than previous solutions. To be compelling, the application will need to either touch our emotions or provide a significant perceived value to the user. SenseWare PC accessories achieve this. By allowing the computer to communicate with us through our senses, they provide a significant advantage to applications like games or media-rich information. But we cannot expect a smart house to be successful if, to turn a light off, one needs to boot a computer and then select the appliance on a menu—a switch by the door will do fine, thank you. ♦

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