COMMUNICATION SCIENCES RESEARCH CORPORATION

The Evolution of New Media in Canada: Phase I, *Overview*

A report prepared for:

DEPARTMENT OF COMMUNICATIONS

Ottawa, Canada

March, 1991

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Mr. Richard Simpson,
Director General,
Telematics and New Media,
Department of Communications,
300 Slater Street, 6th Floor,
Ottawa, Ontario,
K1A 0C8

Dear Mr. Simpson:

It is a pleasure to be able to forward to you our report on phase I of the project, *The Evolution of New Media in Canada.* As you will see from reading it we have concluded on the basis of this early, preliminary research that there is very substantial promise in this new field. In fact, some researchers in the U.S. have already placed values of as much as $16 to $25 billion on products and services legitimately included under telematics and new media in the mid- to late-1990s, and at this stage we have not found reason to doubt such estimates. On the contrary, the potential for expansion is very great, when one considers the following findings:

1. Speeds, memory capacities, and capabilities of personal computers and computer workstations are increasing at a terrific rate, with recently announced machines (PCs) operating at 40 megahertz (up from substantially less than half that today, on average); random access storage of 24 megabytes (from 1-2 megabytes currently); disk drives with 300-600 megabytes and more vs. a 'large' disk of 40-100 megabytes today; and so on. Workstations, of course, operate even faster, and some capable of speeds as high as 60-100 million instructions per second (mainframe speeds until just recently) are coming soon.

2. These machines, and many like them, will accommodate virtually any type of input and output one could want or need, from text, to voice, to music, to graphics at extraordinary resolution, and even, of course, full-motion video with real-time compression and decompression--thus making possible a full range of multimedia capabilities for education and training, animation, real-time 'visualization' of the insides of buildings (a tremendous boon to architects, for example), highly sophisticated entertainment, and many other 'wonders.'

3. In the telecommunications field, similar things are occurring. For example, full video, in colour, is now being transmitted successfully at 768,000 bits per second versus 90 megabits per second, as a result of the development of highly sophisticated, mathematically based compression and decompression algorithms. Moreover, satisfactory performance, at least for some uses, is possible at 56, 64, 112 and 128 kilobits per second (kbps), and improvements in such services are occurring every day. At some point, therefore, transmission of video on the equivalent of today's voice circuits (i.e., 64 kbps) will be possible, ushering in, for the first time, economical, switched transmission of video signals.

4. Printing, publishing, film production, television production, graphic arts, fine arts, photography, business, and entertainment will all be impacted by these changes. In fact, our expectation is that virtually every kind of knowledge- and creative-talent-based activity will stand to benefit from these new machines, techniques, software and capabilities, from engineering to art. In the process, education and training will become easier and more effective; communication among groups and individuals will become even more ubiquitous than it is now, with many more options to choose from; health, security, and cultural

institutions will benefit from more sophisticated data collection, storage, retrieval and dissemination means; and entertainment and expression will gain tremendously as opportunities for the development of multimedia platforms is exploited.

The attached report goes into more detail on these matters. It should, however, be pointed out that the document is still but an overview of the field, as it was intended to be according to our current contract. Thus, much work remains to be done to understand the field thoroughly, and you will accordingly find, as the last part of the report, a brief outline of what we believe should be undertaken next. Specifically, our proposal is for a much more detailed approach to the subject, looking for growth patterns of specific components, interviews with key industry players, development of an annotated compendium of present and potential Canadian participants in the market, and so on. With this information at hand, a complete, true, and accurate picture of how the field is developing, both in Canada and elsewhere, will be achievable.

It has been our pleasure to undertake this work on behalf of the Department. We hope it will be useful and informative to you and your staff, and that others will have an opportunity to read it as well. If you have questions or would like to discuss portions of the report with us, please do not hesitate to call.

Sincerely yours,

COMMUNICATION SCIENCES RESEARCH CORPORATION

R.W. Hough
President

CONTENTS

I Introduction and Background

This report is the result of the first phase of a study concerning The Evolution of New Media in Canada. We have titled it *Overview* because its objective is to review the field only briefly, touching its high points, with more detailed work to follow in a phase II project. Readers will here find,

1. A discussion of *enabling technologies* and enabling *industries* that are central to the development of telematics and new media in the future, including personal computers with enormous memory size compared to today's machines, voracious appetites for computations, and many other technical advances;

2. Analysis of the *convergence* of these different influences and streams of development, from both enabling technologies and enabling industries, into multimedia, hypermedia, virtual reality (called "visualization" now, by its practitioners), advanced forms of telecommunications, other sophisticated applications, and, as well, simple and unsophisticated but still highly practical and useful applications;

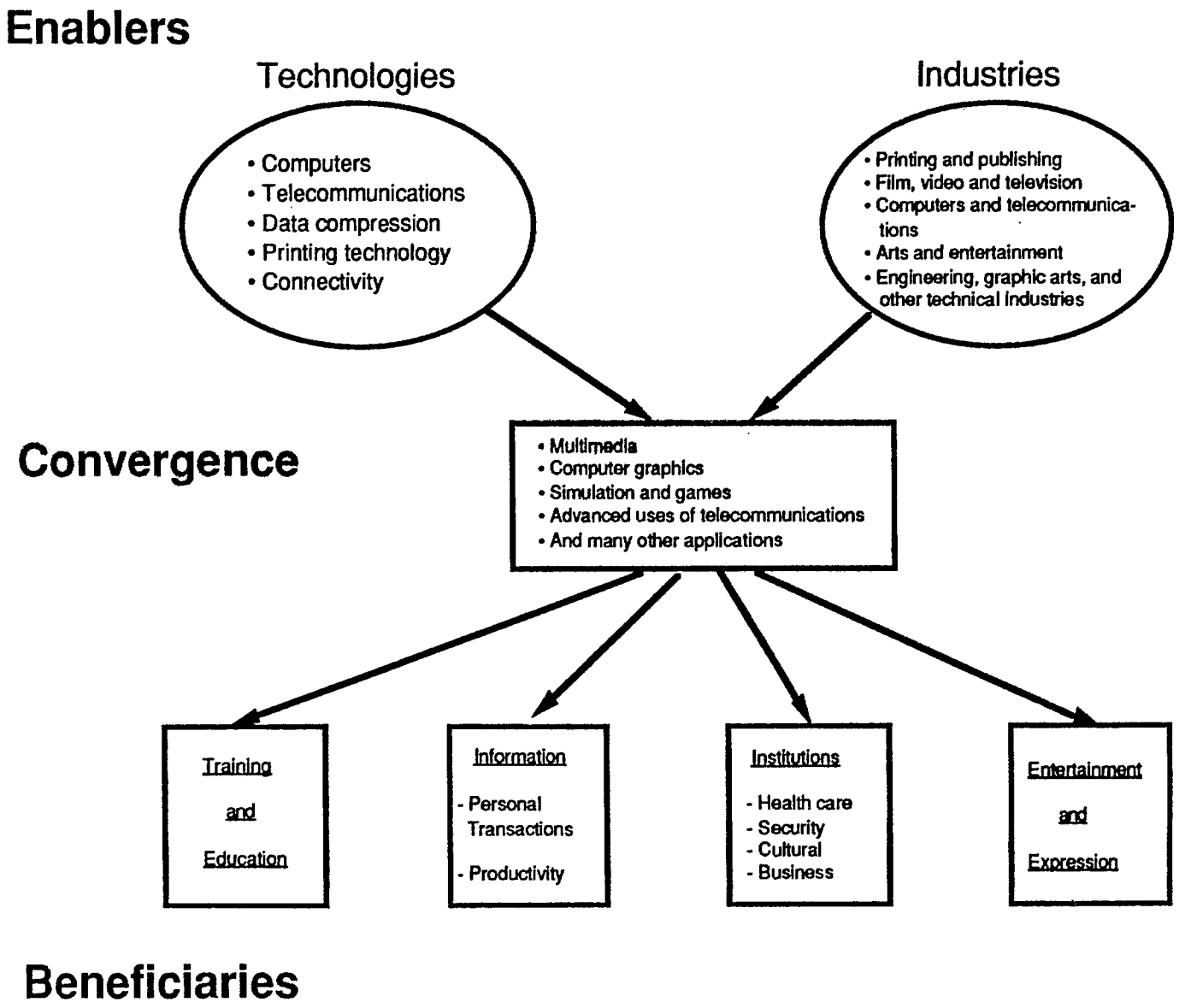
3. A discussion of who *benefits* from such changes and advancements.

In addition to the above, a brief section is included which considers, preliminarily, how Canada might participate in new media markets and what more needs to be done to understand the field thoroughly, and in much greater detail.

The chart on the page following sets the stage for the report. Briefly, there are an enormous number of technical and technological developments under way around the world, which will influence the growth and progression of multimedia and new media activity. Of these, we have singled out what we believe to be five of the most crucial areas of influence, computers, telecommunications, data compression, printing technology, and connectivity, to illustrate the situation.

Coincidentally with the above, five key industries, or areas of economic activity, have also been singled out as fundamentally important to the progressions taking place. These enabling industries, including printing and publishing; film, video and television; computers and telecommunications; arts and entertainment; engineering, graphic arts, and other technical industries, combine with the technologies identified to produce new media and multimedia applications (center of chart), which then can be used to provide benefits to a wide range of individuals and institutions as shown in the boxes labeled 'Beneficiaries.' (The latter, it should be noted, include artists, writers, composers, librarians, one-person consulting organizations, engineers and so on--that is, a truly broad array of contributors to Canada's culture, both individually and collectively).

The report deals with each of the above major sections in turn, followed by Chapter V, Summary and Proposal for Phase II.


Enablers
Technologies
• Computers
• Telecommunications
• Data compression
• Printing technology
• Connectivity
Industries
• Printing and publishing
• Film, video and television
• Computers and telecommunica-tions
• Arts and entertainment
• Engineering, graphic arts, and other technical industries
Convergence
• Multimedia
• Computer graphics
• Simulation and games
• Advanced uses of telecommunications
• And many other applications
Training and Education
Information
- Personal Transactions
- Productivity
Institutions
- Health care
- Security
- Cultural
- Business
Entertainment and Expression
Beneficiaries

II Enablers

Enabling Technologies

Computers

By far the most important of the technologies and technological developments identified on the previous chart, is *computers*--and, in particular, *personal* computers and *workstations*.

The reason for this is two-fold. First, these machines, especially PCs, are becoming more and more accessible to more and more people, providing greater opportunities on a continuing basis to undertake projects that in the past have been left to specialists. Secondly, the capability of these machines has been increasing almost beyond measure, while at the same time prices have been falling like the proverbial 'stone,' thus again making the machines accessible to more groups and individuals, not just 'big business.'

Figures 1 and 2 show, briefly, just how fast some of these changes have been occurring. From 1985, for example, memory sizes have increased four-fold and more, computational speeds have increased ten-fold and more, secondary data storage (hard disk drives in particular) have gone from '*none*,' usually, to commonly 40 megabytes today, at least, and often much more (i.e., 100 megabyte hard drives are not unusual now, from essentially a standing start five or six years ago).

This power-on-a-desk-top has not gone unused. To the contrary, buyers of PCs and workstations want more power, because they continually want to do more with the machines, and they continually want them to operate instantaneously--either to repeatedly recalculate and update a gigantic spreadsheet, totally change and reformat a word processing document, realign, resize, rotate, and transfer a complex drawing from one place to

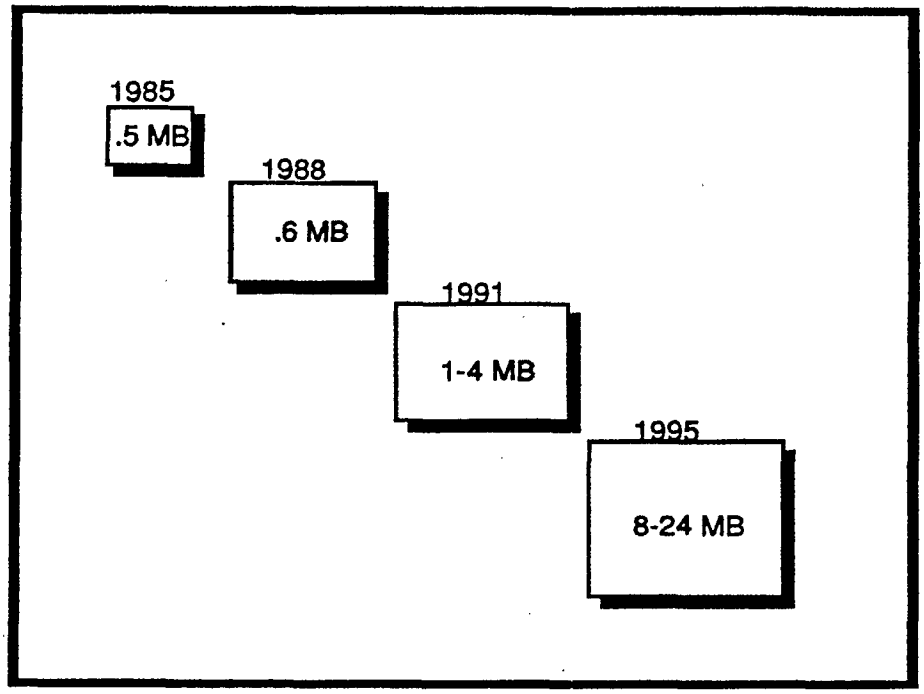


Figure 1 Growth of Memory Size, 1985-1995

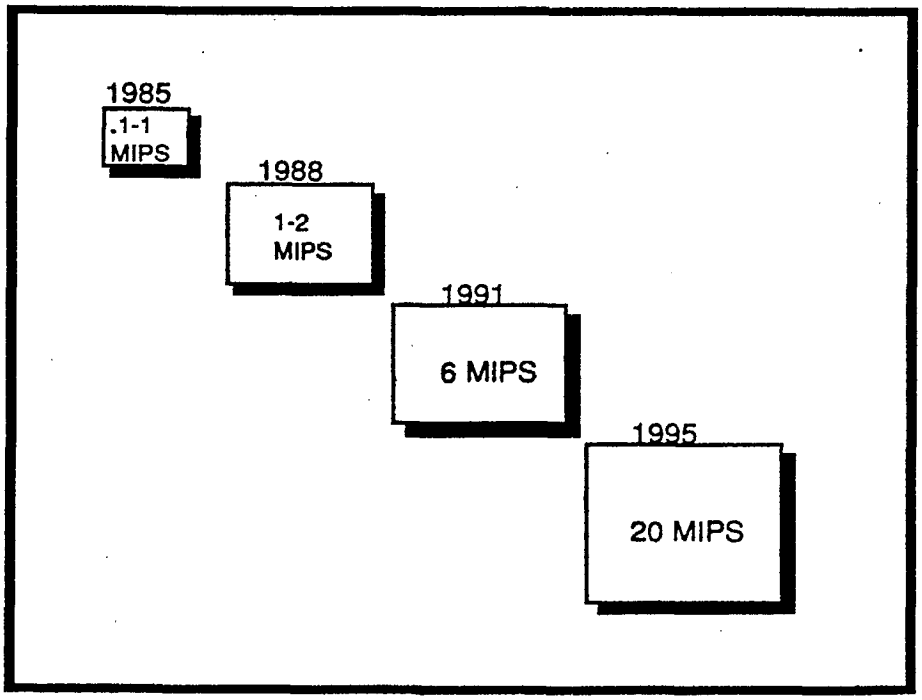


Figure 2 Growth of Computational Speed, 1985-1995

another in a document--or even between documents--or any one of thousands of other operations these machines are capable of.

This progression will not stop. Instead, 8-24 megabyte machines will be commonplace in the future, operating at many times the speed of today's equipment (plus, of course, workstations and larger computers that operate even faster), and these are the kinds of equipment capabilities that lend themselves to sophisticated text, graphics, audio, video and multimedia applications.

Telecommunications

In the telecommunications world also, many changes have been occurring. Of these, the most significant development to date has been the massive shift toward digital as opposed to analog transmission, especially in the U.S. but in Canada as well. This did not happen overnight, of course, as the first operational digital systems were installed in 1962. However, after the breakup of AT&T in the U.S. in 1984, the pace of transition to digital circuits increased enormously, since AT&T's competitors began installing long distance fibre circuits at a feverish pace (especially U.S. Sprint), and began using this activity as a very effective *marketing* device to increase market share at AT&T's expense.

Since that time virtually all interexchange, long distance carrier circuits have become digital, and this provides, among other things, instantaneous and highly effective means by which compressed video transmission can be accomplished. This in turn can be used for many purposes, not least being economical, two-way videoconferencing, a multimedia service by its very nature, since it combines at least voice and video, but often text and graphics as well, plus facsimile. Moreover, modern-day implementations of conferencing and group working include the use of electronic blackboards (or, more accurately, 'whiteboards'), computer screens and tablets that can be written on simultaneously from two or more locations,

and sophisticated, completely open and transparent (i.e., *non-switched*) voice circuitry. These kinds of systems have gained increasing popularity recently, at least in part because of significant economies achieved with reduced bandwidth.

Data Compression

Data compression requires discussion from two standpoints, first, with respect to telecommunications (i.e., transmission) and second, in the context of computers, for data storage, processing, input, output, and so on.

We have touched on the first of these above. What is worth noting, however, is that compressed video is only one use of data compression in telecommunications. In fact, far more commonplace today, is the use of compression algorithms to transmit *facsimile* messages. This requires compression, because speed is what is needed to initiate and maintain market interest (specifically, a less-than-one-minute-per-page machine was the original goal), and to get to this speed or higher, Group III and other advanced equipment 'squeezes out the white space' on a page, and transmits only black or grey, depending on machine resolution, grey scale capability, and other factors.

In the realm of computers, compression has not been quite so crisis-laden, until recently. What has just begun to happen, though, is that truly enormous files are getting ready to be manipulated, by computers. In the main these are files that have *time* associated with them: that is, they represent many 'images,' not just single ones, and they are presented to the computer with great rapidity, thus making storage extremely difficult. This means, again, that compression is required.

The farthest advanced of schemes to do this today is called DVI, for Digital Video Interactive. Recently, Intel Corporation, the current owner of the rights to DVI, developed a hardware chip set with the mathematical

algorithms for DVI built into it. With this hardware, Intel has demonstrated more than a 100 to 1 compression ratio for video material, thus making possible as much as 72 minutes of video on a compact disk CD-ROM, that is, in 600 megabytes or so. This accomplishes, in turn, two purposes. First, it can be used with the personal computers discussed above, to essentially convert them into multimedia machines, and secondly, such compression techniques can, at least theoretically, provide the means by which full-length movies could be distributed very inexpensively on audio-CD-sized disks, to, in fact, compete with video rental stores.*

For the sake of at least partial completeness in this section it is necessary to simply mention that DVI is not the only advanced compression scheme under development. On the contrary there are many others, including CD-I (for Compact Disk – Interactive), JPEG (Joint Photographic Expert Group), MPEG (Motion Picture Expert Group), CDTV (Commodore Total Vision) and hybrids--that is, combinations of the above. In essence, these are standards competitors, much as VHS and Beta were in the early days of VCRs. Thus, time will be required to sort out which schemes survive and which do not.

Printing Technology

It has been suggested by some, recently, that multimedia means 'no printing.' While this may be the case in some instances printing is still highly important and it, too, has been improving by orders of magnitude while again coming down in price. Audio and video multimedia practitioners may anticipate not needing such capabilities, but fine artists,

* N. Negroponte, of MIT's Media Lab, has referred to this idea for some time, calling the scheme the "Paperback Movie." So far, it is not quite yet here, but the possibility exists, and many firms are hard at work to accomplish it. Much more on this, as well as a more thorough review of data compression in all its aspects, is part of the objective of Phase II.

graphic artists, writers, desk top publishing firms, consultants, designers, architects, business, and virtually everyone else will.

In this area, progress has been just as remarkable as in the technology areas already referred to. This document itself, in fact, is a manifestation of how far advanced we are with these machines compared to as little as five years ago. For example, the entire document, including charts and figures, was constructed on a machine just like those described above (in this case a Macintosh), and in particular the chart on page 3 was created, typing was entered, the chart was then rotated to print sideways, resized to fit properly on the page, and 'imported' instantly from one software program into another. Then, when the chart was printed, the type also, even being resized and printed 'on its side,' reproduced clearly and without obvious dots.

Bearing in mind that this is "extremely simple stuff" compared to what else is available, in colour, and at very high resolution, it is easy to see that printing, too, will contribute to transforming computers into more and more versatile devices for more and more uses. This again is new media, because it represents a totally different level of expression from what has been available in the past.

Connectivity

Connectivity represents, perhaps, the least understood manifestation of new media. What we are principally referring to is a phenomenon that in many ways has gone almost unnoticed so far because it happened so quickly and has progressed worldwide almost overnight. It is the connection of many computer networks together to form Internets--that is, networks of networks.

As with everything else in this abbreviated report, details are impossible to give. In brief, however, hundreds of thousands of computers all over the world now have access to each other (the latest estimate is some 800,000), and users are estimated to number in the millions. This has

occurred because of innovative methods of sharing costs, use of telecommunication circuits at night when costs are low, sophisticated transfer and connection schemes, and so on. The result is that people are using, again, a totally new medium to communicate, much as facsimile has expanded also, over the last five to seven years. We suggest, then, that just as data bases, videotex, multimedia and so on are included under the rubric of telematics and new media, the connectivity phenomenon needs to be as well, and investigated thoroughly.

Enabling Industries

We intend this section to be very short. Principally, all that needs to be said is that the impetus for changes such as those described above is coming not from the technologies themselves but from user industries. That is to say, one can be confident that these markets will expand because it is *user-pull* that is driving it, not *technology-push*.

Principally, as we have said, the enabling, demand-generating industries are printing and publishing; film, video and television; computers and telecommunications (note that these are users as well as producers of the technology); arts and entertainment; engineering, graphic arts and other technical industries. In addition to those industries, there are stakeholder institutions that perform key roles as industrial and research partners, and that also represent significant numbers of users--educational institutions, hospitals, libraries, museums, and other public or non-profit organizations.

We have given a number of examples of how new media transformations will occur. In the next chapter we indicate additional ones, drawing from some of the user industries mentioned above.

III Convergence

At the level of new services and products, convergence means the bringing together of different sources of information such as text, graphics, sound, and video. This involves the capability to store, manipulate and display an aggregate of information that was originally encoded in a number of different ways. Convergence of services and products therefore means, simply, the bringing together of many streams of activity, many influences, many media, and many new user needs, with advanced capabilities to meet those needs. Several examples are: multimedia; computer graphics; simulation and games. We discuss these briefly in this chapter.

Multimedia

As this term is now generally used, multimedia refers, specifically, to the added capabilities of personal computers to handle sound and video as well as text and graphics.

Some computers, particularly the Macintosh, have had rudimentary audio capabilities almost from their inception--for example, playing simple tunes, with software for that purpose. What is now on its way however is hi-fi quality, audio CD sound, with digitizing boards to cover the full frequency range (20-20,000 hertz usually) and do it in stereo as well, if desired.

On the video side also, many new pieces of hardware and software are being developed. For example, video boards are now available for a few hundred dollars that make it possible to view an analog video signal--off the air, via cable, from a VCR, or a video camera--in a window on the screen of one's PC. Moreover, the window can be moved around on the screen, resized, and continue to be viewed, even while working on something else in another window, somewhere else on the screen.

Generally, an application such as this does not require compression (although it would normally require digitization) because it works basically the same way as 'Picture-in-Picture' on high-end television sets. However, some such boards include 'frame-grabbers' as well, that allow one to freeze and store, in the computer, a single frame, which can then be manipulated later.

For most multimedia practitioners the above would be small potatoes. Instead, what they are interested in is highly compressed video that can be manipulated--cut, spliced, inserted into a presentation, enhanced, modified, with colour changes and so on. What this represents, in other words, is a post-production studio, on a computer.

According to most recent articles on this subject, video production studios based entirely on a computer--say, a high-end Macintosh or one of the recently announced NeXT machines--comes very close to what is required. We are again 'not quite there, yet' according to most experts, but that time is not far off. When it arrives, once again the versatility of the computer will have proven itself in another demanding application, just as it has in desktop publishing, graphic design, engineering and so on.

In the meantime, the machines we have are being used, with very sophisticated software (MacroMind Director is an example) to create multimedia presentations--for sales presentations, Board of Director meetings, stockholder meetings, product announcements--anything, in fact, that requires or could profitably use generous dashes of television-like, and television-quality, presentations. These represent, probably, the majority of uses of multimedia to date. However, as before, many more applications are coming, including those employing interactivity with sound and video on CD-ROMs (Grolier's interactive encyclopedia and Discis Books from Discis Knowledge Research in Toronto are examples), classical music courses (Practica Musica for the Macintosh), a complete set of audio notes for Mozart's *The Magic Flute*, and many, many others. These few items illustrate, very

clearly, that culture has also come to these machines, as well as spreadsheets and word processing.

Computer Graphics

Perhaps the best way to illustrate the dramatic nature of computer graphics today is to refer to an example or two in areas such as magazine publishing.

The first example is the January 1991 cover of the journal, *IEEE Computer Graphics and Applications*. It is startling because, at first glance, one tends to assume that the image on the computer screen in the picture is *the* "computer graphic." Instead, the whole cover picture is a computer generated image, including the desk, keyboard, lamp, calendar, bookshelf and so on. It is described in the magazine this way:

> The cover picture is not a photograph of real objects. It is a ray-traced image of a fictitious workstation environment displaying a radiosity solution of a complex, nonexistent factory scene.*

Greenberg describes how the picture was made in very complex terms that are unnecessary here. What is important, though, is to realize that even today, truly remarkable things are possible in achieving realism on a computer. It is important in the context of new media, moreover, because it is these capabilities that are now becoming available to visual artists, as well as engineers.

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* Greenberg, Donald P., "About the Cover," *IEEE Computer Graphics and Applications*, January 1991, p. 6.

Another computer graphic that could easily be mistaken for a photograph, titled "Lily Pond," was created by D. Fowler and J. Hanan at the University of Regina, Saskatchewan. This image is important enough to have been featured as the inside back cover of *IEEE Computer Graphics and Applications* in the same January 1991 issue. This particular graphic is also important because it illustrates that Canada and Canadians are participating in these astonishing new developments.

Simulation and Games

"Virtual reality" and "visualization" are the subject matter of this section. These terms, we recognize, could easily be written off as simply the latest computer buzzwords. In fact, they are not that at all. Instead they are *attempts* to describe additional remarkable uses of computer power now available.

Three examples suffice. First is the situation in which an architect, say, has created in a computer a 'model' of a building design on which he or she is working. This model can now be manipulated such that the building can be viewed from many angles and perspectives, inside as well as outside. Moreover, this can be done in real time, giving the impression that one is 'walking' through the building--through doorways, down hallways, up stairs, into other rooms and so on. These methods will prove, over time, to supplement and perhaps even replace expensive and time-consuming physical model building, using conventional techniques.

Games provide the second illustration. In this case we are all familiar with "Star Wars-type arcades" and, of course, Nintendo. Virtual reality is not about to stop there, though, because what is coming next is '*force feedback.*' Here, some type of device, say, a steering wheel or a joystick, is made part of a servo system that gives physical, force messages back to the user, operator, or game player. An example already on the market, is "...an Atari video game called Hard Drivin', which transmits the physical forces on a race car through

the steering wheel—conveying the sense of bumpiness when the driver veers off the road."*

Finally, at the high end of visualization, is a machine called BOOM, for Binocular Omni-Orientation Monitor. This device, manufactured in California by a company named, appropriately, Fake Space Labs, is used by NASA's Ames Research Center to model fluid flows, and to 'experience' them through a stereoscopic eyepiece system using a computer, without the need for wind tunnels, huge buildings, and other expensive pieces of equipment and hardware.

It is, without question, clearly recognized that examples such as these (particularly the latter two) are not for everyone. Our purpose though is to illustrate briefly what is happening at many levels of research and development in new media and multimedia. Practical applications will flow from these experiments, when the market is ready for them.

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* "Reach Out: Touch is added to virtual reality simulations," *Scientific American*, February 1991, p. 134.

IV Beneficiaries

Education and Training

Video disks have been with us for many years, but have experienced disappointing markets. According to reports less than 5 million units have been sold to date (60% in Japan) as against an estimated 200 million VCRs, demonstrating to most observers that the medium of tape, including rentals and the ability to record, is far more palatable to consumers than purchasing a movie or some other material on a disk.

Nonetheless, *interactive* disks have shown market promise, because they perform a function impossible to achieve with tape, namely, random access. This has been used, very successfully, in special purpose systems for education, training, reference manuals in work related situations (automated 'how-to' manuals for example) and other similar situations.

The new media aspect of this is exactly what we have already described --that is, the ability to condense video material onto audio-CD-sized disks. When this is done, the versatility of interactive sound, text, video, diagrams, graphics, full colour photographs, and every other conceivable media will be available on the same kinds of machines we are using now--personal computers and workstations. Moreover, software can be written for the machines, at many levels, that allows for the creation of CD-ROM titles for kindergarten through adult education and for virtually unlimited training software, reference manuals, management training, work related simulations and so on. Recent examples are:

- A desktop simulator for British Rail drivers;
- A generic training package for a UK computer firm;

- A program for teaching sign language to deaf students;
- Training and diagnostic packages for the automotive industry; and, of course, the
- Discis Books for teaching reading, mentioned earlier.

(The latter, it might be noted, are indeed for school age and younger children, as well as those up to 10 or 12. They consist of interactive, CD-ROM-based 'books' whose pages appear on a computer screen. Children use the mouse to turn the page, point to words (which the computer pronounces, with syllables), and listen to the book and interact with it either in English or in one of several other languages, including French).

Information

Our chart on p. 3 referred to two categories of information beneficiaries, those who gain from new kinds of personal transactions, and those for whom productivity is the chief benefit.

Personal Transactions

An example of personal transactions is electronic mail--with voice added, graphics added, and even moving graphics or animation. These kinds of systems are being worked on by many people, because it has now been shown, repeatedly, that the most-used aspect of information systems such as Minitel, CompuServe, GEnie, Delphi--and Alex as well, in Canada--is communications: that is, people like to 'talk,' even using typewritten messages. Graphics adds to this capability, and voice as well--in, for example, certain business situations.

One of the chief reasons we anticipate more use of communications via computer (in addition to the high degree of connectivity mentioned earlier) is the great reduction in cost of modems. Today for example, in the U.S., a 2400 bit per second modem can be purchased for $99....something unheard of as recently as a few months ago. Some manufacturers moreover, including IBM, have started to include built-in modems in their machines, bundling the cost with the price of the equipment.

Productivity

In doing the research for this project, we first explored traditional, online data base searches using InfoGlobe, Dialog, the DOC library's DOBIS system and so on--that is, we approached the problem in a manner exactly like what we have used many times before. However, it was also our good fortune to be pointed in the direction of something new--namely, computer reference data on CD-ROMs.

Because these disks had only just arrived, we were not aware that they were available in the library and had not used them. When we were introduced to the system though, and to the extent of the data base on just one disk, we were not only astonished but delighted: we could do our own searches, we could browse for an unlimited period of time without running up online connection charges, we could go back and forth with different kinds of searches, we could select and print whatever we wanted to--and, we could even download files onto disk, for later searching and printing on another machine.

Our conclusion from this experience is essentially being 'sold' on new media, for many, many purposes. As titles continue to be added to CD-ROM libraries (there are several thousand now and the list increases daily), more and more PCs will come equipped with CD players--NeXT already does this as an option--and more software will be written to handle the material.

Institutions

We now come to an area of particular interest: the use of new media in health care, security, cultural, and business environments.

Health Care

Doctors and other health professionals are often on the leading edge of technological developments. This is the case with new media and multimedia also. For example, reference has already been made to force feedback in the context of simulation and games. In fact, the key use of this technology so far is in experimental medicine and chemistry. One example was recently described this way:

> Force feedback adds feeling to the sight and sound of virtual reality....[A recent exercise in] force feedback allows a chemist to control a servo to move a drug around a display until it binds with [an] enzyme at its lowest and most stable energy state. ... The display shows the relative positions of the drug and the enzyme, and...the software that controls the servo represents both force and torque in three dimension.*

Security

The DOC, through its Canadian Heritage Information Network, has begun a major undertaking to develop a new media application on lost or stolen art works. DVI equipment will be used to 'capture' digitized and compressed images of works of art owned by Canadian museums and institutions. Because these images are to use this latest technology, including compression, transmission of images for security purposes will be many

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* *Scientific American*, op. cit., p. 134.

times faster than it would otherwise be, while at the same time requiring less bandwidth. Thus, images can be transmitted rapidly on ordinary phone lines, negating the need for special purpose networks and equipment. Police forces around the world will take advantage of the network to keep track of and identify stolen art works.

Culture

The above project represents an overlap between security and culture, since the subject matter being protected is art objects, paintings, and other valuables. There are other examples as well, though, including the following:

The Ontario Ministry of Culture and Communications has embarked on a five year project (1989-1994) called the *Smart Library*. Located in Toronto, the Smart Library , as envisaged, would feature one hundred work stations equipped with the latest access and transmission hardware. There would be work stations available which can draw upon the gamut of storage formats (CD-ROM, CD, CDI, CDV, CD-ROM XA and DVI). Users would also be able to access online services, such as commercial databases, teleconferencing, and distance education.

In addition, a multimedia electronic library called *Medialog* is currently being developed by the Canadian Workplace Automation Research Centre (CWARC - Communication Canada) in partnership with On/Q Corporation, the Cinémathèque québécoise, and the Montreal Museum of Fine Arts. This project features a multimedia database (text, graphics, photographs, audio recordings and video sequences) dealing with the arts and cultural industries. The database is to be accessible to users in areas outside major urban centres: DVI-based workstations will be set up in public libraries and universities and linked to an 'intelligent network.' Medialog is scheduled for completion in the Spring of 1992.

Business

Business, as we have said, is where most multimedia is happening so far. Many predict though that this concentration will not continue to the same degree in the future. Instead, as software becomes more plentiful, CD-ROM units grow in number, and computers become ever lower in price and more capable, other segments of the economy will use them. Nonetheless, business will always be a big user of these systems.

The reason for this is simple: business , in general, has 'more money' than anyone else. Thus they can afford the latest, most sophisticated, and most upscale devices, including high powered graphics, animation, sound, video and all the rest. Multimedia demonstrations at widely attended press briefings (Microsoft, Apple, IBM, etc.) are testimony to this.

What is likely to be much more important though, in the future, is the 'very-much-more-capable-machine' on average, ordinary desktops, just as we described earlier. These machines, often with quite inexpensive CD-ROM drives attached, will allow multimedia to come into small and large offices all over the country. Output from this equipment may not be quite so glitzy as that used by Apple and others for 'big bash new product announcements.' But, the equipment will be useful, it will be effective (including printing), and it will work--because it will be simple and easy to use.

Entertainment and Expression

New media and multimedia represent many opportunities for those in the creative arts. The previously referred to "Lily Pond" gives a striking example of this. But computer art, including animation, is a whole new field of endeavor today and one illustration can't possibly convey its dimensions.

Unfortunately, it can't be done at all in an overview document such as this. Thus the best we can do is simply quote, however briefly, from a very informed article on this subject:

> Computer technology has become a dominant force in our society, introducing new potentials for the creative processing of information. This force is redefining our world, expanding our knowledge, and requiring a new level of visual literacy and syntax that will affect our lives at a fundamental level. New ideas exploiting computer graphics and visualization methodology and networks have rapidly changed the nature of scientific research. Other fields and institutions will soon be affected by imaginative models of visualization expanding our knowledge and how we communicate.
>
> The challenge for the artist is to make contact with these changes and use technology to give form to perceptions that can become a meaningful statement about our lives. Computer technology is redefining our world, and art should reflect these changes. By the year 2000--less than 10 years--I predict that artistic activity with the computer will begin to have an important impact on educational institutions and culture in general.*

* Csuri, Charles A., Art and Animation, *IEEE*, op. cit., p. 35.

V Summary and Proposal for Phase II

In this document we have been able only to 'scratch the surface' of a very broad subject, one that increases daily in its scope due both to advances in technology and to expanded uses of the technology. We know, now, what some of the possibilities are, and we know why the field is expanding--that is, it is a result of *demand-pull* forces as well as *technology-push* forces. What we do not yet know, but need to know, is how far this could be carried, specifically in Canada, through judicious and appropriate understanding and encouragement of Canadian participants in the market.

To do this requires more thorough study. In this section, we outline a workable plan for phase II. The scope of the enquiry is potentially vast, but further study could be managed and given focus by identifying a series of discrete projects with individual terms of reference. There is also good potential for such projects to be commissioned jointly by the Department of Communications with other departments or agencies that are interested in the development and use of new media.

Market Size

One of the most important things that needs doing, is to establish, with reliable, *effective* research methods, a better understanding of the numeric dimensions of new media and multimedia markets. To do this requires attention to historic as well as current data. For example, what has been the history of CD-ROM growth up to now (that is, for the last six or seven years) and is it possible that this area might be ready for a significant 'growth spurt' similar to what has happened recently with facsimile? If so, that would mean a great deal in the context of new media and multimedia markets.

Similarly, our interest will focus strongly on Canadian producers of multimedia products and productions, such as education and training materials and the Discis Books example mentioned earlier. An annotated compendium of Canadian firms participating in these markets will be a subsidiary output from this task, in order to both assist in sizing the market and provide input to policy decision-making options regarding stimulation and potential government initiatives.

Applications

Applications are at the heart of new media and multimedia: without them there would be no new field of endeavor called 'multimedia.' As we have seen, applications are possible from a wide range of business and cultural activities. Now, what are the details? How many of them are there? Can we classify them in some way in order to understand them better? Can we rank order them in order to ascertain 'greatest good for greatest number,' or 'success in the marketplace?' Do we want commercial success to be the only factor that's important, or is it also relevant to consider situations in which government or other institutional support (Canada Council, for example) is valid and necessary? Will Canadian firms need government support and assistance, in fact, or is this market going to be big enough, and Canadian firms strong enough, to sustain themselves without it?

Technology

DVI, CD-ROMs, compression algorithms, video at reduced bandwidth, computers that talk and television sets that compute--all are important to new media and multimedia in the future. Our objective in phase II will be to explain in much greater detail than we have been able to here, what these technologies are and why they are important. Interviews with key industry players will be a part of this, as well as much sifting and analysis of published material, including reviews, forecasts, technical data, and much more.

Institutions

Finally, we will want to examine how institutions fit into the picture:

- National Film Board
- National Library
- Other libraries
- Museums
- Canada Council
- CBC
- And so on.

All of these and many more will participate in new media and multimedia developments, either as sponsors, users of the technology, or recipients of its products and production, from animation, to commercials, to art, and teaching aids. How to help the field grow is what we will be looking for, and how to make sure that Canada participates fully.

Our intent in this document has been to introduce new media to a wider audience. We hope we have accomplished this, and that readers will have a greater appreciation for its potential in the future.