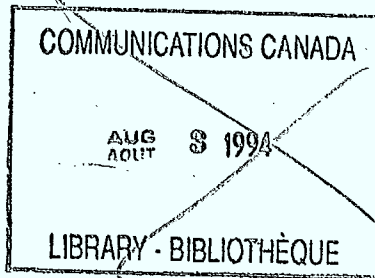
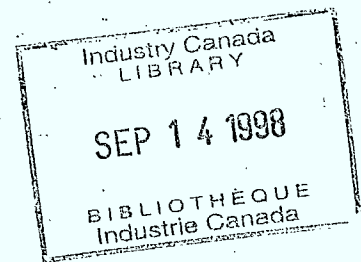


**THE CONVERGENCE AND INTEGRATION OF CONSUMER-ORIENTED
INFORMATION AND ENTERTAINMENT SERVICES**



Fred Van Geest
Communications Development and
Planning Branch
August, 1990

TABLE OF CONTENTS

I. <u>Introduction</u>	3
II. <u>Consumer Premises Equipment and Access Devices</u>	6
A. <u>The Television</u>	6
i) <u>Videoway</u>	9
ii) <u>Service Opportunities</u>	12
B. <u>The Telephone</u>	13
C. <u>The Dedicated Terminal</u>	15
D. <u>The Personal Computer</u>	16
E. <u>CPE Trends</u>	18
III. <u>Networks</u>	19
IV. <u>Direct Broadcast Satellites</u>	21
V. <u>Criteria to Define Services</u>	22
A. <u>Bandwidth</u>	22
B. <u>Interactivity</u>	23
VI. <u>Conclusions</u>	25
REFERENCES	26
APPENDIX 1	29

THE CONVERGENCE AND INTEGRATION OF CONSUMER-ORIENTED
INFORMATION AND ENTERTAINMENT SERVICES

I. Introduction

There is no shortage of electronic devices to assist the consumer in accessing entertainment and information services. In fact, the next decade may present consumers with a bewildering array of potential delivery media. These electronic tools will each attempt to provide a unique set of services to consumers. Although some new services may evolve, it is likely that many of these devices will just repackage the same type of services already offered via existing networks and media. Consequently, not all information and entertainment devices may survive in their quest to find a permanent place in the home.

Among the various devices, there are four types of consumer premises equipment (CPE) that are likely to figure prominently in the future as communications media: the television set, the telephone, the personal computer (PC), and the unsophisticated dedicated terminal of which the ALEXTEL videotex terminal is an example. There are also variations on each of these devices which will be discussed further on. One variation on the telephone, cellular communication, will be left out of the discussion at this time because currently 95% of cellular users are business subscribers, and the cost will prevent it from becoming a mass market media for quite some time. In any case, if and when it does evolve into what has been labelled personal communications network (PCN) services, the repercussions for other media will not be great. Cellular service will not replace or cut into conventional telephone service revenues because it still makes use of the terrestrial public switched telephone network. It will be a service for which customers will dig deeper into their pockets, not a service for which they reallocate their communication expenditures.

Clearly, definitions and the distinction between some of the CPE are somewhat nebulous now, and may become more so in the future. For example, how different will an enhanced telephone be from an unsophisticated videotex terminal? The point in making these distinctions though, is to develop an understanding of what type of electronic media will best satisfy a consumer's need and desire for services. This also necessitates an analysis of the combinations of networks and CPE devices which will provide the best match for a particular service. In a nutshell, the effect convergence will have on services will be defined by the best match between the CPE, the service(s) and the network over which the services are provided (see figure 1). It is useful to note that evidence suggests that consumers view their CPE as single purpose instruments, even if the instruments are capable of many functions. However, many of these devices have surreptitiously become multi-purpose in use. For example, the television set is used in conjunction with cable, VCRs, CAM corders, and video games.

Because of the fact that technology allows a large number of services to be provided by a variety of different service providers, it is increasingly difficult to understand communications services in clearly demarcated categories. The solution is to construct a framework in which communications services can be viewed from the point of view of the consumer. To this end, it will be important to examine or speculate on what services will be desirable and useful to consumers. What services will be convenient, affordable, and perhaps most important, in what medium will they prefer to receive their services? This is the only effective way in which the converging technologies can be understood with reference to the consumer. It is for this reason that the focus of this discussion will revolve around what are perceived as useful and effective CPE.

The critical factors which will have a large part in determining what services will be viable over the various mediums are some very basic quantitative variables such as the penetration rates of the various CPE (see figure 3 and 4). It is likely that the new equipment consumers will face, will be peripherals to existing CPE which have high penetration rates. In the recent past, compact disc players have become popular extensions to stereos, VCR's extensions to television sets, and answering machines extensions to telephones. Since countries experience different growth rates in the acceptance of new technologies, there is no one predetermined path to the future of entertainment and information services. For example, a country with a significantly higher penetration rate of television sets than telephones could follow a much different path than a country which has a higher telephone penetration rate than television set rate.

In discussing the effect convergence will have on consumer entertainment and information services, this undertaking will, in a sense, take for granted the main technological discussions focusing on the deployment of fibre optics and network architecture. It will not be concerned with the "battle for fibre to the home". Recent evidence suggests that there will not be a convergence of local distribution network technology for quite some time. Hence, significant convergence of service offerings is unlikely.¹ There is a great deal of truth to this, in the sense that for quite some period of time, cable companies will not provide telephone services nor will telephone companies be offering programming services. Figures 2 and 6 illustrate that POTS and basic cable still represent the source of major revenues and that convergence has instigated the introduction of relatively few other major sources of revenue. The Canadian Cable Television Association (CCTA) has stated that cable operators do not have the desire to get into telephone service and that network convergence is at least fifteen years away. Only the two largest cable companies in Canada, Rogers and Videotron, have long term plans for consumer services that include voice services.

¹ Poirier, Roger, "Calm Down About Convergence" Cablecaster, June, 1990,

These plans will not materialize for quite some time though, since they depend on a switched star network. The CCTA has further stated that the new cable endeavours into non-programming services for the home are expected to remain a small fraction of programming which is the core of cable business operations, and will continue as such. The exception to this may be Videotron which sees non-programming services as a major source of revenue in ten years which will replace the falling advertising revenues it foresees.

What much of the hype about convergence has cultivated, however, is a realization that there are new types of services that can be offered with traditional network architectures but with more advanced consumer premises equipment. This represents a trend to greater intelligence in the CPE as opposed to greater intelligence in the network. The director in the CATV division of a fibre optics supplier puts it like this:

"The evolution of new services will likely be enhanced as fibre becomes the most affordable medium for distributing cable television. Yet the overall rate at which new services emerge will primarily be governed by advances in programming and processing--and by the development of terminal devices that create new access and uses for the subscriber."²

These new services, many of which will be hybrid services, can potentially be offered by several different players in the communications market. To this end, the focus will be on the degree to which services on one medium and network will be complementary or competitive to services offered via other media and networks. For example, how will audiotex, videotex, and interactive video fare "against" or "with" each other. This is the only context in which network convergence as opposed to service convergence will be discussed, not in the context of who, if, or when broadband and/or switching capabilities will be provided. What this analysis will indirectly provide, is a more precise focus on the actual need for broadband technology. In this way it can contribute to the debate on the "battle for fibre to the home". This is more in line with a demand-pull approach rather than a technology-push approach. It will also be useful in wading through the rhetoric of telecommunications, cable, and other carriers as they try to persuade the regulatory authorities of their intentions.

A particularly useful method of sorting out what new services have a chance of becoming mass market services and which ones do not, is to analyze each of the above four media in terms of the bandwidth and/or memory and storage capabilities needed to provide services over them. The successful service providers will be the ones who know how to integrate these technologies in the provision of their services. For example, the same company might offer the same service via videotex, audiotex, or teletext.

² Cable tv Business, July 1, 1990, p.7A

Another method of distinguishing services from each other is to define which services are interactive and which are one-way broadcast. It is the network architecture which will determine this, therefore it will be enough for our purposes to state which services require interactivity and which ones do not. This is a considerable task in itself since there are a number of interpretations on what constitutes interactivity. An attempt will be made further on to clarify the meaning of interactivity. Initially, broadcast can be understood to mean "point-to-multi-point" distribution, while an interactive network is "point-to-point communication with unique addressing.

Once it is clear as to what type of services will be demanded, i.e. broadband or narrowband and interactive or broadcast, only then will discussions concerning convergence of network architecture be germane. Afterall, there is no sense in supporting plans to set up a network able to provide services for which there is no demand, before it is economically justifiable.

An important caveat to the above discussion is that forecasting consumer demand for services is a highly speculative task. Up until this decade, households have only had to deal with plain old telephone service (POTS) and basic non-interactive broadcast or cable television. It is not possible to know exactly how consumers will respond to the options they will face. It is possible however, to forecast the type of technology that will be in operation and what services can be provided via this technology. It is also possible to estimate the average dollar figure consumers are willing to spend on entertainment and information services (roughly \$35-\$40). Then, based on present and past experiences with information and entertainment services and equipment, some valuable insights can be gained. It must be remembered though, that it is the usefulness of the service that will drive the demand for any non-existent CPE.

II. Consumer Premises Equipment and Access Devices

A. The Television

The television set may be an attractive device to electronic service providers because of its high penetration rate. 99% of households in Canada own television sets, and many own more than one. Up to this point in time, the television set has been used primarily as a passive entertainment device, and as such, has lent itself ideally to uni-directional, non-interactive broadcast and cable television. It is a safe bet that the television set will at the very least, continue for quite some time in this capacity as an entertainment device.

The degree of interactivity of the cable television network is the subject of much misunderstanding and misinterpretation. Almost all broadcast and cable TV is now non-interactive. However, if a special keypad and addressable decoder is added to the television set and the

network is upgraded, then opportunity for limited interaction is possible. For some services the use of the telephone network may be required. The best way for this limited interaction to grow in use is to build addressable decoders right into the television set.

In present interactive systems, very limited subscriber response is transmitted on a cable uplink. Many cable systems have limited two-way capability (In the U.S. this has been required by law since 1972), but this is not two way operability. Limited bi-directional communication is only possible between a subscriber and the headend once the network has been upgraded. This requires upstream amplifiers and filters among other things. However, even if upgraded the network does not allow for bi-directional communication between different users. Thus, for interactive services to be provided exclusively over the cable network, the services must originate at the headend, or special links must be set up between the service provider and the headend. This usually means leasing lines from the telephone companies. To allow interactive communication between a user and a service provider directly, there must be a switch at the headend, and most cable networks do not support this type of switching facility. Usually, the telephone network is used to bridge these problems. In fact, most cable systems that offer interactive services depend on the telephone network for these connections as well as for all communication from the consumer because even limited bi-directionality is not possible on most cable systems. Thus, most cable systems (including Videotron) can only claim what can be called "uni-directional interactivity". With uni-directional interactivity no signals are sent to the headend from the subscribers residence, but specially produced programs allow the viewer to do the switching of any signals on the subscriber's premises.

There are two major limits as a result of this uni-directional interactivity. Since the present cable network can support a maximum of 150 channels if upgraded, there are only so many services that can be offered until the capacity of the network is completely used up, unlike the telco network which can support an unlimited number of services. To overcome this limitation, switches would have to be installed between fibre feeders and coaxial drop cables in the cable architecture.³ This solution, however, is in the distant future since most cable feeders are still coaxial cable. The second limit, is that unless switches are installed at the headend, and a working uplink is in operation, all interactivity has to occur on the user's premises. This means that the cable company will have to ensure that special interactive programming is offered. For any other service use of the telephone network is required.

Thus, the main factor which will prevent fully interactive television for quite some time yet, has to do with the network architecture. The limit of the tree and branch structure of the cable network is such that there are no switching facilities, and the costs of

³ Cablecaster, June, 1990, p.35

installing them are financially prohibitive for most cable companies. As long as the cable network does not have switching facilities, the consumer's interactivity with the headend will depend on the use of telephone lines.

However, some would argue that this limited interactivity is more than adequate for the kind of services consumers will demand. QZZ Inc. a Toronto-based group, claims to have developed the first and still only total concept for interactive television entertainment, education, and transactional services consistent with the existing architecture.⁴ There are others who also claim that no cable plant modifications are needed to provide Minitel-type services.⁵ Something as simple as a viewer response pushbutton terminal will allow subscribers to choose camera angles, select programs, participate in game shows, participate in polling, and respond to appeals or surveys with the telephone. Hybrid services that can be requested include home shopping, educational services, and restaurant reservations and menus. Oddly enough, these type of interactive services have not been widely embraced by the cable industry.⁶ Videotron's Videoway service in Quebec and Cablesare from London, Ontario have been the only significant cable company endeavours in this area in Canada. Perhaps the reason is that broadcasting regulations have ensured that the delivery of programming remains a high priority and that predictable reasonable returns have inhibited innovation. In the future, however, alternative programming sources such as satellite and VCRs, may force cable operators to diversify.

There is also one social factor which can prevent the television from becoming fully interactive for quite some time, if ever. And that is that many consumers view the television as a great way to waste time. Ralph Nader puts it like this:

"...going back to the cultural uses of time, one of the major cultural uses of time after work absorbs most of the day and sleep absorbs most of the night, and the necessities absorb part of what's in between--eating etc.--one of the major uses of time is wasting it; just plain wasting it; that is, even by the admission of the users of this kind of time, they'd rather be doing something else...It is not really as much volitional watching, as it is just despair watching; you sort of forget yourself--the electronic equivalent of opium or other substances. How do you get over that?"⁷

While some people may make use of an interactive television, the continued success of passive one-way television does not depend on these

⁴ Cable Communications Magazine, September 15, 1989, p.3-5

⁵ Cable Communications Magazine, March 15, 1990, p.53

⁶ Cable Communications Magazine, January/February, 1990, p.11-17

⁷ Ralph Nader, Telematics, vol. 7 No. 1, p.53-62, 1990

users since many appreciate the television solely for its passivity. A delicate balance must be struck with the desire for interactivity and the simplicity of the device so that the user will in fact use it. People do in general prefer more control over the programming they view, hence "interactive programming" may grow in use. But a radical switch from using the television set as a passive entertainment device, to an active informational tool for transactional services and the like, may be too much, too quick, for the average consumer.

i) Videoway

Videoway is the cable company Videotron's counterpart to Bell Canada's Alex. These two services are similar in many ways, but different in others. Introduced in Montreal on January 24, 1989, Videotron anticipates deploying 250,000 terminals by 1995. Currently, 25,000 terminals are in homes. Videoway is available to basic cable subscribers for an additional \$18.95 a month on top of the \$19.95 a month for basic cable. This extra charge includes one pay TV channel, which alone is worth around \$15 a month, plus converter rental worth \$2.00 a month, thus the incremental cost for cable, pay TV subscribers is only \$2-\$3 a month. There are no usage charges since the network is not capable of monitoring service use in this way.

There are several types of services offered on Videoway. One of the most innovative services they offer is what they call interactive TV. Specially produced programs allow the viewer to choose camera angles, choose a particular plot line for a program, and choose the outcome of a game show, or educational program. The system simultaneously broadcasts four or more camera angles or program options on separate channels. The Videoway terminal then translates these into one channel from which the viewer can select a camera angle. Because this is still one-way broadcast, this type of programming can be called "uni-directional interactive". Videotron expects this type of programming will cost 25% to 500% more to produce than regular programming, depending on the sophistication of the programming. While it may cost more to produce, this programming has more value to the viewer because the program can be viewed many times with different plot outcomes each time, depending on the choice of the viewer. The effect is as if the viewer actually watched several different programs. The incentive to watch a program again is even greater than watching a completely new program because viewers can ask "what if this happened..." and actually go back and view the program again. It is important to note though, that VCRs cannot tape this programming because of the number of channels required to offer it.

Game shows and educational programs are also produced so the viewer can interact with them. All the programming signals are sent to the viewer who then chooses the outcome of the program. This uni-directional interaction could be especially effective in educational programming.

CD-ROM interactive educational disks work in much the same way except

on a stand alone basis. Broadcasting educational programs to a large number of users may in fact be cheaper to produce than CD-ROM disks if economies of scale can be gained. Certainly, for the user it will be cheaper since it is not necessary to buy the computer hardware. Both forms of education can accommodate the user's specific learning needs by allowing the users to proceed at their own pace.

The significant thing about these uni-directional interactive programming services is that there are no competitive alternatives (except for the educational programming); they are exclusively enhanced television services. It is not a substitute for any other service or product and therefore aims at extracting dollars that are currently not dedicated to entertainment.

Videoway also offers games. These games can be downloaded on the converter/decoder with 128K of memory which has many of the functions of a low-end computer. The game can then be played at the user's leisure. This is a competitive alternative in both price and quality to special purpose game systems such as Nintendo or Commodore's Amiga.

Videoway's e-mail on the cable television network will be limited for the simple reason that the number of users to which mail can be sent is limited to those cable subscribers on that particular network subscribing to Videoway. The low volume of data the television screen can support is also a limitation. It is a hybrid service where users phone up the headend and leave their message. Other telecommunications e-mail services can reach a much broader user-base because of the interconnectivity of networks. Thus, cable e-mail does not pose a threat to other e-mail services, and will likely be used only because it is part of the bundle of Videoway services for which the user pays anyways. It will be more of an amusement type service, or a mass messaging service for advertisers. The fact that cable networks are not widely interconnected may restrict the ability of cable service providers to offer other services similar to e-mail such as chat lines.

The services that face the most competition from other media are the transactional services offered on Videoway. The services that will be the most likely to carve out a niche for the television, will be those services that depend on video images. For example, the television set is a much better medium for someone engaged in home shopping and needs to view a product to be convinced. This is not to say that all home shopping will be best suited for the television since there are some goods which do not need to be viewed before purchase. Since the telephone is needed to conduct Videoway transactions, cable television home shopping services must have an advantage over audiotex and videotex home shopping services which are conducted much quicker exclusively over the telephone lines. Still video images do represent this advantage, and in three years, moving video images may enhance this advantage if regulations permit.

It should be noted that Videotron is the exception among cable companies. Many smaller systems have no desire to get involved in this

type of service provision. This is curious, since most cable systems can provide uni-directional interactivity with some upgrading. Although there are no major changes to the network architecture as long as it depends on the telco uplink for many of its services, there are a few costs, before two-way capability becomes two-way operability. Upstream amplifiers and filters are needed, and the headend computer equipment needs to be upgraded. This would cost around \$50-200 per subscriber. The consumer premises equipment consisting of keypad, keyboard, converter or microprocessor, also needs to be installed in the user's home. A single addressable converter can cost around \$200-250. These may be the limiting factors for many small operators. Videoway may be an exception since it did not shoulder the full burden of the development costs. The system was developed over the last 12 years at a cost of \$35 million with substantial funding from both federal and the Quebec governments. And this is only for uni-directional interactivity. A truly bi-directional system would cost between \$1000 and \$1200 per subscriber because most of the distribution network would have to be rearranged to resemble a switched star network. This is because Videotron's cable network, as all cable networks, were designed for one-way broadcast services. Even if the capital existed to fund this type of network upgrade, it is questionable whether the subsequent revenue streams would justify such an investment.

An interesting thing about broadcast services such as datacasting, teletext, home shopping, and other "non-programming" services is that they can make use of both cable and telephone networks to support hybrid services (see figure 8). As noted, many of the services on Videoway do indeed depend on the telco uplink. Teletext is interactive in the sense that viewers "grab" a frame from the set with a keypad. This is exactly how Videoway information services work. The system stores up to 15,000 screen images in the central database which are transmitted on a continuous basis to subscribers on one channel. Viewers then "grab" the desired frame with a wait of a few seconds. These services are really one-way broadcast, and any consumer response is via the telephone to the service provider or headend.

To survive and be successful, Videoway will have to succeed where other similar types of services have failed. The poor performance of Telidon cable field trials, and the unsuccessful attempts of American CATV operators to provide such services are important historical examples. Time Inc.'s full channel teletext service was abandoned after a hundred million dollars of investment in the early 1980s and the lack of appeal of the interactive QUBE service around the same time are just two examples. If Videoway is to buck the trend there are two advantages it has which may help. First, it has a captured market, that being existing cable subscribers. Second, introduced in conjunction with Pay-TV, and superior converter technology (receiving unauthorized signals is almost impossible), it has the potential to be perceived as an incremental addition to an existing service. To support this foray into unfamiliar territory, Videotron expects to see new revenues from pay per view, specialty channels, niche advertising, and exports to its U.K. cable connections.

ii) Service Opportunities

What services then, have the potential to be delivered by television? Figure 9 summarizes the potential service opportunities. The television set in conjunction with the cable network or with VCRs will likely support continued growth in educational applications. One application is university courses offered over cable channels. Wilfred Laurier University's Telecollege has been in operation for over ten years now. It offers twenty-one courses to an enrolment of 1850 students. Although there are other methods of electronic education, televised courses are likely to retain a niche. However, these courses may evolve into the type of uni-directional interactive courses that can be offered on Videoway or Cablesare. There are other educational services will likely become interactive as well. An example may be taking courses on a PC which has a CD-ROM disk equipped with audio, text, and images and which allows users to proceed at their own pace. Typically, since education involves reading, writing, speaking, and listening, there may be a niche for broadcast, as well as computers with CD-ROMs, and VCRs with television sets. Textbooks and classrooms are not likely to disappear either. Thus, because of the nature of education these services will likely be complementary.

As a medium for entertainment services, the television will continue to be a popular choice, and does not face any immediate competition from other CPE, except for maybe games and some information services. These entertainment services running the gamut from traditional broadcast to pay-per-view (PPV), and over the air and interactive TV, can be provided via the cable network, a hybrid network, direct broadcast satellites, or via VCR tapes, although the VCR does not allow interaction. Whether or not high definition television (HDTV) will become a reality in the near future will not have a large effect on consumer services. The only difference is that it could make text more readable on the television screen. Entertainment services because of their broadband nature will be competitive only at the transmission level. This competition appears to be quite significant though, as the products and services provided via VCR, cable, satellite, and broadcast are not that differentiated from each other. While the gross revenues for the cable industry in 1988 were \$989 million, revenues for the VCR industry and private TV broadcasters were \$1 billion each.

In order for PPV to become a widely used service, subscribers have to be able to order on impulse and at the last minute before the program begins. This requires a significant upgrade in headend equipment for most cable systems. Only those subscribers with addressable decoders have the ability to purchase PPV programs, and in Canada this figure is at only about 10%. The number of addressable decoders is a significant number since many of the uni-directional interactive cable services depend on such a device. For PPV to become a significant revenue earning service, it is estimated that there needs to be a 30% penetration rate

of addressable homes. However, the number of addressable homes will probably contract rather than expand according to industry experts, because of a move towards trap technology.⁸ A single addressable device can cost between \$200 and \$250.

The television set is not likely to be a widely used device for information services excepting community information channels which already exist, and for applications which require sending information from one to many. However, this depends on the definition of information. Are documentary programs to be considered information? One limit to informational programming is that most television screens can not handle the volume of data necessary for extensive information retrieval. Another limit is that information services may require a degree of interactivity the cable television network or hybrid network does not have, at least in the short term. More importantly, the television set is perceived as a passive entertainment device, not an active information retrieval device.

The ability of the television to support transactional services is more difficult to forecast. This is most likely a group of services that will be competitive with other media, such as audiotex, and videotex. To the extent that these transactional services depend on video images to aid the consumer in deciding whether to conduct a transaction, they will be better provided over the cable television hybrid network. And it is an important point that all cable television transactional services are hybrid services that depend on the telco uplink. For the initial period services are provided, the service providers will likely offer services via several media capitalizing on the benefits of each.

B. The Telephone

The telephone is also a universal device with which consumers are familiar and comfortable using. The unenhanced telephone is capable of allowing the consumer to make local and long distance calls. This capability is not likely to receive a threat from any other CPE for just plain old telephone services (POTS). Nor is it in the foreseeable future that any other network or mode of transmission will be able to provide this service affordably to the consumer. Cellular service and personal communications networks (PCNs) have received a lot of hype, but the expense for these services is only justified for those with a high demand and value for mobile service; usually business users. It is therefore not a competitive threat to POTS but is a complementary service. Cellular service still makes use of the PSTN as a result of the two networks being interconnected. Thus, to the extent that cellular service grows, the basic POTS carriers will also benefit.

There are two major areas where convergence will affect the use of

⁸ Cable Communications Magazine, August 15, 1989

the telephone as a communications device. First, is the growth in audiotex services. These services include 900/976 numbers and are aimed at customers with touch-tone telephones. Because they depend on the consumers' ability to remember what they hear over the telephone, audiotex services are not suited to transmitting lengthy pieces of information. However, enhanced telephones with display screens could eradicate this limit, and stimulate a convergence with traditional videotex services. Right now, audiotex services are ideal for short messages, and transactions such as reservations, banking, and registrations. These audiotex services are growing rapidly and represent a group of services that depend on an unenhanced touch-tone telephone. Link Resources estimates the demand for 900 services alone will increase from the current \$455 million a year to \$2 billion a year in 1995 (see figure 7). The number of programs is estimated to increase from the current 2,600 to 24,000. Other forecasts are even more optimistic. BIS Macintosh Electronic Messaging services forecasts that the North American market for mailboxes will grow from 9 million in 1989 to 55.5 million in 1994. The Gartner Group believes that the voice processing segment will be \$4.1 billion by 1993.

By all measurements, there seems to be a consensus that audiotex and voice response services are a high potential growth area. These services depend on the switching capabilities of the telephone network and will therefore most likely be provided only over the telephone network. The way in which convergence affects these services is that they can be provided by three different CPE, the telephone, the dedicated terminal, and the PC. The only thing that distinguishes audiotex from videotex is that the user hears a voice and does not see text, but in most cases the same function is performed. Many audiotex and videotex services are identical. The main advantage audiotex services have are that there are far larger numbers of users who have a touch-tone telephone than have a PC or dedicated terminal.

The second area where convergence will affect the use of the telephone as a media device is the enhanced telephone. The definition of an enhanced telephone is a transitory one since "enhanced" is a relative term. For example, a telephone that allows the user to program numbers into memory, forward and transfer calls is an enhanced device relative to a device that can only make and receive calls. However, an enhanced telephone only has relevance to convergence if the device incorporates some type of visual display screen and is a touch-tone phone. Thus, for the purposes of discussion, an enhanced telephone will be defined as one that has at the minimum a display screen. These devices have been marketed before and have failed because of a lack of a need for such a device.

While an enhanced telephone could evolve into something that resembles and functions like a personal computer, the effective introduction of enhanced telephones depends on the consumer's ability to adapt the device to their current communication patterns. This necessitates an incremental approach to add-ons to the telephone. If consumers become familiar with audiotex services and using the device for

purposes other than conversation, then an enhanced telephone with a display screen could be viewed as a build-on to audiotex. Instead of listening to three choices before pushing a button for a transaction, one could hear and/or see more than three choices displayed on their enhanced telephone. Software might replace the dial tone with access to menus of functions. Obviously this would allow the telephone to be used to provide a wider array of services to consumers. As an example of this, Citibank recently introduced an enhanced telephone which is a specially designed product that comes with a miniature viewing screen and a keyboard, facilitating bill-paying and other banking activities. The phones cost \$49.95 to install, with a \$9.95 monthly rental fee. Users can pay bills, transfer funds, get a loan, review account journals and, in the future, get price quotes and trade securities.⁹ To those familiar with videotex, this will appear to be much the same type of service offered via a dedicated terminal or PC. Thus, with the advent of the enhanced telephone, it is likely that audiotex and videotex services will become directly competitive. While the service provider may have a choice of format, the carrier will remain the monopoly telephone company. While an incremental approach needs to be taken to additional enhancements, change in other media devices used for different applications may be converging in the same direction. It is quite possible that as personal computers become more familiar and user friendly, that there will be little difference between the enhanced telephone and the PC. This will be discussed further in section D.

As long as there is no broadband switching or broadband wire to the home, the enhanced telephone will not be a likely candidate for entertainment and educational services. Entertainment and education services normally require a wide bandwidth, because they usually depend on images. As well, unless the enhanced telephone develops to the point where it can access a CD-ROM or VCR tape, it won't be used for education services.

C. The Dedicated Terminal

Although the penetration rate of dedicated terminals for home use is very small, this may change. Bell Canada's strategy of renting these terminals for \$7.95/month and the acceptance of these terminals in French homes suggests that the unsophisticated terminal could become a popular device in a short period of time. Whether it does or not depends on its utility to the consumer relative to the utility derived from other devices. If there are other communication tools that perform the same functions equally well or better, than the dedicated terminal may be a short lived phenomenon. The other three devices discussed in this paper are general purpose devices, or are moving in this direction to compensate for the variety of different services that can be provided with a little enhancement.

⁹ The New York Times, March 3, 1990, p.16(N), p.48(L) and The Wall Street Journal, February 28, 1990, p.B1(W) p.B1(E).

Dedicated terminals based on the Minitel model are dependent on a switched star network architecture. The primary appeal of these terminals is that they are easy-to-use and are interactive. This makes these terminals ideal for information retrieval, messaging and e-mail, and transactions. Since these terminals are not already in place in most homes, the transactions which can be made with this device must be a major drawing card or else it will not be worth it to purchase or rent such a device when a telephone or PC can perform the same task.

This device will not be an effective medium for education and entertainment services. Even the terminals with better graphics capabilities (NAPLPS) do not compare with high quality computer graphics or television video games or Nintendo. The exception to this may be multi-player games. Such games exist in France, but are not substitutes for traditional media which games rely on. Moving images and video are out of the question for such a device since they depend on a wider bandwidth.

If ever conceived, the concept of an enhanced dedicated terminal would be a paradox. If this terminal were to be enhanced it would become much like a PC, which is a general purpose device, not a dedicated tool. The reason why the dedicated terminal is really just a stripped down version of a PC is to keep the cost low. Thus, enhancing the dedicated terminal so that the services it could accommodate would increase, would make the device converge with the PC in both capability and price. Thus, the need for a dedicated terminal would disappear, except maybe as a second or third piece of equipment. The PC can do everything that the dedicated terminal can except better. The only difference is cost. The one advantage that the dedicated terminal may have is that some consumers may prefer to deal with single purpose appliance.

D. The Personal Computer.

The dedicated videotex terminal may be only a temporary phase in the long-term development of the electronic information industry. The question may be whether there is a time period sufficiently long enough for unsophisticated terminals to satisfy consumer needs for electronic information, before the majority of consumers appreciate the advanced capabilities of the PC. In the long run, the contest between the modem-equipped PC and the dedicated, limited-function terminal as the access device of choice, will almost certainly be decided in favour of the PC. Future generations of PCs will have communications capabilities built into both the hardware and the software and the human interface will be greatly improved, so the machines will be easier to use.

IBM claims its PS/1, introduced on August 28, 1990 in Canada, will be this easy-to-use computer. Aimed specifically at the home market, it comes equipped with a 2400 baud modem built into the machine, and an easy-to-use icon interface operating system. Trial service subscriptions

to Prodigy and Quantum Computer Services come bundled with the purchase in the United States, and in Canada, ALEX and Suzy software come installed with the machine. The goal is to sell the computer as a communications device, as well as a stand-alone tool. Although the price of a low-end model is a modest \$1300, this is still significantly more than the cost of a dedicated terminal, or any other home entertainment or information device. IBM seems determined to make this computer as easy-to-use as possible. The computer is supported with 800-number technicians, and two separate on-line help services. In addition, if a mechanical failure occurs, IBM will immediately dispatch an overnight shipment with the part or unit.

The personal computer is by all measurements, the communication device that can support the greatest number and variety of services (see figure 7). Its only limit is that it does not work well with moving video images at this time. There are technological developments which are making headway at removing this limit, and there is a lot of hype surrounding these developments. One such product is Intel's Digital Video Interactive (DVI). Some estimate that by 1993 world sales of interactive video products and software will be about \$2 billion. The hardware components of PC-related interactive video include a video display, mass optical storage, an interactive user input device, a logical control device for the system or CPU, and an optional audio output device. Multimedia uses the computer to integrate and control other diverse electronic media such as videodisc players, CD-ROM disks, and speech and audio synthesizers, which has the effect of overwhelming the user's sensory perceptions.

The multimedia PC is a far too expensive and complex a tool to gain acceptance into consumer homes in the near future. If and when this does occur, it will most likely happen in an incremental fashion. This technology will first enter in businesses and schools before it hits the home. If all barriers are to be removed, then advancements need to be made in digitizing video signals, and additionally, to accommodate transmission of such signals, a broadband communications network would be also be required. This is often ignored by individuals raving that multimedia's "greatest potential lies in revolutionizing electronic mail." They say that "Multimedia will allow users to transmit a full range of business communications, including voice, images, animated sequences, and distributed databases."¹⁰

Aside from the grand ideas for the multi-media PC, which are largely business applications anyway, the PC already has many utilitarian applications for the average consumer. As the PC stands now, it is ideal for information services. The memory and processing capabilities give this device a huge advantage over other devices in vying for information services. It is also ideal for messaging or e-mail, transactional services, and employment at home. With the appropriate peripherals such as CD-players and large memory banks, the PC also becomes an excellent device for more advanced multi-media purposes, such as desk-top publishing and desk-top video. The potential to be an educational device

¹⁰ PC Magazine, May 29, 1990 p.69

is also great. Interactive CD-ROM allows users to proceed at their own pace, and can be a more stimulating educational device than traditional textbooks. These disks can also contain images and audio to enhance the presentation. As an entertainment device the PC can support games, and can also connect to chat lines and bulletin boards on videotex gateways or on-line services.

The paradox of the PC is that although it is the most useful device, very few households own one. Naturally, the cost is an inhibiting factor, as well as the fact that it is an unfamiliar and intimidating device to many. However, in the distant future, some form of the home computer is likely to win out in the battle for the consumer premises equipment. Computers will come with software already installed and ready to operate. The personal computer will perform all functions of the dedicated terminal, thereby eliminating the need for that device. It will also eliminate the need for enhanced telephones. Simple unenhanced telephones will not be replaced for the simple reasons of their low cost, ease of use, and convenience. It is likely that the telephone will be limited to voice conversation, as the PC will perform other functions much better. It must be stressed though, that this is the long term.

E. CPE Trends

There is one overriding trend in the production of new CPE and that is that there is a progression towards greater intelligence in the devices consumers use. The ramifications of this are great. It will be necessary to retain the simplicity of use for these devices for the many users who do not desire the use of enhanced services. This means it is likely each household, will at the minimum, have a simple television and easy-to-use telephone.

The trend to enhancing existing CPE is best illustrated by the fact that each device has been outfitted with some type of keyboard. Televisions used for interactive services are starting to come with keypads and keyboards, telephones have more and more push buttons and many resemble low-end computers already. Computers and dedicated terminals which are increasingly connected to networks have always had keyboards and function keys. What this increasing complexity in the CPE also requires, is a higher level of "computer" or "electronic device" literacy on the part of users, despite software which makes accessing services an easier task.

The introduction of integrated services digital network (ISDN) CPE will accentuate these trends. With advances in very large scale integrated circuits (VLSI), ISDN CPE will eventually evolve into a type of small computer. The premises set may become part of a multiservice configuration of up to eight different physical devices. William C. Kanupke states two essential requirements for wide user acceptance of ISDN CPE. First, the sets and users must be willing to accept non-voice functionality in their CPE. Second, the continuity of existing voice

telephone service must be ensured while the data function is provided in a non-intrusive way.¹¹

Advanced ISDN CPE may also allow for the introduction of new types of services. For example high-fidelity audio has potential to greatly enhance communications. With hi-fi audio the effective distance between the speaker's mouth and the listener's ear measures less than three inches. It also will boost the accuracy of speech recognition and speech-to-text conversion, enhance the clarity and quality of voice response telecommunications applications and, through greater fidelity, make voice mail more acceptable. There also may be applications in the distribution of audio/music programming for commercial or consumer use. Designing ISDN CPE with high quality microphones and receivers may create a mass market for ISDN voice CPE rather than a niche for special-purpose CPE now available.¹²

One important point to make is that the CPE associated with the telephone network will, in a short time, be all digital, as the term ISDN implies. The implication for hybrid cable services is that when a user sends a response via the telephone network, to the cable headend, the signal must be converted to an analogue signal before the cable subscriber can receive the response. When cable services become digitized, then the potential for extended growth in hybrid services becomes much greater, as the signal flow will be much smoother. But for the time being, the headend needs a considerable amount of equipment to deal with the different signals.

An additional trend worth pointing out is the growing use of fax machines for home use. Models are available for as low as \$300 now, and some expect prices to eventually fall to around \$100. These low prices along with improvements in transmission speed, quality, and user-friendliness may turn them into a popular consumer product. The effects of this aspect of convergence would be to increase use of the telephone networks, and decrease the use of the public mail system. Fax facilities may also be built into ISDN CPE in the future.

III. Networks

As indicated earlier, the discussion of networks in this paper will be limited to its relevance to services. Since, for at least the next ten to twenty years the telcos will not have universal broadband capabilities and the cable network will not have switching facilities, the present discussion deals with the existing state of the networks. However, it is important to note that there is general agreement upon the future direction the two major networks will take. Prominent cable

¹¹ Telephony, July 16, 1990, p.22

¹² Telephony, July 16, 1990, p.14-16

engineering consultant Israel Switzer stated at the annual convention of the Ontario Cable Telecommunications Association:

"I think there is no doubt that in the long term we will have cable systems that are all switched all digital, all fibre. They won't at that time be called cable TV systems. Instead, each will be comprehensive telecommunications system that does everything, including voice, data and images...But the time needed to develop, prove and bring down in cost that kind of technology is such that few of us will probably be around to see it happen. I'm talking about 20 years or more."¹³

President of Bell Canada, Jean Monty speaks from the telco point of view when he says: "Right now, we cannot, economically, ...bring fibre to the residence, ...It's a nice thought, but it's not reality. It could take another 20 years to make it economical."¹⁴

However, in the interim, it is useful to consider how the two networks can function together to provide services. Thus far, "hybrid" has been used to refer to only services which depend on both the separate cable and telco networks. The only red herring in all of this convergence is whether or not the two networks will be more explicitly interconnected and whether it is technically possible. In a recent interview, Jean Monty suggested that an alternative to putting fibre to the home is to connect to the coaxial cable of the cable companies for the last stretch to the home.¹⁵ However, there are regulations prohibiting this now, and the receptiveness of the cable industry to this is not likely to be great. Most likely, the type of hybrid network we will see for the next number of years is one where the cable company depends on the telephone company for the subscriber uplink and for connections to service providers (see figure 8).

Before this hybrid network can become fully functional though, there are some problems to be overcome. A network for effective hybrid services would have a connection from the television keypad or converter, directly to the telephone line, so that to the viewer it appears as if the service is conducted over one network. This would of course, require great cooperation from the telephone companies. The second obstacle is the lines that the cable companies have to lease from the telephone companies to connect to their service providers and to receive the signals from their customers. This also requires the cooperation of the telephone companies. The telephone companies may welcome this since it adds to telco revenues in the short term, and keeps cable companies from developing their own two-way capabilities. But if the type of services offered are directly competing with telco services then cooperation may

¹³ Cable Communications Magazine, Nov. 15, 1989

¹⁴ Cablecaster, June, 1990

¹⁵ Cablecaster, June, 1990

be a little less forthcoming. It may be appropriate in this instance for regulators to become involved to ensure equal access.

Essentially, there are only two important things to note about the networks if one is interested in the services they will support. First, if you want truly interactive real-time services, then the service depends on the telco network. This network offers point-to-point communication between unique addresses. For cable operators, a true point-to-point bi-directional network would be exorbitantly costly to achieve and difficult to maintain.¹⁶ This is the upgrade that would cost around \$1200 per subscriber. However, hybrid services ameliorate this problem to some extent, although, by definition they depend on the telco network. The way to a truly bi-directional network has to be taken in steps, as the technology becomes financially feasible.

Second, if the service depends on high quality video images, then the services must be supported over the cable network or the broadcast mode. Currently, this is point-to-multi-point distribution and does not use a unique addressing system. Complementary and competitive video service can also be provided via the VCR, and advances in computer digitization of video and in laser disk technology may also support different types of video services. The corollary to this is that if the services depend on text, and the manipulation of text, then the telco network or mass local storage probably best meets the need.

There is one other important aspect concerning the networks which is particularly relevant from the consumer's point of view, and that is the pricing structure of services. The cable network is not able to monitor in an efficient way the length of time services are used. Thus, a flat fee is the best way to charge for services. This means the onus is on the cable company to ensure that a useful bundle of services is provided. The telephone network on the other hand does allow for usage sensitive pricing. This means consumers are charged only for the services they use. It is a much more efficient way of billing, and consumers do not feel as if they are paying for unwanted services. A real estate service is a good example of a service that a user might use once every five years, and would be much more attractive to the user if they were to pay for actual use rather than subscribe to the service for five years and use it only once. Local services such as computer bulletin boards which make use of the telephone lines are often free of charge. This is true for North America only, where an unlimited number of local calls of any duration can be made once the access fee for basic telephone service is paid.

IV. Direct Broadcast Satellites

The promises of direct broadcast satellite for widespread use in the

¹⁶ NGL, 1990

1980s failed to materialize. However, DBS may be in a position to compete with cable and broadcast services in the 1990s. This is evidenced by recent Federal Communications Commission (FCC) permission to two DBS consortia to launch and deliver DBS services by 1993. One of the two consortia will offer a service called Sky Cable, with an investment of \$1.2 billion. It will eventually have 108 channels as well as the ability to offer HDTV transmission. The ace in the hole for DBS however, is that the small dish required will be available to subscribers for \$300 including a decoder. Since roughly only 10% of Canadians own or rent an addressable decoder currently, there are no significant sunk costs which would prevent most consumers from subscribing to DBS services.

DBS will initially be best suited for one-way broadcast entertainment services. Thus, the services offered will likely be similar to those now offered by cable, therefore consumers will likely face more choice. Non-programming services are relatively foreign to both DBS and cable right now, so cable does not have a significant advantage in this area. Where satellites may have an advantage though, is in the transmission of HDTV channels, and service to rural areas. Some observers have suggested that cable operators could transmit over their networks the very same DBS signals aimed at dish owners. If given regulatory approval, this could take some of the thunder out of DBS.

V. Criteria to Define Services.

Defining services as broadband or narrowband services is an especially useful way of determining which network can support such services, since the cable network is broadband and the telco network is not. An additional way of clarifying and distinguishing services from each other is to specify the degree of interactivity needed for the service. It is these two factors which for the next ten to twenty years will define where convergence exists and where it does not (see figure 10).

A. Bandwidth

The following is a list of services defined as broadband or narrowband. It is important to note that narrowband services can also be provided over a broadband network but the reverse is not true. Figure 11 gives a list of services and the required bandwidth for each service. Anything below 64 Kbit/sec can be defined as narrowband. The basic rate access service on narrowband ISDN will provide two 64 Kbit/sec and one 16 Kbit/sec channels (2B+D). Anything up to 1.544 Mbit/sec can be multiplexed and carried over the existing copper distribution plant fed by fibre. Thus, what ISDN has done, is to increase the available bandwidth of the twisted pair wire. However, anything above 1.544 Mbit/sec is generally considered broadband and must be transmitted over

wire with greater bandwidth than the telephone twisted pair.

Broadband

- entertainment
- education

Narrowband

- information
- messaging
- transactions
- telemetry
- entertainment

The entertainment services that are narrowband are few. These include multi-user games, and chat lines on videotex. Almost all entertainment services depend on a broadband network which can offer images. Those services requiring a bandwidth in excess of 1.544 Mbit/sec are almost all services which can now only be provided over the cable network. Coaxial cable can even support HDTV channels. However, HDTV may be a service that won't be available to consumers for some time yet, and it is expected that when and if it does, it will make its inroads via satellite and video cassette. Currently, a self-contained HDTV monitor costs between \$10,000 and \$20,000.

Education services are likely to evolve from the present educational services offered via the television, and hence will continue to be broadband. The exception to this are educational services or products that are neither broadband nor narrowband. These make use of compact disk storage, because the amount of information is too great to transmit over network lines. The trends indicate that these products and services may evolve from being an exception right now, to a much more pervasive set of products and services.

Information, messaging, transaction, and telemetry services usually consist of alphanumeric text or small bits of data and therefore do not require a great deal of bandwidth. Aside from whether they are interactive or not, these services could be provided over both major networks.

B. Interactivity

Interactive (Telco & CD-ROM)

- information
- entertainment
- messaging (telco only)
- transactions (telco only)
- telemetry (telco only)
- education (CD-ROM)

Non-Interactive

- information
- entertainment
- education (broadcast, VCR)

Most information services require some degree of interactivity. Often a large database will be accessed and the user has to specify what type of information is desired. The need for interactivity arises when people have different informational needs. Videotex and audiotex information services are good examples of interactive information services.

There are two types of non-interactive information services. First, there is datacasting and teletext. The main characteristic of this information is that it is a one-to-many application. The second non-interactive type of information could almost be called a product and not a service. This is the kind of information that is found on CD-ROM, although sometimes CD-ROMs even facilitate access to online services. The disk has relatively non-current information and can include information from encyclopedias and educational texts.

In some cases, it is the interactivity that gives a service its value. For example, real estate information can be non-interactive as it appears on cable television now. However, if this information were to be provided on CD-ROM, or over the telco network, it would allow the user to customize their searching by defining parameters such as location, price, and size. A list of pertinent listings could be viewed in seconds saving the potential buyer the frustration of traditional searching methods. Videoway claims to offer an interactive information service over its cable network, but the user can only select a pre-determined choice as defined by the programmers; he or she cannot specify parameters of a search as on a CD-ROM or telco online service.

Entertainment services can be both interactive and non-interactive. Non-interactive entertainment services includes almost all broadcast and cable television. Interactive entertainment services include games (either over the network or stored on some tape, disk or cartridge) and chat lines.

By definition, messaging and conferencing services require some degree of interactivity, because it is usually a one-to-one application although it doesn't have to be. Interactivity in this sense means that messages can be stored and forwarded.

Transaction services are also a one-to-one application and because a transaction is being made this is clearly interactive communication.

Telemetry services require an interactive network but little or no interactivity from the user. The signals are automatically sent from the consumer's home over the network.

The potential growth in educational CD-ROM disks is great. Although not offered over a network, the CD-ROM can support extensive interaction with the application. Non-interactive education can also be offered by broadcast or with VCR tapes.

Figure 9 shows the combinations of services available when both the

characteristics of bandwidth and interactivity are included. Most notable is that there are no interactive broadband services because of economic and technical factors. However, one could consider Videoway's interactive TV a broadband uni-directional interactive service. Also, it is worth noting that there are very few non-interactive narrowband services. Telemetry could be considered non-interactive from the point of view of the consumer, since all data is originated by home appliances or monitoring devices. However, it could also be considered a service that requires an interactive network because individual subscriber signals must be sent to a central office.

VI. Conclusions

1. Convergence at the network level remains at least twenty years away. The types of changes likely to be seen in the near future are moves to offer services which take advantage of both networks. These are the so-called hybrid services. While these services will not rival the core programming and communications services for quite some time, if ever, they have great growth potential.
2. The television will remain primarily as entertainment device, albeit a less passive one. There may be potential for some specialized "uni-directional interactive" television services.
3. The telephone will be continually enhanced and upgraded to the point where it could function as a low end computer designed specifically for communications. ISDN will accentuate this trend. The expected growth in audiotex services will also support expanded uses for the telephone.
4. The unsophisticated dedicated terminal will be a short-lived phenomenon, designed to bridge the gap between the telephone and the PC. It will likely evolve and converge with an easy-to-use form of the PC.
5. Ultimately, some easy-to-use form of the personal computer will be the most useful general purpose communications device. It may include voice capabilities and may be similar to the device described in the third conclusion.
6. The two factors which help in distinguishing between services are the degree of interactivity and bandwidth required. This is how the major networks are defined. The cable network is one-way broadband or uni-directional interactive at best. The telephone network is narrowband bi-directional interactive. CD-ROM is a stand alone combination of the two.

REFERENCES

- Abel, Glenn. "A Young Industry Gears Up", Communications Week, Oct. 2, 1989, no. 268 p.46(2).
- Ashley, Lynda. "Monty and Ma Bell", Cablecaster June, 1990, p.6-12, 38.
- Baer, Walter S., "Telephone and Cable Companies: Rivals or Partners in Video Distribution?", in Eli Noam, ed., Video Media Competition: Regulation, Economics, and Technology, New York: Columbia University Press, 1985, p.52.
- Bodin, Madeline, "Getting Interactive" Teleconnect, March 1990, p.46-47.
- Consumer Information Appliance Jupiter Communications company, vol. 1, no. 1, May, 1990.
- Datapro Research, "An Overview of Integrated Voice/Data Terminals" March, 1989.
- Degnan, Kim E. and Freyer, Daniel B. "Seizing Tomorrow's Broadcasting Opportunity Today", Satellite Communications, April, 1990.
- Desjardins, Gilles. "Cable's Advantage in Convergence", Cablecaster June, 1990, p.33-35.
- Digital Information Group, Information Industry Bulletin, August 9, 1990.
- Easton, K.J., "A new look at outside addressability" Cable Communications Magazine, May 15, 1990, p. 38-42.
- Fox, Jim. "Distance education classes on cable TV: The Telecollege success story of Wilfrid Laurier University" Cable Communications Magazine, May 15, 1990, p.44-48.
- Fronk, Robert L. "Interactive Video" Decision Resources, February 1990
- Globerman, Steven. "Policy Implications of the Convergence between Communications Technologies: The North American Case." A study prepared for the Organisation for Economic Co-operation and Development, March 5, 1990.
- "High-Definition Television" The Economist, August 4, 1990.
- Hebert, Claude, A report on Infotext '90 conference in Las Vegas, January 23-24, 1990.
- Information Industry Factbook, Stamford CT: Digital Information Group, 1989.

Interactive, One-Way & Standalone Entertainment, Cambridge Mass.: The Yankee Group, 1981.

International Resource Development Inc., "Interactive Video Systems & Services", Report #554 August, 1983.

Leigh-Bell, Peter. "Interactive cablevision: A prerequisite for survival", Cable Communications Magazine, Jan./Feb. 1990, p.11-17.

Lawless, Jack. "Audiotex is coming out of its shell", Telephony, July 10, 1989, p.21-23.

Kanupke, William C. "ISDN CPE bursts on the scene" Telephony July 16, 1990, p.18-22.

Machrone, Bill. "Data Communications and Multimedia" PC Magazine May 29, 1990, vol. 9 no. 10, p.69(2).

MacLean and Associates, "The New Media: A discussion Guide" A consulting report prepared for The Strategic Policy Planning Division Communications Canada, July, 1990.

McVoy, D. Stevens and Baldwin, Thomas F. "Interactive Cable TV: technology, applications and markets" The Interactive Cable TV Handbook, 4th edition, 1984, p. 5-17.

Moorecroft, Klinkhammer, Craig, "The misty horizon of PPV in Canada" Cable Communications Magazine, April 15, 1989, p. 10-14.

Nader, Ralph, "U.S. Telecom Policy: A Consumer Perspective" Telematics vol. 7 no. 1, p. 53-62, 1990.

"New Media Strategic Directions Research and Development Program", Broadcast Technologies Research, Communication Research Centre, August, 1990.

"New Study explores merits of Minitel technology for cable television industry", Cable Communications Magazine, March 15, 1990.

NGL Consultants. "Competition in the current and future local distribution networks in Canada" A study contracted for The Ontario Ministry of Culture & Communications, April, 1990.

Perry, Tekla S. "Telephone challenges: a plethora of services", IEEE Spectrum, July, 1990, p.25-28.

Poirier, Roger, "Calm Down About Convergence", Cablecaster June, 1990.

Quint, Michael. "Bills to pay? The number is...", The New York Times, March 3, 1990. v139 p.16(N) p.48(L).

Robinson, P., Lippincott, R., Shetler, T., Cook, R. "Multimedia" BYTE February, 1990, p.200-236.

Salewsky, Udo. "QZZ interactive television revisited", Cable Communications Magazine, September 15, 1989, p.3-5.

Schlender, Brenton R. "Couch Potatoes! Now it's Smart TV" Fortune, November 20, 1989, p. 111-116.

Steuernagel, Robert A. "Is high-fidelity audio under ISDN an overlooked opportunity?" Telephony, July 16, 1990, p.14-16.

"The TV Answer System--a new approach to interactive television", Cable Communications Magazine, January, 1988, p. 28.

Veith, Richard, Talk-Back TV: Two-Way Cable Television, Pennsylvania: Tab Books, 1976.

Waung, David, "Characterizing the New Media" Notes for an ADMRS seminar series at Department of Communications Canada, July 12, 1990.

Wilson, Kevin G. Technologies of Control, The New Interactive Media for the Home, Madison Wisconsin: The University of Wisconsin Press, 1988.

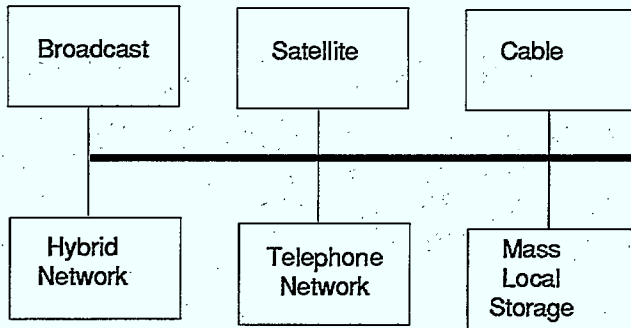
APPENDIX 1

CHARTS AND TABLES

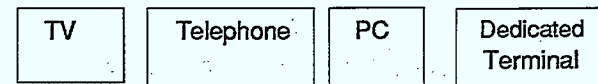
THE CONVERGENCE OF SERVICES

(Figure 1)

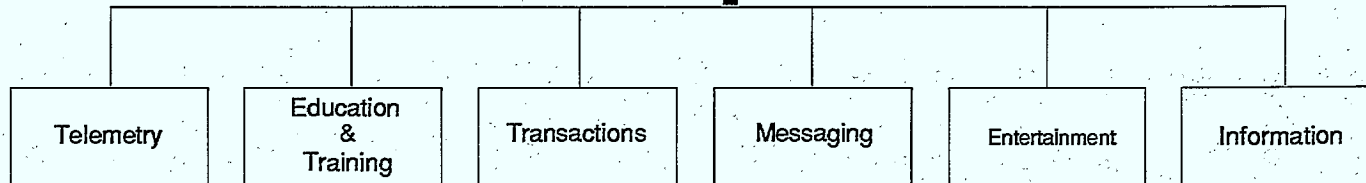
Method of Storage or Transmission



Consumer Premises Equipment

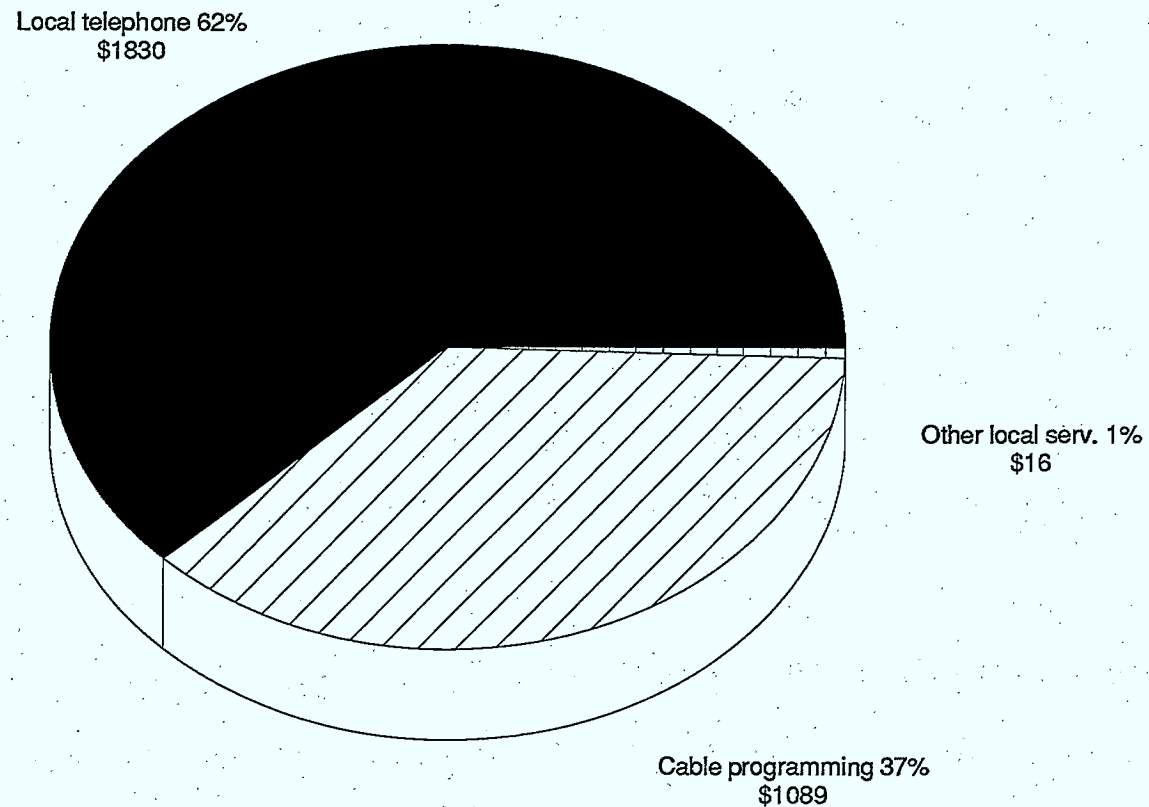


Service Opportunities



1987 Canadian Residential Local Distribution Market (Revenues in \$M)

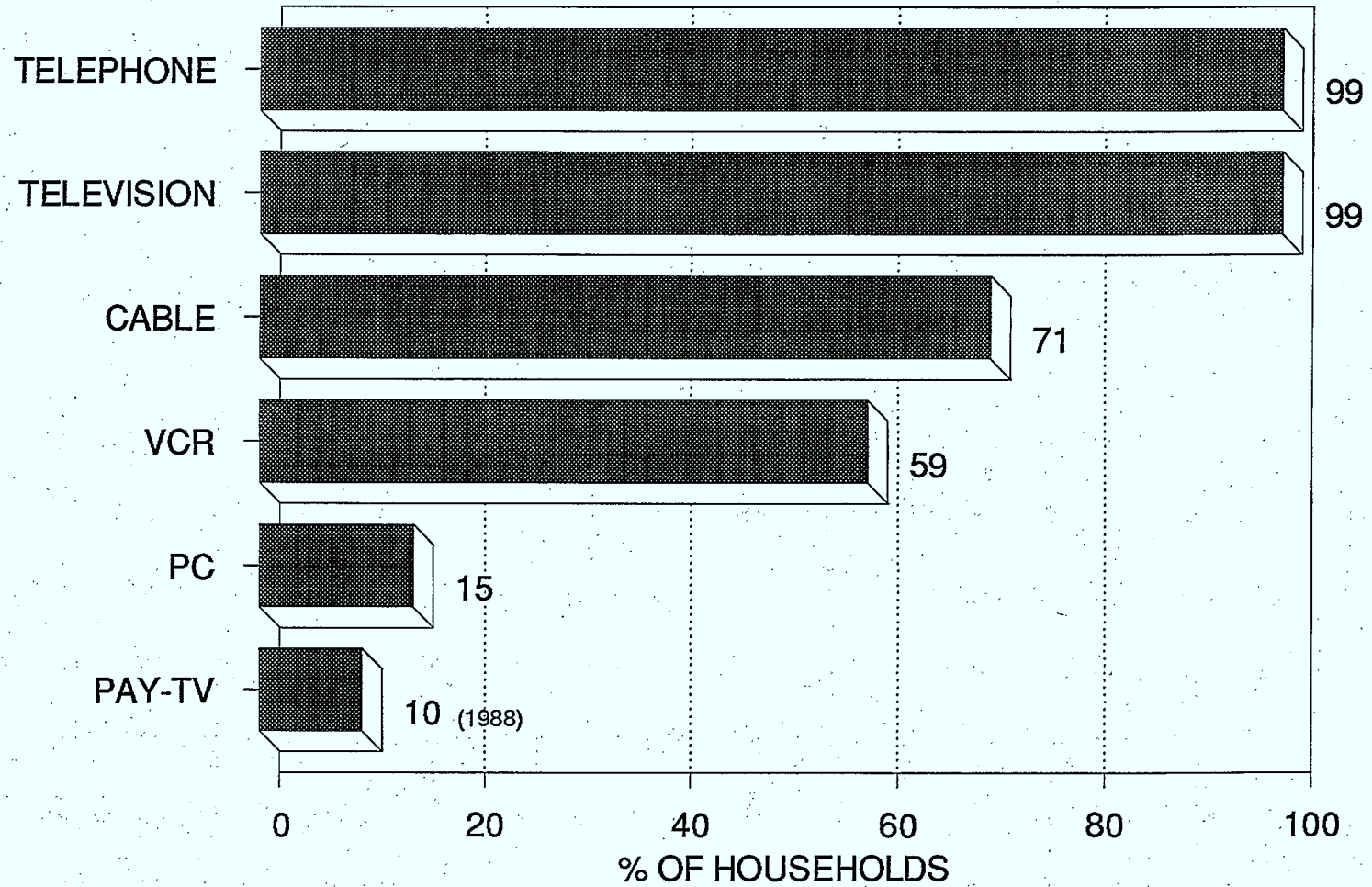
(Figure 2)



Source: NGL Consulting Ltd.

MEDIA PENETRATION CANADA, 1989

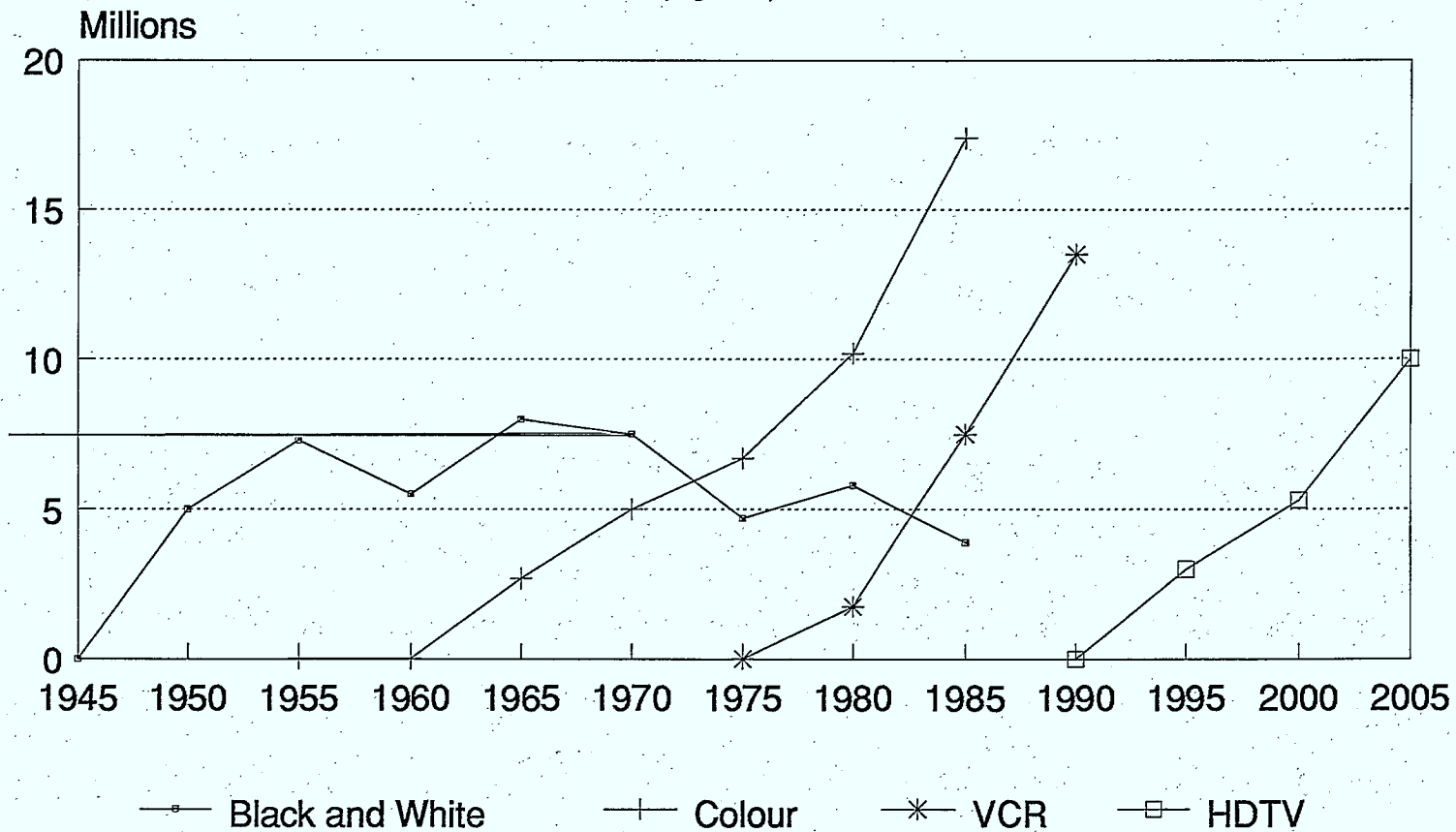
(Figure 3)



Source: Stats Canada

U.S. DOMESTIC SALES FOR TELEVISIONS AND VCRs

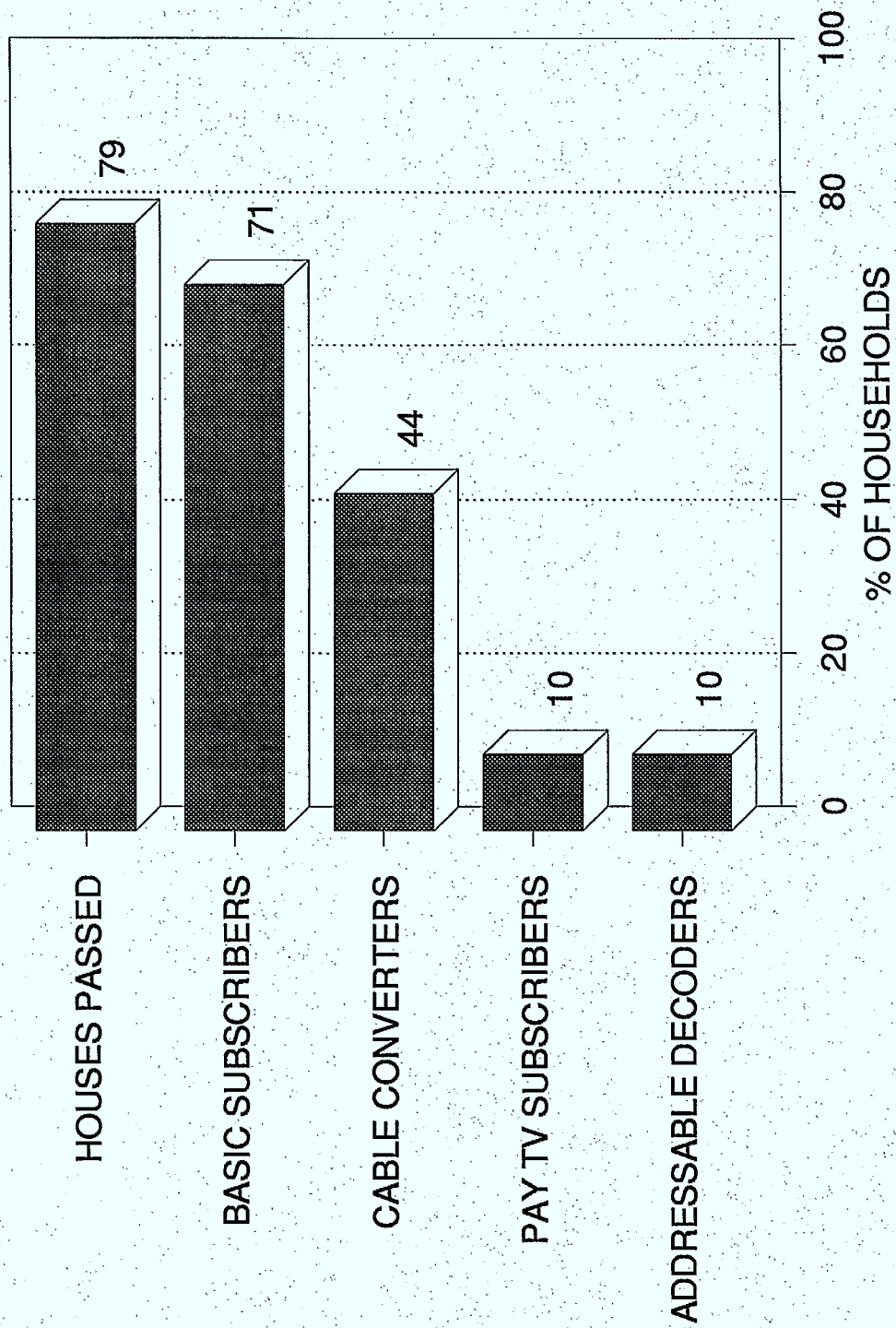
(Figure 4)



Source: U.S. Office of Technology
Assessment

CABLE PENETRATION CANADA, 1989

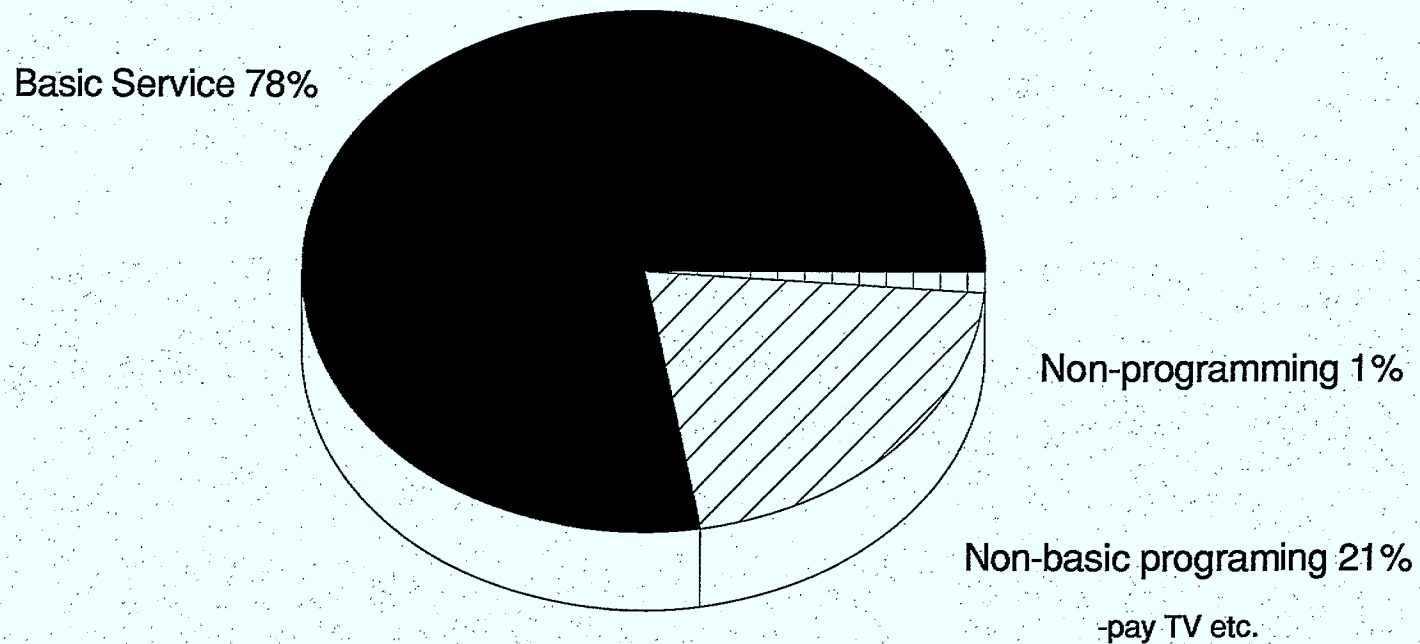
(Figure 5)



Source: Stats Canada

1988 CABLE SERVICE REVENUES

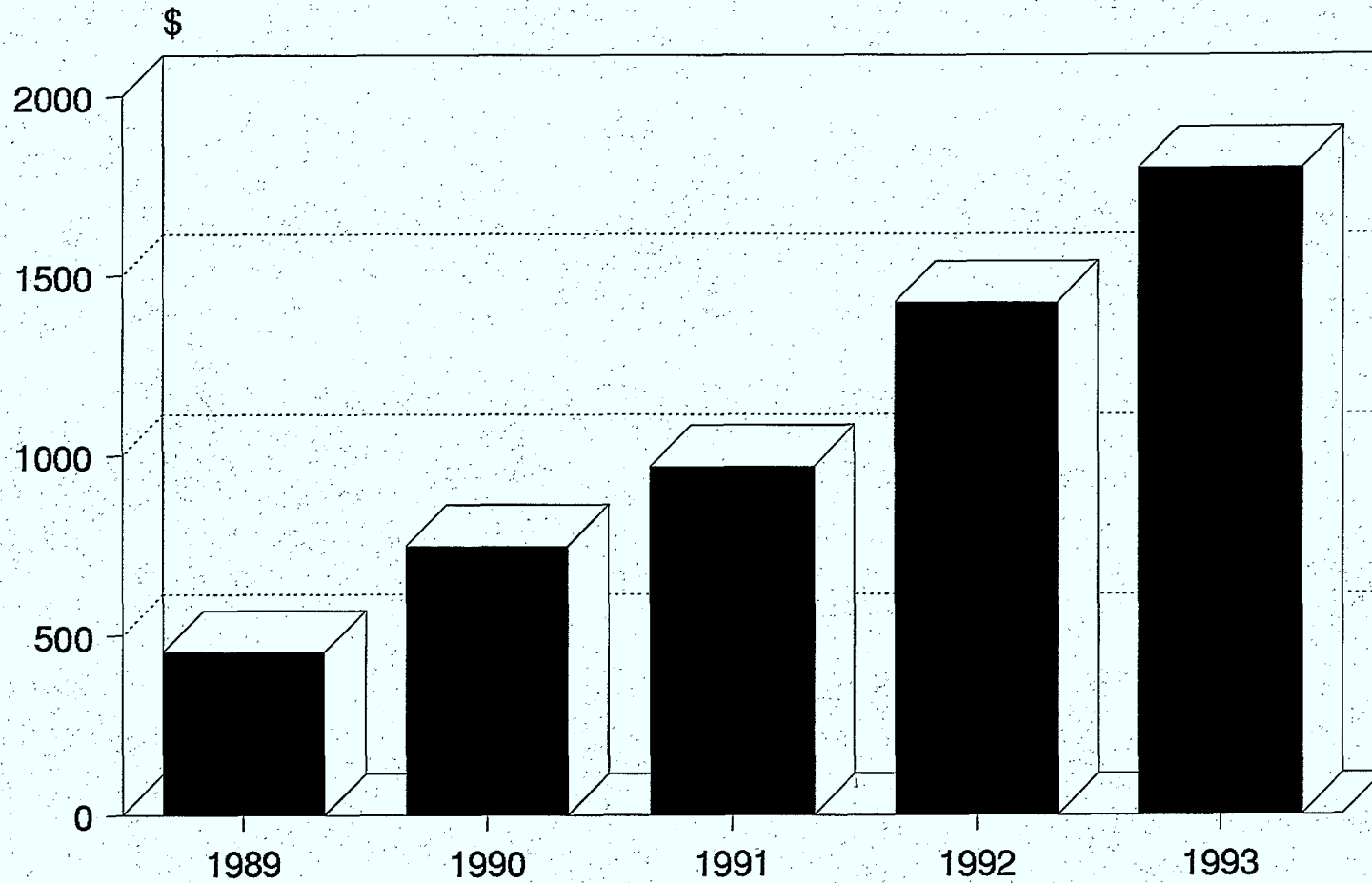
(Figure 6)



Source: Statistics Canada

FORECAST FOR 900 SERVICES (Millions)

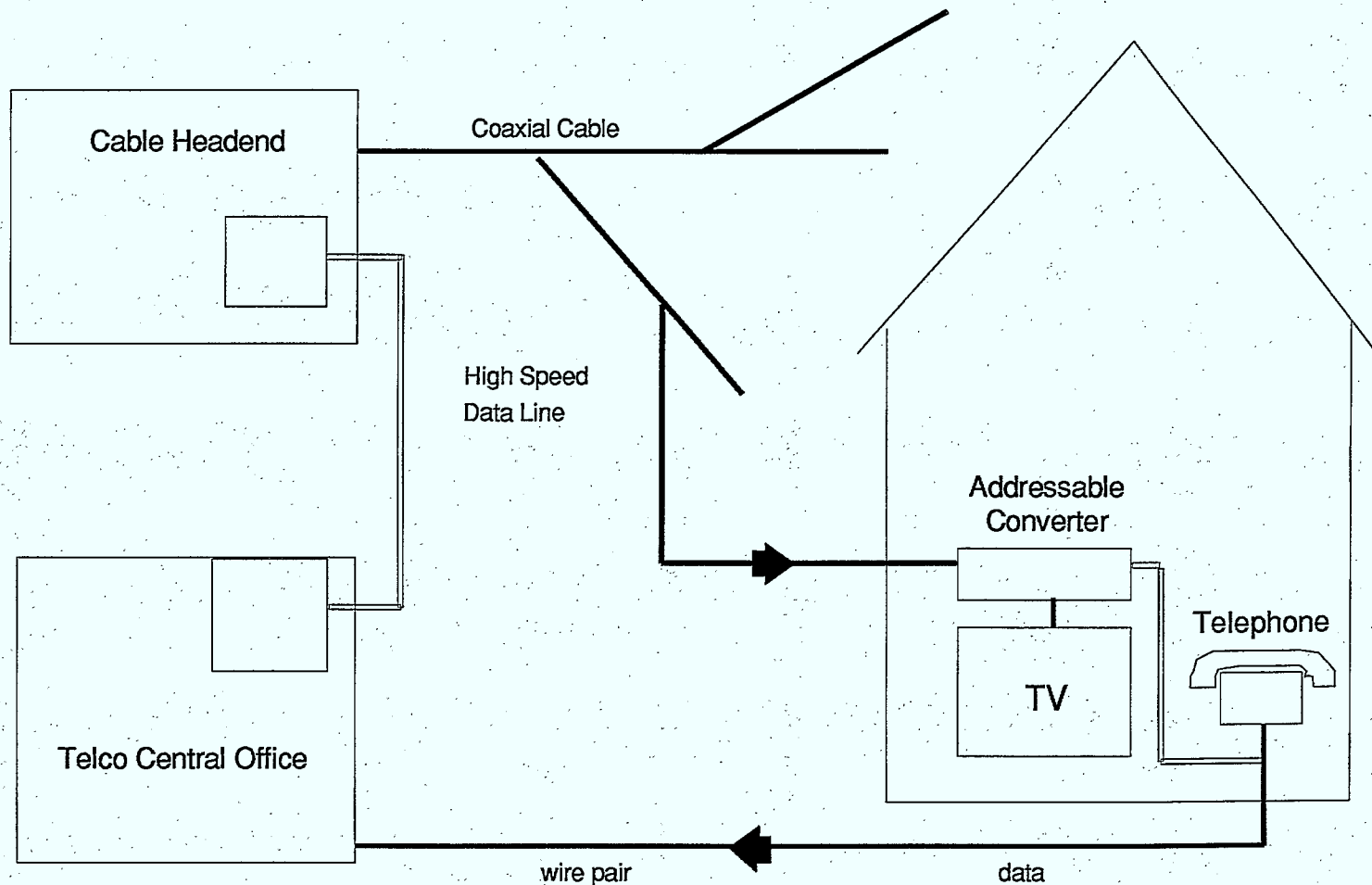
(Figure 7)



Source: Strategic Telemedia

TELCO/CABLE HYBRID SERVICES

(Figure 8)



Source: "Video Media Competition"

POTENTIAL TRANSMISSION AND DELIVERY MEDIA FOR SERVICES

(Figure 9)

Access Device Network	Television	Telephone	Dedicated Terminal	Personal Computer
Telco Network		-messaging -transactions -information	-messaging -transactions -entertainment -information	-messaging -transactions -education -entertainment -information
Cable Network	-education -entertainment -information			
Hybrid Network <small>(cable downlink telco uplink)</small>	-transactions -information	-transactions -information		
Mass Local Storage	-entertainment -education			-education -entertainment -information

Interactive and Broadband Services

(Figure 10)

Interactivity Bandwidth	Interactive	Non-interactive
Broadband	-entertainment (e.g. Videoway's uni-directional interactive TV)	-entertainment -information -education
Narrowband	-information -entertainment -messaging -transactions -telemetry	-telemetry

BANDWIDTH REQUIREMENTS FOR HOME COMMUNICATIONS SERVICES

(Figure 11)

Can be transmitted over twisted pair

SERVICE	BANDWIDTH
Analogue Voice	4 Khz
Telemetry	< 0.1 Kbit/sec
Videotex	0.1 Kbit/sec
Electronic Mail	1.2-64 Kbit/sec
Slow Scan Video	1.2-64 Kbit/sec
Digitized Voice	64 Kbit/sec
Data Transfer (e.g. file transfer, graphics)	200 Kbit/sec
Hi- Fi Audio	1000 Kbit/sec
Compressed Video (e.g. video teleconferencing)	1, 500 Kbit/sec
Digitized Video (e.g. broadcast, pay- TV)	45, 000 Kbit/sec
HDTV	140,000 Kbit/sec