QUEEN
HC
120
.I55
C339
1997
c.2

STATUS AND EVOLUTION OF CANADA'S INFORMATION INFRASTRUCTURE

Background Paper for the Information Highway Advisory Council

April 1997

Queen
HC
120
.I55
C339
1997
c.2

Information Highway Advisory Council
(http://strategis.ic.gc.ca/ihac)

STATUS AND EVOLUTION OF CANADA'S INFORMATION INFRASTRUCTURE

Background Paper for the Information Highway Advisory Council

Industry Canada
Library - Queen
FEB 23 1998
FEV
Industrie Canada
Bibliothèque - Queen

Max E. Melnyk, Maxem Enterprises International, Ottawa, April 1997.

This background document was prepared to assist the Information Highway Advisory Council in its deliberations. The content of this document and the positions advanced are the responsibility of the author and do not necessarily represent the views of the Information Highway Advisory Council or of the Government of Canada.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This report has been prepared as a snapshot of Canada's information infrastructure at the present time, with some indication of what future trends are evolving.

The analysis covers not only the information infrastructure in its physical sense and the technologies and services which form its parts, but also the overall demographic and socio-economic factors which are forcing its development, particular policy and regulatory aspects which impact its growth and the international trends which relate to its development. As well, additional details are provided on the Canadian information infrastructure industry and a conceptual framework for international benchmarking of Canada's performance in relation to its development as a knowledge-based economy.

The information infrastructure is defined as consisting of the telecommunications networks and software and hardware which allow for the delivery of information services. The growing importance of the traditional telephone, radio and television broadcasting, and cable television systems coupled with the addition of computing and information industries and systems has made the telecommunications and information technology industries a leading force in the global knowledge economy.

Although massive changes are occurring in the current state of the economy, emerging innovative technologies, and new policy frameworks, Canadians continue to enjoy affordable access to a sophisticated telecommunications network and a level of network modernization which is one of the most advanced in the world.

Canada is a major player in the promotion of connectivity and interoperability of information networks and a world leader in the development of communications and information technologies. Research and development continues to play a significant role in these areas and Canada's tax treatment is very attractive by international standards.

The rapid growth and proliferation of the Internet into the households and businesses of the nation has, however, made the major industry players to rethink many of their development and service strategies. Due to the high level of systems integration, digital switching and advanced technologies, Canada is at the forefront in the development, testing and implementation of new services.

With the necessary legislation in place, concentrated efforts in policies and regulations are continuing to deregulate and liberalise the Canadian telecommunications and broadcasting environment to allow more competition, which provides a wider range of services at competitive rates for the consumer.

On the international level, Canada is an active participant in international bodies associated with information infrastructure standards, policies, trade and a global information infrastructure.

Recent agreements concluded by the World Trade Organization (WTO) on trade in services, provides immense opportunities for Canada to become a greater player in the international arena, not only in services, but in technologies and expertise.

The future evolution of the information infrastructure will continue in line with Canada's "vision" with appropriate telecommunications, technology and infrastructure policies.

1.0 THE CANADIAN INFORMATION INFRASTRUCTURE

1.1 Introduction

This report is intended to provide an overview of the status and possible evolution of Canada's information infrastructure at this point in time. This work resulted from a requirement to assemble material describing the current status and future evolution of telecommunications network infrastructure, to collect and assess statistical data regarding telecommunications network development and modernization and to prepare an overview of the status of Canada's information infrastructure as a formal report to the Information Highway Advisory Council (IHAC).

The purpose of this document is:

(a) to provide a general overview of the Canadian information infrastructure, the technical, economic, policy and regulatory factors which have determined its evolution, and the growth and development of services through the use of the infrastructure up to its current state;

(b) to provide a vision of the future infrastructure in concert with potential developments which may impact directly on its evolution;

(c) to determine the factors and issues which impact on the development and evolution of the infrastructure; and

(d) to outline a set of policy imperatives and principles which could be used to ensure the orderly and effective evolution of the infrastructure.

1.2 Overview of the Information Infrastructure

Before defining the Canadian information infrastructure, it is worthwhile to outline the concept of an infrastructure and why it is increasingly important today; information infrastructures, in their own right, have become the new focus of governments worldwide primarily due to the significant role they can play in reenergizing their economies. Emphasis is also being placed on the socio-economic benefits to nations in addition to enhancing productivity and competitiveness of the business and industrial community.

What do we mean by infrastructure? In the concept of any national economy, the infrastructure comprises the arteries of transportation and communication (roads, public utility facilities, telephones, broadcasting, airlines, etc.) through which the life-blood of commerce flows: goods, capital, ideas, energy, people and areas associated with education, health care, water and sewer and housing. These are the basic and necessary building blocks and structures which determine and provide the impetus and flexibility of a nation to adapt to economic growth and development. An information infrastructure or "infostructure" has been defined in a number of studies and papers. In the report, *A Telecompetitiveness Infostructure*[1], the term *infostructure* was meant to

---

[1] Davidson, Dr. William H. and Ronald H. Hubert, *A Telecompetitiveness Infostructure: Enabling a New Future for Canada*, Mesa Research for Northern Telecom, May 1994.

include the combination of elements of a country's information communications infrastructure, which would include capabilities related to the creation, capture, storage, processing, transmission and reception of all forms of information. It included the telecommunications facilities and networks, broadcasting, software, computers and data processing equipment, financial settlement systems and data libraries. Melody[2] identifies the specific components of the information infrastructure, in relation to the development of information society policies, as the telecommunications facility system, information content and value-added communications services, the equipment sector, human skills and policies. However, in defining the information infrastructure, consideration should be given to the need to measure the elements of the information infrastructure in relation to its role in the information economy.

Considerable activity has commenced by countries around the world to identify statistical components of the information infrastructure to enable them to track economic and social relationships and to allow comparisons of elements among the various countries. Recently, the Canadian government proposed statistical definitions to measure the global information infrastructure for a global information society.[3] It included the information and communication technologies (ICT) and the arts and culture industries. The ICT sectors include the ICT services sector (e.g., broadcasting, telecommunications carriers, computer services) and the ICT goods sector (e.g., communication and electronic equipment, computing and peripheral equipment, office, store and business machines, etc.). In the initial Information Highway discussion paper,[4] Canada's existing infrastructure was described as comprising communications networks, research facilities, the information technologies industry and content providers.

Within this document, we can consider the information infrastructure as consisting of the telecommunications networks--a collection of telecommunications mediums or technologies, services, equipment, features and capabilities available to user--and other technologies and services such as computers and office equipment, software and computer services, and consumer electronics which allow for the delivery of information services. The arts and culture sector or the content provider sector are not included in the definition of information infrastructure in this report.

In order to consider Canada's information infrastructure, it is important to put the infrastructure in perspective with international developments and the overall role and importance of the infrastructure within the national economy.

---

2 Melody, William H., "Toward a framework for designing information society policies", *Telecommunications Policy*, vol. 20, no. 4, p. 243-259, 1996.

3 Government of Canada, *Measuring the Global Information Infrastructure for a Global Information Society: Concepts and Performance Indicators*, Submission to the OECD Committee for Information, Computer and Communication Policy, September 1996.

4 Industry Canada, *The Canadian Information Highway: Building Canada's Information and Communications Infrastructure*, April 1994.

1.3 Role and Importance

The growing convergence of the traditional telephone, radio and television broadcasting, and cable television industries coupled with the addition of computing and information industries and systems has made the telecommunications and information technology industries a leading force in world economics. These infrastructures permit global communications virtually at the speed of light; they transform national and regional economies into one global economy.

This globalization permits the rapid and efficient worldwide transmission of information and national boundaries have little or no effect on the flow of this information. Increasingly, with the very rapid changes in technology and service opportunities, it will be possible shortly, if not at the present time, to communicate with anyone, anywhere, anytime--whether it be voice, data, text or image. In a globally competitive world, the countries which have the information infrastructures in place are the ones who will reap the most benefits.

Advanced telecommunications networks within the infrastructure are the powerful new engines to advance social, cultural and economic developments at local, regional and national levels. These networks affect the way in which goods and services are distributed and advance the growing shift in job growth from the manufactured goods sector of the economy to the services sector, thus fostering the growth in all aspects of Canadian telecommunications and information technologies. Telecommunications have a unique ability to capture and disseminate information through intelligent point-of-sale devices, automated teller machines and information databases for example, and they facilitate and enable activities and structures which would not be available without them--business productivity, global competitiveness, social policy goals, entertainment, etc.

There are many factors which are changing this environment. Technological innovations are driving the convergence of networks so the same transmission links can be used to transmit a multitude of services; there could be a proliferation of alternative delivery systems; there is a digitization of devices and networks as well as the functionalities of networks and services; the services niche is no longer well defined and increasing competition is allowing companies from different industry segments to impeach on each others territories.

In Canada, new uses and alternative means of communication as a result of increasing competition, have introduced new elements to this environment making the industries more dynamic and responsive than ever before. The provision of local telephone service and of cable services are the only major telecommunications monopolies remaining; however, both are increasingly being challenged by alternate industries such as the mobile services industries, wireless broadband systems, direct broadcasting satellite (DBS) systems, direct to home services and home video for the cable companies. Economic costs as well as economies of scope and scale and technological changes (digital signals, fibre optics, etc.) are requiring a rethinking of the traditional Canadian approach to infrastructure policy as the networks of the future will likely

consist of a network of companies, which are indistinguishable among broadcasting, cable or telecommunications enterprises.

1.4 The Canadian Information Infrastructure

The information infrastructure in Canada is rapidly undergoing its own transformation and restructuring due to the current state of the economy, emerging innovative technologies, new government legislation, policies and regulations and increasing levels of competition. This infrastructure plays a significant role in the development of the Canadian economy. In fact, in the last few years the growth portion of the Gross Domestic Product (GDP) attributable to telecommunications has been the only component of Canada's overall economy to show steady growth, outstripping even traditional Canadian GDP components of energy and forestry. The annual impact of telecommunications on the GDP has consistently risen annually (telecommunications services directly contribute some $18 billion or 3.3 percent to the Canadian economy and 145,000 jobs).

The Canadian telecommunications infrastructure is comprised primarily of a mixture of public and private networks utilizing telephone carrier facilities, wireless systems, satellite systems as well as broadcasting and cable television undertakings linked by advanced computer software and hardware.

The nine major telephone companies across Canada together form an association called Stentor, with approximately $16 billion in revenue. AT&T Canada Long Distance Services is the largest competitor of Stentor in offering national telecommunications services. In addition, there are 50 smaller independent telephone companies, one satellite carrier, Telesat Canada, one overseas carrier, Teleglobe Canada. As well, there are some 200 radio common carriers, two national cellular telephone systems and other mobile communications carriers. There are also some 40 resellers of telecommunications services.

Broadcasting and cable television networks are another major component of the infrastructure. The broadcasting industry is a complex array of publicly-funded and private networks, stations and services including the CBC, four provincial broadcasters, private TV stations and private radio stations. Cable television systems are a main delivery vehicle for broadcast signals to most Canadian homes. The cable television industry today reaches seven million homes in Canada and has an annual revenue of $3 billion.

With regard to the information technology (IT) industries, which comprises telecommunications and electronic components, computers, instrumentation and consumer electronics, there are a number of statistics of interest.[5] IT revenues reached $54.4 billion in 1994. An increase of 10 percent from 1993. Total shipments of computer equipment in 1994 increased 74 percent over

---

5 Industry Canada, Information Technologies Industry Branch, *Statistical Review: Information Technology and Content Industries* - A Working Document based on Statistics Canada data, February 1995.

1993. The contribution to Canadian GDP was over $30 billion in 1994 (up from the 1993 level of $27 billion). IT exports also increased 29 percent to $16 billion over 7 percent of total Canadian exports. More recent details indicated that this growth will not abate.[6] Other more recent statistics are provided in Annex A.

By international standards, Canada is a relatively small, but specialized producer of information technology. Although Canada accounts for only about 1 percent of world exports of information technology products, it has earned a reputation as a world leader in telecommunications and a significant producer of software and computer services.

A more detailed description of the information infrastructure industry with more detailed statistics is provided in Annex A.

Canada's information infrastructure has evolved on the basis of legislative and regulatory guidelines allowing for orderly development in Canada. As indicated later in the document, the evolution has been gradual and in accordance with specific incremental policies in the past.

In the following chapters, the technological, services, economic, policy and regulatory evolution will be reviewed in terms of their impact on the information infrastructure, followed by specific factors which will affect its future development.

2.0 TECHNOLOGIES

The primary focus of this chapter is the technical elements of the information infrastructure, outlining the historical basis of the systems and networks in Canada, how these have evolved and the importance and impact of technological development on the evolution to the present state. This includes the telephone network (microwave, satellite, fibre), broadcasting network (cable and television), radiocommunication networks (cellular, mobile, microwave, satellite) and private/other networks (private business, utilities, resellers, etc.). There is also some information provided on the structures of the various networks highlighting their commonalities and differences. Included as well is some discussion of information systems, multimedia, and modernization of the networks -- switching system evolution (analog to digital/intelligent), the role of standards and the impact of emerging technologies. Also provided is an indication of what is the overall capability (capacity) of the existing network and what it could evolve to based on capital expenditure programs. In addition, there is some discussion on technology developments such as digital systems, signal compression, convergence, etc., modernization and research and development activities.

---

6 "Information technology sector becoming. Industry output grows an average of 8.1 percent annually, but employment drops during five-year period", *Globe and Mail*, December 6, 1996, B11.

2.1 Telecommunications, Broadcasting and Radiocommunication in the Canadian Environment[7]

The current wire-based network infrastructure has evolved over many years; for over a century in the case of the telephone industry and over four decades for the Canadian cable television industry. Broadcasting has its beginnings in the use of electromagnetic energy in 1906 to send messages.

Canada's geography challenged its inhabitants to find ways to communicate reliably and economically over long distances. The nation responded by developing advanced telecommunications carrier services and by fashioning policies that have nurtured the telecommunications industry. Canadians enjoy affordable access to a sophisticated telecommunications network (98 percent of households subscribe to basic residential services) that has been designed and built by Canadian industry. The level of network modernization is one of the most advanced in the world. Canada's toll switches are now digital as are a majority of local switches. Broadcasting today comprises a mixed array of public and private systems, for radio and television. Today, cable television systems are the primary means of delivering television programs to the home.

In the past hundred years, the basic low-density transmission technology--twisted copper wire routed through underground conduits or via overhead poles--has not changed much, nor has its price. Fibre-optic cable has slashed transmission costs for high-density applications, but the last kilometre of the network, where a large amount of the transmission expense arises, carries mostly low-density traffic. In the past fifteen years, on the other hand, revolutionary developments in electronic technology have slashed the costs of switching and other forms of network intelligence.

Stentor and AT&T each maintain coast-to-coast microwave routes for interprovincial and long-distance traffic. Over most of the last 30 years, the largest use of microwave radio has been by telephone companies to provide long distance telephone communications and a few channels of network television. These systems accounted for more than 80 percent of the systems in use. The remainder were operated by electric and pipeline companies, by government agencies and departments, and by broadcasting undertakings. In the last few years, the more stringent demand of error-free data transmission as well as reliability needs have caused the telephone companies to move to fibre optics on the major traffic routes.

In March 1990, the members of Stentor Canadian Network Management completed their national fibre optic network linking Vancouver, B.C. with Halifax, N.S. It is the longest terrestrial fibre optic route in the world. Operating at 2.48 Gbits/sec, these fibres can carry more than 129,000 voice or data transmissions simultaneously. If necessary, these could be quadrupled to

---

7 For an historical background of the development of the telecommunications infrastructure in Canada, consult the 1992 government documents *Telecommunications in Canada: An Overview of the Carriage Industry* and *Convergence, Competition and Cooperation: Policy and Regulation Affecting Local Telephone and Cable Networks.*

9.95 Gbits/sec with upgrades in electronics. The installation of SONET (synchronous optical network) throughout the network permits the delivery of customized services, such as bandwidth-on-demand, regardless of the bit rate of the individual customer.

In the past few years, the cellular radio telephone operators have increasingly used microwave to interconnect cell sites. More recently, there are new demands for digital radio from new common carriers for long distance telephone and data competition. Again, until traffic levels grow, they will often opt for radio.

Telesat Canada's network of satellites and earth stations augments the capacity of the microwave systems and provides links to remote areas which cannot be served by terrestrial links. Stentor, Teleglobe Canada and AT&T have upgraded their networks with fibre optics and new digital systems.

The heavy-traffic routes connecting most major cities already provide digital service. Conversion of networks to digital technology improves network performance, increases the carriers' ability to manage their installations, multiplies the services offered to businesses and homes and lowers costs dramatically.

Telesat Canada provides commercial satellite services throughout Canada. It owns and operates five satellites (including Anik E-2 and Anik E-1, launched in 1991) and a network of some 500 earth stations. Telesat's subsidiary, Telesat Mobile Inc. (TMI) provides mobile voice and data communications services for ground use and to vehicles, ships and aircraft.

Private networks established in the mid 1980's have enjoyed tremendous growth and altered the landscape of telecommunications. Telecommunications in Canada and other countries have traditionally been based on the concept of multiple users sharing a common public infrastructure. With advances in technology and liberalization of regulations, it has become increasingly attractive for large corporate users to install private networks. Next to the common carrier networks, the combined systems of the provincial hydro companies represent the largest microwave network in Canada and often extends into rural and remote areas. Broadcasters utilize microwave systems for rapid deployment and coverage of news and special events, as well as being a cost effective and efficient medium for the delivery of programming material from one end of the country to the other. In addition, province-wide private microwave systems are employed in at least four provinces providing communications for key public services such as police, ambulance and other emergency services.

2.2 Wireless Radiocommunication

Due to Canada's vast distances separating its population, Canadians as a matter of necessity have turned to radio as the primary electronic link to provide efficient and reliable public and business communications service.

Cellular networks established in the mid 1980s have enjoyed tremendous growth and drastically altered the landscape of telecommunications. The desire for increased flexibility in communications and advances in radio-based mobile and portable products such as cellular radio, radio paging and cordless telephone systems has given rise to an evolution towards Personal Communications Networks (PCNs). With PCN, instead of calling a number which is attached to a particular location, one would call a person using his or her unique Personal Identification Number (PIN) and be able to reach that person anywhere in the world where the service exists. It has been suggested that the deployment of micro-cellular technology in the local network will provide opportunities to bypass the local telco network for the provision of residential voice service. Growth in cellular in the past few years is reflective of the consumer demand for increased flexibility in communications.

As broadcasting and wireless communications systems adopt digital technologies, and particularly advanced digital compression, the potential arises for more efficient utilization of the radio spectrum. More efficient use of the spectrum could free available bandwidth for the introduction of more local distribution services by broadcasters and other communications service providers. This in turn could lead to an even more competitive local network environment.

The growing use of cellular radio has developed to such an extent that many users have become primary users of this service. Work has progressed further on technology and standards for Personal Communications Services (PCS). Direct competition will ensue between wireless local loops and fixed wire as technology developments increase the capacity of wireless systems and reduce their cost. The growing use of Personal Digital Assistants via wireless access is only limited today by the channel bandwidth. With increasing possibilities of wideband wireless access, any limitations on the available spectrum may be diminished rapidly.

The wireless systems revolution is beginning to bring significant changes to telecommunications and computers by enabling fully distributed and ubiquitous mobile computing and communications any time, anywhere. With integration with the fixed network infrastructure, the evolution of a future universal communications grid is possible. High capacity wireless local loop technologies are now available to act as a bypass to the local loop services by competitive local service providers.

The advancement of the information infrastructure in Canada will depend in part on the availability of radio frequency spectrum for wireless access and capital resources. Wireless communications is an essential element of any advanced telecommunications and broadcasting infrastructure by allowing narrowband or wideband access to services. For examples, the provision of broadcasting services in remote and rural areas using multipoint distribution systems (MDS) or satellite delivery systems, the availability of mobile communications by cellular, paging, public cordless, personal communications and mobile satellite or private and public multipoint radio access services complement the existing wireline-based distribution systems and require extensive spectrum.

2.3 Network Developments and Modernization

Up to the early 1980s, the typical architecture of both the local telephone and cable TV networks were markedly different. The telco network was single star shaped, narrow bandwidth and bidirectional, while the cable networks were based on tree and branch configurations and provided unidirectional broadband transmission.

Recent advances and competitive pressures have resulted in the rapid evolution of the local networks of both sectors. Telco networks are now built with a variety of configurations from double star to a mix of star shape and bus configurations.

Progress has proceeded on two areas to prolong the viability of existing copper plant. Image compression technology makes it possible to encode VCR-quality video at bit rates as low as 1.5 Mbps, and broadcast quality at rates below 5 Mbps. Advances in digital signal processing have raised the ceiling on what can be transmitted over a copper loop with acceptable error rates. AT&T and other manufacturers have announced a technology known as Asymmetric Digital Subscriber Loop (ADSL), would allow existing copper plant to carry 3-4 Mbps, enough for a single broadcast-quality video signal or two VCR-quality signals downstream, while carrying a lower speed voice/signalling channel upstream. These developments will likely delay the use of fibre to the home. Instead it is likely there will be a mixed scenario of fibre to a neighbourhood concentration point and copper pairs to the last few hundred metres. This is the copper versus fibre dilemma of the telephone companies. Two other approaches to providing the access to the subscriber include the use of coaxial cable for the carriage of cable television and radio/wireless technology.

High Bit-Rate Digital Subscriber Line (HDSL) technology permits full duplex (two-way) 1.544 Mb/s or 2.048 Mb/s transport over existing copper pairs, which represents a 100,000 times improvement in transmission capability in less than 20 years. This resulted from advances in microprocessor technology. HDSL and ADSL technologies have been made possible by the rapid advancements in digital signal processing and microprocessor technologies. Based on economics and due to the high cost of installing and powering of fibre and the large installed base of copper twisted pairs, some carriers and manufacturers have developed HDSL and ADSL technologies to provide full duplex, switched and large bandwidth capabilities to the local loops to provide services such as video on demand.

ADSL is one member of the xDSL family of digital subscriber line technologies.[8] Since its downstream rate (1.5 to 9 Mbps) is so much higher than its upstream rate (16 to 640 kbps), it is an ideal technology for Internet access. The speeds most commonly associated with ADSL are 6 Mbps downstream and 640 kbps upstream. Lower speeds are able to operate over longer distances.

---

8 "ADSL: ready for prime time", *Telecommunications*, December 1996, p. 35-44.

Cable modems, on the other hand, deliver higher speeds at 10 Mbps, but users of cable modems will need to share the bandwidth available.

Broadband Integrated Services Digital Networks (ISDN) provides for simultaneous applications; for example, a home office worker could simultaneously access an external data base, make and take telephone calls, and receive facsimiles. Telco network design is moving in the long term in the direction of being able to offer video program transmission through a switched broadband capability, or Video Dial Tone.

Digital video compression (DVC) techniques have been perfected for broadcast applications, business TV and video conference applications. DVC will delay for some time the large scale replacement of subscriber plant with fibre optic technology in both industries. Digital compression of video signals results in bandwidth conservation, more economical use of the network or satellite, and new service possibilities for delivery of video over the existing telephone company infrastructure of twisted copper pairs in the local network.

There is little doubt that the demand for long distance data transmission will increase dramatically to, and beyond the end of the century. With improvements in fibre network capacity, the unit traffic costs will also drop dramatically. If the regulator encourages price competition, this should result in a decrease in the number of large microwave radio systems which are not expected to match the fibre efficiency increases.

In the long term, microwave radio will be used in dedicated and specialized communication systems, and for serving lightly populated areas with difficult terrain. A new and larger role for microwave radio is the provision of wideband local loops. Telecommunications service providers have expressed an interest in moving to multipoint communications systems (MCS) above 20 GHz to support wireless access to a large number of users, particularly for access to the Internet and other computer networks. These new frequency bands are particularly useful for Local Multipoint Communications Systems (LMCS) for the distribution of services such as interactive video, broadcastiing, multimedia, voice and data services as well as fixed point-to-point radio for emerging new services and new backbone/backhaul facilities. There is no additional cost to install a connection to an additional subscriber except for the terminal electronics. At some time in the future it may be possible to use this same system to provide wideband service to mobile users. At that stage, microwave radio will cease being the spinal cord of telecommunications, and will become the nerve endings.

Satellite capabilities have been significantly improved in the past few years by developments in technology. Increased transmitter power has permitted smaller and much less expensive earth stations. Operation in urban areas has increased the transponder capacity potentially available to users.

More recent technology developments have been directed toward smaller satellites, with lower capital costs and smaller revenue requirements, plus the ability to place several of them in the

space formerly allocated to one very large satellite, with the small satellites being launched at various times as the market demands. Also, use of non-geostationary orbit satellites has become a major technology development activity, with close to a dozen organizations vying for spectrum and obtaining financing for start-up systems of various types of both large and small satellites. The particular advantages of this technology are the ability to cover the entire globe, and the use of smaller ground stations (hand-held). Methods of using all types of satellites have also advanced, the use of digital video compression being the prime example, although it is of course not restricted to satellites. More efficient modulation techniques are now available. With higher transmit power on the satellites and more sensitive receivers both on the ground and on the satellite, earth stations are smaller than ever, with 30cm diameter antennas now coming into use for data services. This results in a lower cost as well as a simpler, more flexible installation.

The mobile satellite service adds the element of "service anywhere" to the concept of universal communications. At the present time, true mobile satellite systems designed to serve the land environment have begun service. In the mid term, mobile satellite systems providing service to small personal terminals will be implemented. Much of the emphasis has been on the availability of voice services but the provision of data has a large potential as well. There were very strong indications from early use of mobile satellites of the market requirements of data transfer for tracking, dispatch and surveillance of trucking fleets.

Direct Broadcast Satellite (DBS) could eventually prove to be a major competitor for cable television. Planned DBS service will be based on using advanced digital compression technologies to provide a large number of broadcast channels. Once in place, a DBS system, by virtue of its nature, would provide access to a large number of subscribers over a very large geographic area.

Efforts by the telecommunications carriers and cable operators to upgrade their transmission facilities in the 70s, the switching centres in the 80s and new transport networks in the 90s have resulted in digital switching and toll networks in Canada which are capable of transmitting and switching data (voice, images and data) at bit rates above the Megabit/sec range.

Fibre optics and digitization have enabled the development of technologies to offer wideband and broadband services. The key technologies, Asynchronous Transfer Mode (ATM), Frame Relay and Switched Multimegabit Data Service (SMDS), have one thing in common: they are based on fast packet switching technology. ATM makes more efficient use of the carrying capacity of the network, be it fibre optics or copper, land lines or satellite and allows for two-way exchange of voice, text and video data.

Rapid improvements in silicon technology and distributed processing have also resulted in a large number of user applications and requirements which require access networks and technologies to support a multitude of new voice and data services but also multimedia and a full spectrum of visual communications services.

It has been assumed in the past that the local network capacity would be wireline based, with the radio spectrum primarily utilized for broadcasting and mobile applications. What is emerging is a more complicated environment, where a variety of competing technologies and institutional structures (with different regulatory regimes) may provide the same services. This is being driven by technology developments-more efficient use of radio spectrum (cellular concepts), increase in digital traffic and the development of efficient, low-cost information storage and processing technology.

2.4 Information Technology and Multimedia

Information drives the knowledge economy. The ability to generate high-quality, timely information and to make it available to potential users for commercial exploitation in Canada is essential to knowledge-based economic growth.

Since the introduction of the first microprocessor, the Intel 400 in 1980, the PC industry has been in a steady march forward and upward and there is no end in sight. Moore's Law, which states that the number of transistors on a microprocessor doubles every 18 months will continue to occur, unabated.[9] In the 1980s, there was a proliferation of desktop computers in offices, factories and homes resulting in processing power in the hands of people. During the first half of the 1990s, these computers were networked for data communications purposes. In the second half of the 1990s, with the capabilities of broadband telecommunications in hand, networked multimedia including images, motion video and high quality audio have become possible.

In addition, the advent of the mainframe computer in the 1960s led to remote data processing and time sharing via the telecommunications networks. Telecom Canada responded by forming the Computer Communications Group to design an appropriate network. In 1973, Canada became the first nation to have a commercial digital network (data route). In the 1970s, Canadians were instrumental in developing an international standard (X.25) for public shared data networks. In 1977, Telecom Canada introduced interactive business systems (Datapac). These technological advances and others have helped to place Canada at the forefront of telecommunications.

A developing broadband market that is perceived as representing a significant growth potential is multi-media communications - defined in its basic form as the integration of audio, text, graphics and video images in applications designed to run on multi-media terminals such as desktop computers. Canada is attracting a variety of large players in the multimedia industry, with backgrounds in the video games development, training and publishing houses. Revenues for multimedia firms were in excess of $1 million for 1994.

Applications for multimedia communications emerging at a fast rate are in medicine, education, travel, real estate, banking, insurance, administration, publishing and advertising. Also, video conferencing is expected to triple over the next five years.

---

9 "1987-1989 Corporate Computing", *PC Magazine,* 15th Anniversary Issue, March 1997.

By the end of 1999, as a result of Industry Canada's Advanced Satcom Initiative, satellite-based multimedia services will complement those provided by terrestrial means.

2.5 Standards

Major efforts to promote connectivity and interoperability of networks, services and new information technologies are being made at the global level to permit information system users to interconnect with as many facilities and applications as possible. For that to occur, appropriate, timely and flexible international telecommunications standards are vital. Standards play an significant role in the global acceptance of an emerging technology. Increasingly, these standards are negotiated internationally by government and industry working together through international standards-setting bodies. These standards have to be flexible enough to accommodate important changes in technology as well as meet the current and future needs of industry, governments and users. The mechanisms for telecommunications standards development is of increasing concern, since the establishment and implementation of national standards as globally-accepted standards is one of the decisive factors in determining international competitiveness.

Because Canada imports most of its technology and because our exports must meet international standards, we need to be at the forefront in the development and setting of international standards.

An important part of the establishment of a more competitive infrastructure is the development of a Canadian telecommunications standards strategy through the Telecommunications Standards Advisory Council (TSACC). One of Canada's main objectives is to work in concert with all countries as well as all regional and international organizations to develop flexible and compatible global telecommunications standards. The main challenge is to ensure the provision of universal service over combinations of multiple networks, as well as free and fair competition in the provision of services and products. In addition, two main issues arise in standards development; interconnection of networks and interoperability.

In *Building the Information Society*, the Government stated that only open standards, universally adopted in Canada and around the world, would allow Canada's Information Highway to develop into an interconnected and interoperable network of networks, where access to one network means access to all. The acceptance of open international standards is also deemed a necessary precondition for the emergence and growth of information-based markets and services.

A Government policy on standards was stated as part of the Convergence Policy Statement of August 1996. The policy was as follows:

> "The Government supports the development, distribution and implementation of open interconnection and interoperability standards for the Information Highway. The Government recognizes that, given an increasingly competitive and global market and the rapid pace of technological development, market forces, not governments, should,

to the extent feasible, determine the most appropriate standards. Where required to meet specific needs such as security, safety or international obligations, the Government will use its legislative and regulatory powers to establish and enforce standards. As well, the Government may take appropriate action where competition or the interests of consumers may be adversely affected by standards-related considerations."

In support of this policy, the Government has agreed to strengthen:

- "support for the removal of roadblocks to interoperability and openness through standards, and the use of open and interoperable standards;

- its support for development of open and interoperable standards as a key strategy for removing unnecessary barriers to trade by encouraging greater business participation in international standards development activities including standards development consortia, and in its role as an international negotiator;

- its role as a facilitator of standardization and standards development in Canada and the use of open and interoperable standards, including its encouragement of the adoption and use of international standards by Canadian business, and increased consumer awareness of standards issues;

- its resolve as an informed procurer of goods and services by encouraging the purchase of goods and services based on open and interoperable standards; and

- its role as a facilitator and partner in the establishment of electronic standards information networks providing access to worldwide standards information".

2.6 Research and Development

Canada has been a world leader in the development of communications and information technologies. The Government of Canada has helped to play a role in those areas where special requirements were needed, either through research in the laboratories or through financial assistance. Canada's R&D tax treatment is very attractive by international standards; Canada gives the second most favourable tax treatment for R&D investment in the OECD.[10] Research and development in the information and communication technologies (ICT) sector in 1995 was $2.5 billion or 37 percent of all industrial research and development in Canada.

Broadband telecommunications is a research intensive area in Canada. Research in this area is being conducted in many university and government research laboratories as well as in Canadian

10 The Conference Board of Canada, *Canada ranks near the top in R&D tax incentives*, News Release, February 20, 1997.

corporations. ATM test networks provide for testing applications such as networked multimedia and assessing the quality of service. Local and wide area ATM test networks are available in many research organizations including the Communications Research Centre, the coast to coast Canadian Network for the Advancement of Research for Industry and Education (CANARIE), TRLabs and the Canadian Institute for Telecommunications Research.

This section is directed at three specific areas: Science and Technology Strategy, the Communications Research Centre and CANARIE.

The Science and Technology Strategy of the Government provides a number of key government responsibilities in the research and development area:

- Supporting research in universities and colleges, Networks of Centres of Excellence and other non-governmental research institutions
- Supporting private sector research and technology development
- Providing information and analysis, and building networks.

As a result of the recent budget,[11] the Canada Foundation for Innovation was created. This Foundation will provide significant financial support for the modernization of research infrastructure at Canadian universities and research hospitals in the areas of science, health, engineering and the environment. The federal government is providing $800 million up-front investment which will allow the Foundation to provide about $180 million on average annually for research infrastructure over the next five years. It will also work to ensure that Canada is among the best in the world in applying and commercializing S&T for sustainable job creation and economic growth which is at the heart of the government's S&T strategy.

In addition, the 1997 budget renewed the Networks of Centres of Excellence Program (to encourage universities and other partners to work together on major research priorities) and strengthened the National Research Council's Industrial Research Assistance Program (provides technical support to small business).

The Communications Research Centre's mandate is to "conduct communications and related research and development to serve the national need, with or on behalf of Industry Canada, other federal departments and agencies, provincial governments, academia and the private sector". Its primary focus is on advanced wireless telecommunications services, particularly digital radio broadcasting, advanced television systems, wireless broadband and innovative PCS information services. A facility of interest to the information infrastructure of the future is the Broadband Applications and Demonstration Laboratory, BADLAB. BADLAB is using ATM and other technologies to increase the capacity of existing optical-fibre networks. This research is aimed at increasing the capacity of the Internet and other networks, such as intranets, LANs and WANs.

---

11 Industry Canada, *Chair of the Canada Foundation for Innovation Welcomed by Science Community*, News Release, Ottawa, February 19, 1997.

CANARIE, The Canadian Network for the Advancement of Research, Industry and Education, has been established to facilitate the development of critical aspects of the communications infrastructure in Canada and to contribute to Canadian competitiveness . CANARIE is involved in three main areas of activity: upgrading of the National R&D and Educational Network (CA*net), establishing the high-speed experimental test network-the National Test Network (NTN) and stimulating the development of new networking technologies, products, applications, software and services through their Technology and Applications Development Program (TAD).

CANARIE's support of the national Internet backbone CA*net increased the network capacity from 56 Kbps in 1993 to a capacity of 100 Mbps in 1996 with three 45 Mbps links to the U.S. CA*net connects over 20 regional networks from all parts of Canada.

The NTN is an ATM test network spanning Canada with connectivity to Europe provided by Teleglobe Canada and US connectivity provided by Unitel (AT&T). This test network connects 10 regional ATM test networks with inter-network DS3/OC3 facilities (45 Mbps/155 Mbps) Internet (TCP/IP) and Asynchronous Transfer Mode (ATM) connectivity over 200 ATM switches and routers configured in a variety of architectures. This network connects over 18 universities, 30 companies, 6 research and teaching hospitals and hundreds of researchers in the collaborative testing and development of R&D projects aimed at increasing the efficiency and commercialization of multimedia broadband technology and applications.

3.0 SERVICES

This section deals with the development of services. Included is the development and growth of enhanced services, new products and services, multimedia, technology diffusion, wireless, electronic commerce and the Internet.

The Canadian telecommunications infrastructure is in the midst of a very rapid evolution, at rates almost qualifying for the term "revolution", for the following reasons:

1. the use of high-capacity wide-band digital switches that are essentially special-purpose digital computers, with the capability to provide value-added services beyond the basic switching function;

2. the rapid implementation of high-capacity digital optic-fibre transmission links between switches and to user terminals;

3. the ability to implement highly reliable spacecraft with extensive signal-processing capability in either geostationary or low-Earth orbit as required to meet user requirements; and

4. the ability to implement complex LSI (large scale integration) consumer equipment and telecommunications network equipment with computer capability as required with high reliability and low cost.

3.1 New Products and Services

DirecPC is a satellite based Internet access technology provided by Telesat Canada. It allows access to the Internet at speeds up to 400 Kbps.

Local Multipoint Communications Systems (LMCS) is a broadband wireless telecommunications common carrier service in the 28 GHz range capable of providing "wireless" cable television, high speed Internet access and video teleconferencing. These systems will provide competition to cable, telephone and satellite distribution systems.

Personal Communications Services (PCS) is a family of small, low-cost, personal and fully portable handsets providing advanced digital telecommunications services.

An explosive growth is expected in mobile and personal communications, anywhere from 10 to 20 percent per year and in the introductory years, as high as 85 percent. Some telecommunications companies have estimated that 50 percent of their connections will be mobile at one end by the Twenty-First Century.

Radio communication is an essential element of any advanced telecommunications infrastructure. It allows communications over great distances (satellites and microwave), coverage of large geographic areas (broadcasting) and provides mobile communications (cellular and paging) and easy access (cordless phones, public digital cordless phones). The scheme whereby licensees are authorized on a first come first served basis continues to be used with success in Canada. Market based criteria (i.e. comparative licensing) have been used to select licensees for competitive services. Industry Canada continues to monitor and study competitive processes like spectrum auctions and lotteries.

The introduction of cable/telco competition in Canada will expand the horizon of services available to Canadians, particularly in the area of multimedia. Bell Canada and Telus Multimedia Inc. recently were heard by the CRTC on their applications to offer cable television service on an experimental basis in Ontario, Quebec and Alberta.[12] The trials will use a hybrid network that links customers by coaxial cable to nearby nodes, which are connected by higher-speed fibre-optic lines to high-speed switching computers and video servers. Customers should have access to more than 300 TV channels, along with video-on-demand service, CD-quality audio and high-speed access to the Internet.

---

12 "Bell, Telus to defend cable TV market trials", *Globe and Mail*, February 10, 1997, B1.

Cable operator Vidéotron and PCS operator Microcell recently announced a trial of their wireless local loop service, as an alternative to the services provided by the local telephone monopolies.[13] The new service would route signals from Microcell's PCS network onto Videotron's hybrid fibre-coaxial cable network. PCS subscribers, in addition to their wireless voice transmission, would be able to receive faxes and electronic messages on their hand sets. The cable service would also provide Internet access.

Cable television companies are presently offering WAVE, a cable modem service providing high-speed Internet access to residential customers. Rogers Cablesystems states that they have 200,000 WAVE customers, with the service being available to 1.5 million Rogers cable customers by the end of 1997.

Direct-To-Home (DTH) television service are now available through AlphaStar Canada Inc. and Star Choice TV Network/HomeStar[14] and ExpressVu will provide services later this year. The DTH providers expect to target the 1.2 million consumers who live in uncabled and undercabled rural areas.[15]

The Federal Communications Commission (FCC) approved in December 1996 a set of guidelines for high-definition television (HDTV) transmission, which will allow beaming of a television signal at 19 Mbps and digital content from the Internet. It included a number of multimedia technologies such as MPEG-2 compression, Dolby AC-3 audio, and Zenith's digital transmission scheme known as the vestigial sideband.

The new frontier in telecommunications includes computer networking, on-line databases, electronic mail, electronic financial and credit transactions, remote sensing, energy management and other data applications. Most data traffic flows over dedicated private circuits supplied by carrier or privately-owned landline, microwave or satellite facilities. In these applications, the customer provides its own network intelligence, in computers, terminals, and data switches installed on the premises.

During the last ten years, there has been an explosive growth in information services available at a distance. This includes local bulletin boards, financial services, communications networks (Internet, Compuserve, Freenet, etc.)

3.2 Electronic Commerce

Electronic Commerce is the use of telecommunications and computers to do financial transactions with a monetary value between end users. Software development will continue to drive network user enhancements and user penetration will continue to increase, but the coming developments in

---

13 "Duo target local phone market", *Globe and Mail*, February 26, 1997, B9.

14 "HomeStar, Star Choice join forces in DTH race", *The Ottawa Citizen*, March 7, 1997, C3.

15 "AlphaStar gets set to beam direct-to-home TV signals", *The Ottawa Citizen*, March 1, 1997, D6.

electronic commerce will be in how the user is communications-connected to and from the public switched telephone network (PSTN). Issues will revolve around increased capacity, increased network intelligence, packet switching, global standards, and end user applications improvements. The best is that all of the technology is here today and it is just the combinations of technology that need to be simplified. A conservative estimate of Canadian firms using electronic commerce today is 20 to 25 percent.

The Canadian government has already made significant progress in the adoption of electronic commerce as a means of conducting its business, mainly through electronic payments, requests for technical information and access to its Internet site. A formal framework for the use of electronic commerce as the preferred way of conducting government business is currently under development.

Price Waterhouse Technology Forecast: 1997[16] indicated that electronic commerce over the Web will begin to accelerate reaching at least $12 billion (U.S.) worldwide on the public part of the Internet by 2000 with at least another $32 billion from corporate intranets. It indicated that Internet commerce amounted to $183 million last year whereas intranet commerce totalled $679 million.

Canadians are the world's no. 1 users of Automated Banking Machines (ABMs) and debit cards.[17] CIBC recently announced a test of the Web ABM, an automated banking machine that uses Internet technology to offer a range of new services, such as find information, buy tickets, make reservations, order catalogues, in addition to the usual cash withdrawals and bill payments. ABM transactions account for 58 percent of routine banking transactions in Canada, while Americans use ABMs just 28 percent of the time. There were more than one billion ABM transactions in Canada in 1995; about 35 per person. Canada's 30 million residents have 43 million bank cards.

Call centres are one area of Canada's economy which is growing by leaps and bounds. These centres do business by phone, combining centralized data bases with automatic call-distribution systems. In Ontario, the number of call centres is expected to rise by 27 percent in 1997, up from the 15 to 20 percent annual growth rate over the past few years. In New Brunswick, more than 5,000 jobs have been created in 35 new call centres in the past three years.[18]

3.3 Information Access and Technology Diffusion

The key to information is access. Access to the information infrastructure will continue. Through SchoolNet, all of the 16,500 schools and public libraries will be connected to the Internet by 1998. The Community Access Program will put 1,500 remote communities on line by 1998.[19] In

---

16 "Internet driving high-tech, report says", *Globe and Mail*, February 26, 1997, B9.

17 "CIBC brings the Internet to bank machines", *The Ottawa Citizen*, February 21, 1997, D12.

18 "Call centres let consumers dial up service", *Globe and Mail*, March 3, 1997, A1.

the 1997 budget, the new target for the Access program is 5,000 communities and the Computers for Schools initiative will provide 100,000 surplus computers from governments and companies by the year 2000 (the current number of computers distributed is 25,000).

Canada's telecommunications infrastructure has a high level of systems integration, digital switching and ATM technology.

In the past, high quality, reliable basic wired telephone service was the key element in accessing the information infrastructure. For most Canadians, access is available to a single digital "touch tone" line. When combined with digital switches, access is available to a wide range of optional services and the Internet. Telephone companies in Canada have been upgrading their network facilities in remote and rural areas and to phase out multi-party lines and analog switches by the turn of the century. It is expected that the national public telephone network will be 100 percent digital by the year 2000.

However, other means are increasingly being made available to Canadians, such as a wide range of wireless access.There are 4 million users of wireless technology in Canada today (2.6 million cellular users, 1 million paging users and some 400,000 users of other mobile radio applications like mobile dispatch and narrow band PCS applications). An untapped 90 percent of Canadians do not use certain wireless technologies.[20]

In addition, cable TV companies, together with over-the-air broadcasters, distribute TV program services to the residential market. A majority of Canadian households (81 percent) subscribe to basic cable service. Internet access is also being made available through ISPs (Internet Service Providers), telephone and cable companies.

Business applications vary considerably not only by industry but also by size of firm (small, medium, large). Most of the services are being offered by the telephone companies, but increasingly other competitiors have increased their market share. For example, larger cable companies, such as Rogers in Toronto and Vancouver, and Videotron in Montreal and Quebec, also offer telecommunications services to business customers. These services include a variety of point-to-point voice and data services, and are made available through the utilization of excess capacity on the cable networks, primarily in urban areas. However, additional facilities, such as PBXs and local circuits, are required to provide the services. Rogers makes available circuits for local interconnection between businesses and large computing facilities. Videotron provides intercity private line service.

---

19 "Being connected key to universal access", Interview with Industry Minister John Manley, *Hill Times,* February 17, 1997.

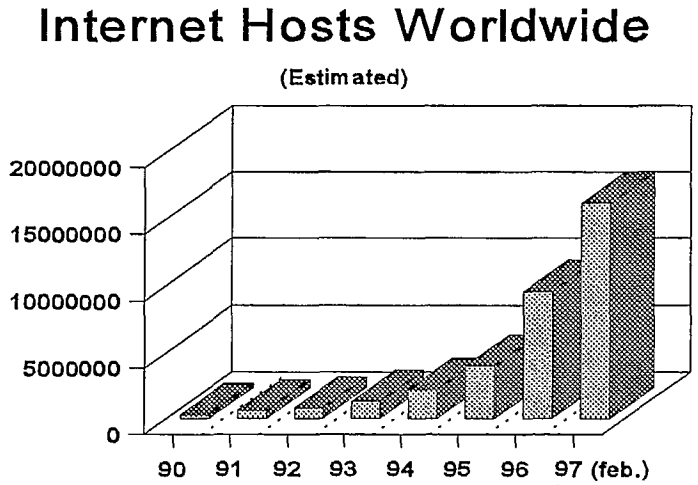
20 Canadian Wireless Telecommunications Association (CWTA), Annual Conference, May 1996.

3.4 The Internet

The Internet is essentially a network of interconnected network computers. It was developed in the 1960s as an essentially nuclear-attack free system by the U.S. Defense Department and named ARPANET (Advanced Research Projects Agency Network). Interconnection of researchers and universities in the 1980s using the NSFNET (National Science Foundation Network) led to a expanded network of capabilities and access. This was expanded further through use of microwave, fibre optic, satellite, cellular radio, etc. In 1991 the U.S. government made access free. Today, the growth is in excess of 10 percent per month.

In terms of growth, there are a number of areas that have been measured, but there is a variation in the data from a number of sources which may vary up to 25 percent. Based on some of the predictions, in early 1996, there were an estimated 10 million hosts worldwide with an estimate of 100 million host computers by the year 2000.

A report by Network Wizards[21] identified that the "Internet currently consists of countless autonomous networks, representing 828,000 domains, with 16,146,000 "advertised" connected computers in 176 countries and territories. Because of the unknown and potentially unlimited numbers of multiuser computers and networks or application gateways, it was not possible to correlate any of this information with the number of end users." The annual host growth rate of 70 percent represents an exponential growth rate.



21 "Internet survey reaches 16.1 million Internet host level--Exponential growth record continues", *Biannual Strategic Note*, Network Wizards, Feb. 13, 1997.

The convergence of digital technologies including television, telephony, and computers has stimulated the reach of innovations of the Internet. Digital video, audio, and interactive multimedia are growing in popularity and increasing the demand for Internet bandwidth. However, there has been no convergence or consensus on either the economics or the future policy framework of the Internet.[22]

Time magazine[23] recently reported there were 57 million Internet users worldwide exploding to 700 million by the end of the century. In comparison, it states that it has taken 100 years to get the telephone system to its current level and the Internet would achieve the same level in five years. A chief scientist at Belcore recently predicted that there would be more Internet users across the globe than users of telephones by 2000 or 2001.[24] Other predictions expect the number of users to reach 1 billion by the year 2000. According to *U.S. News Online*,[25] every 30 seconds, someone logs onto the Internet for the first time: every 10 minutes a new corporate or academic network is added.

Demographics of Internet users are scarce and variable. A February 1996 Everglade research survey[26] indicated that the average user age was 33 years old, 75 percent of the users were male, 80 percent were university graduates, 63 percent were professional or management employees, their average salary was greater than $65K per year and that their main purposes for using the Internet were research, entertainment and communications.

For merchandising and electronic commerce, a U.S. study[27] by Jupiter Communications and Women's Wire entitled *Women Online: Developing Content and Advertising for an Emerging Market*, found that in the real world of malls and mail order catalogues, women account for 70 percent of retail purchases, but only account for 25 percent of Web purchases. Most of their use was e-mail swapping. Demographically, by the end of the decade, women will make up 47 percent of the online market, a fivefold increase from the 1996 population.

The Internet has been described as a "disruptive" technology. This technology or service has captured the consumer away from other services and changed the marketing and development strategies of the major communications companies, such that they are all getting on the Internet bandwagon. It is a good example of "build it and they will come".

---

22 McKnight, Lee W. and Joseph P. Bailey, *An Introduction to Internet Economics*, presented at MIT Workshop on Internet Economics, March 1995.

23 "Welcome to the wired world", *Time*, February 3, 1997, p. 43-56.

24 Ravensbergen, Jan, "Information highway ready to pass telephone", *The Ottawa Citizen*, March 6, 1997, G79.

25 Simon, John, "Only market forces can unclog the Internet", *U.S. News Online*, www.usnews.com, January 24, 1997

26 Everglade Research Corporation, Toronto, 1996.

27 "Selling to Women Online: The Rules", *Netguide*, March 1997, p. 59.

Where is the Internet going? Some of the next steps include video conferencing, Internet telephony, faster modem access, cable company services, satellite transmission, Internet appliances and electronic commerce. The next phase in the development of the Internet is "active" Web sites with a full range of sounds, images, text, and video.[28] However, television broadcast quality video flows at 27 megabytes per second, which is hundreds of times faster than the 28.8 kilobit modem. Two solutions to the distribution problem are compressed data, based on the MPEG (Motion Picture Experts Group) standard, or "streaming video", where the video begins to play as soon as the first packets reach your computer. Another option is Internet TV, using the television set as an Internet channel.

However, with the exponential growth in the users of the Internet, as well as a change in the nature of the transmissions from text only to graphics and voice, there are Internet bottlenecks. This arises mainly from the nature of telephone traffic; telephone sizing of trunks, cables, circuits and switching equipment is based on the theory of average voice telephone calls traffic distribution. With an increase in users as well as holding times, there is a resulting delay in the interaction with the Internet and the longer term possibility of a lack of connection, due to a lack of dial tone. The average voice telephone call lasts an average of three or four minutes. The average Internet user spends an average of 28 minutes online.

Some alternative options to deal with these traffic problems include technological methodologies (ADSL, ISDN, data compression, cable modems) as well as different means of transmission (satellite transmission, wireless systems, alternate advanced networks). The technology is moving very fast: "X2" modems allow the delivery of 56 kps versus 64 kps or more for ISDN lines.[29] Another alternative is the provision of the equivalent of an Internet Protocol dial tone separate from the regular voice type dial tone. Other options include a new array of pricing plans ("usage-sensitive pricing") and the addition of value-added services, like Internet faxing, and better connections to customers willing to pay more.[30]

A network solution to the congestion on the Internet has been Internet II, a separate network for research and educational purposes. The core of Internet II is vBNS (Very High Speed Backbone Network System), which will emphasize research networking rather than network research. With an upgraded CA*net and NTN (Neutral Twisted Nematic) routers, interconnection with vBNS can be developed.

Digitization of libraries around the world will make today's Internet pale by comparison, says a recent special report by *Scientific American*. By the year 2000, half the material accessed in major libraries will be digital and access will likely be via the Internet.[31]

---

28 Campbell, Todd, "Video on the Internet", *Internet News*, www.msn.com, February 1997

29 "Z@pped: Home ISDN", *The Globe and Mail Report on Business*, March 1997.

30 "The Flat Rate: Morning After", *Netguide*, March 1997, p. 32.

31 Lesk, Michael, "Going Digital", *Scientific American*, March 1997, p. 58.

3.5 Markets and New Services

As the evolving information infrastructures are based on broadband communication technologies, they are able to carry integrated data, video, text and voice traffic and allow the capability to carry multimedia services and allow interactivity. There is no consensus to date on whether information infrastructures will require fibre to the home, fibre to the curb or other transmission technologies. However, with advances in compression technologies, investments have tended to be placed into upgrading networks rather than investing in fibre with the uncertainties in residential demand.

A report from the OECD[32] indicates that the costs to connect a new customer vary a great deal. The costs to connect a new customer with: copper wire are between US$200 to US$2,000 per connection; fixed wireless and cellular are US$500 per connection; coaxial cable are US$500 per connection; fibre to the curb are US$1,050 per connection; fibre to the home are US$2,000 per connection.

4.0 DEMOGRAPHIC AND ECONOMIC FACTORS

In this section, we examine the principal socio-economic role of the information infrastructure for Canada. As a general overall socio-economic context, the first section discusses the Canadian demographic and socio-economic environment. The economic importance of infrastructure development and the business environment are then reviewed.

4.1 Socio-Economic Environment

Telecommunications in Canada is well advanced in both urban and rural areas thanks in part to the use of satellite facilities to provide transmission in the more remote regions of Canada.

Government policy to provide universal and affordable basic telephone service has nearly been achieved.

Approval of just, reasonable and non-discriminatory prices for various services offered by the telephone companies remains the responsibility of the Canadian Radio-television and Telecommunications Commission (the CRTC).

The CRTC has adopted route averaging and value of service pricing concepts which resulted in a relatively low flat monthly rate for basic local telephone service regardless of how many local calls are made and varying long distance telephone rates. This relatively low price was due to the fact that on average a consumer would pay more for its long distance calls. The additional revenues acquired by the telephone company from long distance calls were used to subsidize basic local

---

32 *Alternative Local Loop Technologies: A Review,* OCDE/GD(96)181, Directorate for Science, Technology and Industry, 1996.

telephone service. The relatively low price of basic local services has eliminated the need to impose low income support programs.

As more competition is permitted in Canada, prices of telecommunications services will tend to more truly reflect the cost of providing the services. This may lead to increases in the price of basic telephone service. However, it is unlikely this trend will lead to a significant decrease in the current availability of telecommunications services in either the urban or rural areas of Canada. Studies have indicated that penetration rates are high in all income brackets. However, income is a determinant, so only future research work will determine if rates will be affected by price increases.

4.2 The Canadian Demographic and Economic Environment

To put the economic importance of telecommunications in perspective it is important to briefly discuss the demographic characteristics of Canada and the economic environment in which our nation evolves, both nationally and internationally.

Canada's population was 24.0 million at the 1981 census, rose to 25.3 million at the 1986 census, was 27.0 million as of July 1, 1991, and reached 30 million as at September 30, 1996. In comparison, the United States has a population roughly ten times that of Canada. Japan's population is four times larger, and the United Kingdom, France, Germany and Mexico are each twice as populous as Canada.

Real living standards in Canada nearly tripled in the last 40 years and only in deep recession years (1990) has real per capita GNP declined. In 1996, Canada was first in the world in quality of life standards as measured by the United Nations.

In Canada's economy, the service producing industries account for two-thirds of the GDP and for almost three-quarters of total employment (1994). The increasing relative importance of the service sector as an employer reflects labour-saving technological innovation in the primary and secondary sectors.

Events and socio-economic trends in the rest of the world are very important for Canada's business environment. World economic development means markets for Canadian products and services, sources of supply for imports and opportunities for Canadian-based multinational corporations. International trade is a very important activity for Canada's economy and its largest trading partner is the United States. Between 1981 and 1991, exports and imports averaged 25 percent of GDP. Furthermore, at least 40 percent of private sector activity in Canada depends on international trade. The importance of trade has grown substantially over the years. This indicates a sharp increase in the openness of Canada's economy.

Canada's trade in goods boomed in 1995, with total exports worth $254 billion and imports $225 billion.

4.3 Penetration/Users

Over the past several years, there has been a greater effort to determine the penetration of products and services in the Canadian household. Statistics Canada annually conducts household surveys to assess the Canadian technology environment, shown below:

Availability of Household Equipment
% of Total Households

	1984	1989	1994	1995
Telephone	98.6	98.7	99.0	98.5
Radio	98.9	98.9	98.9	98.9
Colour TV	88.5	96.1	98.2	98.5
VCR	12.6	58.8	79.2	82.1
Cable Television	60.1	70.8	74.1	76.2
Compact Disc Player	----	11.6	40.8	47.4
Personal Computer	10.4	12.6	25.0	28.8
Modem	----	----	8.4	12.1

---- data not available for that year
Source: Statistics Canada, Catalogue no. 64-202

By 1996, the computer penetration increased to 31.6 percent and the modem penetration increased to 15.5 percent.[33]

The paging market penetration rate in Canada is 4 percent compared to the U.S. which is 14 percent. By the end of the decade, a market penetration of 10 to 40 percent is anticipated by the wireless industry.[34]

The Canadian Policy Research Networks Inc.[35] indicates that the "on-going spread of computer-based technologies over the past two decades is resulting in fundamental changes in the nature of work." These surveys have documented the spread of computer use across Canadian business establishments and the intensity of use. "Early applications consisted largely of the introduction of stand-alone technologies, creating "islands" of automation. By the late 1980s, computer use had begun to shift to include higher proportions of data and communications networks. The intensity of computer use has increased steadily through time, rising from an establishment mean of

---

33 Dickinson, P. and G. Sciadis, "Access to the Information Highway", Statistics Canada, *Canadian economic observer* (Catalogue no. 11-010-XPB), December 1996.

34 CWTA, Annual Conference, May 1996.

35 McMullen, Kathryn, *Skill and Employment Effects of Computer-Based Technologies: The Results of the Working with Technology Survey III*, Canadian Policy Research Networks Inc., January 1997.

16 percent of employees working with computers in 1985, to 37 percent in 1991, to 43 percent in 1994. A key conclusion is that the on-going deepening of use of computer-based technologies within organizations is resulting in a transformation of the skills structure and in a widespread process of upskilling of jobs through both an occupational shift to high-skill jobs and an increase in skill requirements, especially for know-how, that is evident across the occupational spectrum."

4.4 New Economy

A national, modern information infrastructure is essential to compete in the information era and constitutes an important economic development tool. It can be argued that competitive and modern networks contribute to Canada's economic growth in four ways:

1. Increase competitiveness of existing firms.
2. Attract new businesses and investments, both national and international.
3. Favour the diversification of the economic base.
4. Enhance the quality of life of Canadians and ensure the effective delivery of vital services such as health services.

Many business experts support the belief that industries integrating communications and information technologies with their current production technologies will reduce their costs as well as increase their output. For example, service sectors industries can provide more efficient financial services if they use advanced telecommunications networks and computers.

A modern and advanced low cost information infrastructure moves information more efficiently from one location to another, including remote areas. This is an important factor when information-intensive firms make investment decisions to locate their operations in a particular region of Canada.

It can be argued that economic diversity constitutes a key factor to growth and stability. Local economies are often dependent on one type of industry and are more exposed to economic downturns. Value added services supported by state-of-the-art telecommunications networks allow small businesses to compete with large firms with competitive advantages because they developed their own sophisticated private networks.

Most industrialized economies are currently experiencing a severe downturn and restructuring, including public sectors. Highly advanced telecommunications networks will reduce costs of delivering those services without drastically changing service levels. This suggests that a modern telecommunications infrastructure can significantly enhance the quality of Canadian life.

The telecommunications network is a key element for cost-efficient services provided by industry. In addition, many organizations use telecommunications to gain a competitive advantage through innovation.

The economic importance of the information infrastructure supports the development of national telecommunications policies designed to stimulate development and investment in this crucial sector and to support current and future national needs.

5.0 POLICY AND REGULATORY EVOLUTION

This chapter concentrates on legislation, regulations and policies impacting on the development and evolution of the information infrastructure.[36]

5.1 The Policy and Regulatory Framework

Until recently, regulation of the telecommunications industry was split among agencies of federal, provincial and municipal governments. This fragmentation of the telecommunications regulatory framework impeded the development of innovative and competitive Canadian telecommunications services.

In 1989, a Supreme Court decision recognized federal authority over all Canada's major telephone companies (the members of Telecom Canada, now Stentor). This important clarification of the jurisdictional issue allowed the application of a coherent telecommunications policy throughout the country.

The new Canadian policy integrates the objectives and principles that have traditionally guided the development of the country's telecommunications system but also reflects the demands arising from new realities, such as the globalization of markets and the extremely rapid evolution of the telecommunications sector. Canada's new *Telecommunications Act*, which came into force in October 1993, represents the primary means for applying the policy.

5.2 Telecommunications Legislation

The 1993 *Telecommunications Act* established a new legislative and regulatory framework for all federally-regulated common carriers. In so doing, it provides for an integrated Canadian market for telecommunications services. In addition, it allows the federal regulator, the Canadian Radio-television and Telecommunications Commission to put in place a more flexible regulatory system which will facilitate innovation and the development of Canada's principal high-technology industry. This will be increasingly important as domestic and global markets become more competitive.

Application

The Act provides for the supervision, and where required, regulation of telecommunications common carriers under federal jurisdiction who own and/or operate their own transmission

---

36 For a detailed summary of previous policy and regulatory factors, see the two government documents, *Telecommunications in Canada: An Overview of the Carriage Industry*, 1992 and *Convergence, Competition and Cooperation: Policy and Regulation Affecting Local Telephone and Cable Networks*, 1992.

facilities. These are referred to as "Canadian carriers". Currently, these include national carriers such as Telesat Canada, Teleglobe Canada, Unitel (AT&T) and most of the telephone companies belonging to Stentor (Telus, Bell Canada, BC Tel, Manitoba Telecom Services, Island Tel, Maritime Tel & Tel, NBTel, Newfoundland Tel). By federal-provincial agreements, SaskTel was exempted from the Act for five years. "Resellers" who do not own or operate transmission facilities but who lease facilities from Canadian carriers to provide services to the public are not subject to regulation under the Act. All carriers who make use of the radio spectrum are subject to licensing and regulation under the *Radiocommunication Act*. Under the recent Agreement on Basic Telecommunications, 100 percent foreign ownership and control in the resale sector will be allowed.

Policy Objectives

The Act includes a statement of Canadian Telecommunications Policy. This policy recognizes the strategic importance of telecommunications in the maintenance of Canada's identity and sovereignty and for the social and economic development of the country. It contains a list of nine objectives which strike a balance between traditional concerns such as universal, affordable access to services, and newer considerations such as the need for increased reliance on market forces and a competitive, efficient, telecommunications industry. In addition, it provides for Canadian ownership of "Canadian carriers" who own and operate the national telecommunications infrastructure.

Major Powers of the Government and the Regulator

Various provisions of the Act outline the respective powers of the Governor in Council (GIC), the Minister and the CRTC.

The Governor in Council has the authority to issue directions on broad policy matters to the CRTC and to review, vary, rescind or refer back any CRTC decision. The Minister has the authority to establish technical standards and to require the CRTC to enforce these standards. However, the provinces must be informed and consulted before any of these powers are used. In addition, the Governor in Council can make regulations to implement the Canadian ownership objective.

The CRTC has the full range of regulatory powers of an independent, quasi-judicial regulatory agency. The CRTC must exercise its powers with a view to implementing the policy objectives stated in the Act and any directions issued by the GIC. The CRTC must ensure that rates are just and reasonable, and that Canadian carriers do not engage in unjust discrimination, or accord any undue preference.

The CRTC was also given important new powers: it can exempt classes of carriers from the application of the Act; it can forbear from regulating where there is effective competition or where forbearance is in the public interest; and it can use any method of regulation it considers appropriate (e.g., alternatives to traditional rate-base, rate-of return regulation).

5.3 Other Legislation

The *Radiocommunication Act*

The *Radiocommunication Act* was proclaimed in October 1989. The amendments to the *Radio Act of 1936* reflect the enormous advances in radiocommunications over the last five decades. The Act also established a legal framework to ensure that Canada maintains the highest standards in using and developing radio communications.

The *Broadcasting Act*

In June 1991, a new *Broadcasting Act* for Canada came into force. This Act established a new broadcasting policy for Canada, set out the mandate and powers of the Canadian Radio-Television and Telecommunications Commission, and changed the mandate and structure of the Canadian Broadcasting Corporation. The broadcasting policy, which outlines the roles and responsibilities of private and public broadcasters including the CBC, was updated to reflect changes in society and technology since 1968. At the same time, the Act was made "technology neutral" to facilitate the introduction of new technologies. The Act encourages greater regulatory flexibility and provides for decentralization of the CRTC and its decision-making process.

In September 1992, the CRTC announced a public proceeding, which subsequently commenced in March 1993, on the structure of the broadcasting industry. The proceeding was to review issues related to CRTC regulations and policies for the distribution, packaging and carriage of television programming services, alternative distribution technologies and criteria for licensing new Canadian specialty-broadcasting services.

The CRTC decision, issued in June 1993, reconfirms cable's primary role in the distribution of broadcasting services and does not endorse any direct competition to cable. The Commission laid out a scenario for a five year transition period designed to enable cable to respond to increased competition from U.S. DBS services and other future contenders.

In doing so, the CRTC reinforced cable's central role in achieving the objectives of the *Broadcasting Act*. In particular, the cable infrastructure will be strengthened and updated (the Commission allowed partial recovery of the costs for implementation of universal addressability and digital video compression), several new Canadian services will likely be licensed, and a production fund is created to finance Canadian programming.

5.4 Competition

In the last decade, a series of regulatory decisions by the CRTC has liberalized the telecommunications service market and facilitated the entry of new suppliers into key segments of the industry.

Terminal Attachment
In 1980, the CRTC first authorized competition for terminal attachment, allowing customers to own and interconnect telephone sets and other terminal equipment to the facilities of federally regulated telephone companies. As a result of this decision, users can now attach any terminal to the network, as long as it complies to the requirements of the Terminal Attachment Program Advisory Committee (TAPAC).

Resale and Sharing
After extensive consultations, a July 1984 CRTC decision allowed competition in enhanced services between the federally regulated common carriers and the resale carriers which lease transmission capacity. To facilitate this competition, the decision also allowed the resale and sharing of all carrier services for the provision of enhanced services. To forestall undue competitive advantage by the carriers, the Commission developed specific regulatory requirements to govern their participation in the market.

Since 1984, the CRTC has continued to liberalize the restrictions on resale and sharing. It became possible to resell capacity on private voice lines and to combine traffic from multiple users over a single channel ("joint use"). The new rules apply to private lines leased from Bell Canada, BC Tel, Unitel (AT&T) and Telesat Canada. The Commission also allowed the resale and sharing of Teleglobe Canada's international services but not a joint use basis.

In Telecom Decision CRTC 92-12, the Commission extended the resale and sharing rules to Atlantic Canada, and also allowed the resale of all discount services, e.g., WATS and Advantage.

Long Distance Telephone Service
In May 1990, Unitel and BC Rail-Lightel applied to the CRTC for permission to compete in public long distance service. In June 1992, the CRTC approved the introduction of such competition. The Commission determined that allowing facilities-based competition would increase the affordability of long distance service, improve the overall competitiveness of Canadian industry and maximize the use of Canadian facilities.

While favouring long distance competition, the CRTC established new mechanisms to safeguard the provision of universal public telephone service in all regions of Canada including rural areas. Among its other provisions, Decision 92-12 requires all new long distance carriers to make contribution payments to the telephone companies providing local services that the CRTC believes will be sufficient to keep local rates at affordable levels.

Regulatory Framework
In September 1994, the CRTC issued Telecom Decision CRTC 94-19 regarding the regulatory framework for the telecommunications industry. The decision was directed toward Regulation, Rate Rebalancing, Competition, Safeguards and Convergence, summarized as follows:

REGULATION: focus on monopolies and areas of market dominance, leading to forbearance and deregulation:

- Price caps for local utility services only, as of 1998
- Transitional incentive-based rate of return regulation starting in January 1995
- Freedom to price competitive services, with costs covered and losses absorbed by shareholders.

RATE REBALANCING: Commencing January 1995, monthly rate for basic local service increases $2 for each of next three years, with rate reductions in long distance services.

COMPETITION: All telecommunications services, including basic local service, open to competition by cable-TV service providers or others.

SAFEGUARDS:

- Split rate base for utility and competitive services
- Carrier access tariff
- Unbundling of bottleneck services
- Interconnection and interoperability of networks
- Investment on advanced networks at telco's risk.

CONVERGENCE: Telephone companies can invest in content services.

Follow up proceedings would be required on rate rebalancing, split-rate base, co-location and unbundling.

Implementation of Regulatory Framework

Further to the announcement of the regulatory framework, the CRTC is implementing regulations concerning Local Interconnection and Network Component Unbundling pursuant to Telecom Public Notice CRTC 95-36 issued in July 1995 and Telecom Public Notice CRTC 96-11 issued in April 1996. Decisions on these matters are expected in 1997.

Public proceedings to deal with the stimulation of effective competition on the local telephone market are continuing. These are related to co-location, number portability and costs of local service.

Broadcasting Distribution Undertakings Providing Non-Programming Services

In January 1996 in Telecom Decision CRTC 96-1, the CRTC concluded that companies which are broadcasting distribution undertakings under the *Broadcasting Act* may also in certain circumstances be Canadian carriers within the meaning of the *Telecommunications Act* when they distribute non-programming services. This was followed by the CRTC issuing Telecom Public Notice CRTC 96-36 in December 1996 to deal with the regulation of certain telecommunications services offered by broadcast carriers, as well as Internet access services, in order to develop a regulatory framework.

Affordability of Basic Telephone Service
In Telecom Decision CRTC 96-10 *Local Service Pricing Options* issued in November 1996, the CRTC found that local telephone service is affordable for the majority of Canadians and implemented a number of steps to ensure that access to basic telephone service will remain affordable in the future. These include the following: bill management tools and affordability monitoring plan.

New Regulatory Framework for Broadcasting Distribution Undertakings
In Public Notice CRTC 1997-25 issued in March 1997, the CRTC changed some of the rules for cable operators, telephone utilities, direct-to-home satellite distributors and others in the broadcasting distribution business. These rules include the following:

- Contribution of 5 percent of gross revenue to an independent production fund.
- Cable companies no longer require a community channel.
- No regulation of subscriber fees of new entrants.
- Cable rate increases based on capital expenditures eliminated.
- Distribution companies cannot favour one programming service over the other.
- Customer-ownership of cable will be allowed.
- Linkage and tiering rules simplified.
- Optional subscription to pay-per-view only.
- New players to offer simultaneous substitution.

5.5 Communications Policies

Convergence
In May 1991, the Minister of Communications established a private sector Local Networks Convergence Committee to report on the continuing convergence of telecommunications and broadcasting and the new multimedia services that will be delivered by the telecommunications common carriers and the cable television operators. The Co-chairs' Report, made public in November 1992, is invaluable in helping to ensure that Canadians benefit fully from new and innovative services.

In October 1994, the government issued an Order in Council related to convergence and requested the CRTC to hold hearings and report back on issues associated with its implementation. In May 1995, the CRTC reported on the review and suggested implementation principles. The Information Highway Advisory Council (IHAC) also reviewed and commented on the report. In August 1996, the government issued a policy statement, aimed at allowing fair and sustainable competition between cable and telephone companies, and principles covering three main areas: facilities, content and competition.[37] Policies in each of these areas are as follows:

---

37 Government of Canada, *Competition and Culture Set to Gain In Convergence Policy Framework*, News Release, Ottawa, August 6,1996.

FACILITIES - It is Government Policy that:

- "Cooperation or sharing between cable licensees and telecommunications carriers should be permitted.
- The facilities and capacity of telecommunications carriers under federal jurisdiction, including facilities of cable licensees beyond that used by the licensees for the carriage of broadcasting services to the extent practicable, be made available for lease, resale and sharing by service providers and other carriers on a non-discriminatory basis.
- Facilities and capacity, including support structures, should, to the extent practicable, be provided in a manner that allows users to use and to pay for only those parts of the network infrastructure they require".

CONTENT - It is Government Policy that:

- "Participants in the Information Highway make equitable and appropriate contributions to the production and distribution of and access to Canadian-cultural-content products and services.
- Government continue to have the tools and mechanisms necessary to promote Canadian content".
- What constitutes a "basic package" of services will be defined.

COMPETITION - It is Government Policy to:

- "Foster fair competition and an increased reliance on market forces in the provision of facilities, products and services.
- Encourage the regrouping and interconnection of cable licensees' systems on a national basis in order to maximize their efficiency as long as this does not impede access.
- Update Canadian ownership rules for broadcasting licensees to encourage the investment required to accelerate the implementation of the advanced technologies and to increase Canadian content services by harmonizing the rules for the broadcasting industry with those of the telecommunications industry.
- Ensure that anyone acting as both a broadcasting undertaking as defined by the *Broadcasting Act*, and as a "Canadian carrier" as defined by the *Telecommunications Act* is subject to both Acts, for those activities to which they respectively apply".

5.6 Other Communications Policy Initiatives

In October 1991, the Minister of Communications created the Radio Action Plan Consultative Group to recommend measures to deal with the serious economic situation of private broadcasters and to establish a framework for their future.

In December 1991, the Minister of Communications acted upon the Task Force Report on the Economic Status of Canadian Television (Girard-Peters) by convening a Television Summit involving all sectors of the industry.

In October 1995, the Minister of Canadian Heritage established an industry-government task force to give advice on the policy framework for the transition to digital television in Canada.

In 1992, the federal government established the task force on the introduction of digital radio to coordinate the steps required for the successful introduction of digital radio broadcasting (DRB) in Canada. This industry-government task force was mandated to recommend a policy and regulatory framework to the Departments of Industry and Canadian Heritage for the development of DRB service during the transition period and beyond. Industry Canada released the revisions to the *Canadian Table of Frequency Allocations* (October 1994) and the *Spectrum Utilization Policy* (January 1995) for the allocation of spectrum for DRB and the *Allotment Plan* in June 1996. The CRTC in June 1995 also requested public comments on the proposed approach to the introduction of DRB. Industry Canada has recently released a proposed spectrum policy to permit the use of DRB installations to provide non-broadcasting services.

In November 1996, the Minister of Industry issued a call for the development of a Canadian DBS facility and released a call for applications to develop and operate direct broadcast satellite (DBS) facilities.

5.7 Telecommunications Policies Advancing Infrastructure Development

Microwave Licensing Policy

The microwave radio licensing policy strives to give proper attention to the social and economic importance of radiocommunications. Consequently, all microwave applications are assessed against the broad principles based on the need to establish microwave facilities that serve the public interest. Over the years, this microwave policy has evolved. As a result licences are now being granted to organizations that serve the public such as telecommunications carriers, utilities, licensed broadcasters and federal and provincial governments. Industry Canada continuously reviews the effectiveness of its policies and conducts public consultations to adjust policies to evolving needs. In August, 1991, as the result of a comprehensive public consultation, the Department published the limited area radio licensing policy. This policy provides greater choice of services and flexibility in the establishment of radio facilities that would generally be confined to a free-calling area.

Regional and Global Satellite Systems

In November 1994, the Minister of Industry released a new policy on regional and global satellite systems. The policy states that a regional or global mobile satellite service provider can offer service in Canada if:

- it provides demonstrable benefits to Canadians (such as the provision of services otherwise unavailable);
- Canadians hold a share of equity in the system that is proportional to the level of Canadian use; and
- the Canadian service provider is "Canadian" as defined in the *Telecommunications Act.*

Cellular Radio Telephones
Cellular mobile radiotelephone services in Montreal and Toronto officially started in July 1985. Cellular service is now available to more than 85 percent of the population. There are over 2.8 million subscribers to cellular service and it is available in metropolitan areas in all ten provinces and both territories. Service has been extended into smaller communities and major highway corridors between cities.

Public Cordless Telephone Service
Public cordless telephone service refers to the use of pocket-sized, cordless, lightweight digital telephones that can be carried about and used interchangeably in residential, business and public settings. The government initiated field trials of public cordless telephone service in November 1989. At that time, the government invited submissions from interested parties describing how they would propose to establish public digital cordless telephone service in Canada.

Personal Communications Services (PCS)
As part of the Information Highway strategy, the government outlined its objectives in Industry Canada's document in June 1995 *Policy and Call for Applications: Wireless Personal Communications Services in the 2 GHz. range (Implementing PCS in Canada)*:

1. Stimulation of additional choice in provision of cellular-like mobile radio/telephone services, and support of new technologies and facilities of high security and low cost which could compete with existing local wireline services.
2. Provision of additional and innovative personal communications services at 2 Ghz.
3. Facilitation of national, North American and world-wide service offerings to enable both Canadian equipment suppliers and consumers to benefit from the availability of large markets and the opportunity to make use of wide-scale roaming capabilities throughout most of North America and perhaps the world.
4. Stimulation of competitive and comprehensive service offerings, provided through utilization of both existing and new facilities, through among other measures non-discriminatory access by third parties to networks, thereby also promoting value-added services and content.
5. Support of service provision to the greatest possible number of Canadians.
6. Promotion of jobs and investment in Canada, through support of domestic research and development activities and the concomitant development of expertise for international trade and investment opportunities.

In December 1995, the Minister of Industry licensed four companies to provide PCS on a competitive basis across Canada. These compact fully portable, low-cost devices will provide a digital wireless connection to the information infrastructure. Four licences have been issued to Microcell, Rogers Cantel, Mobility Canada and Clearnet.

Wireless Broadband Services

In February 1996, the Minister of Industry issued a policy for wireless broadband services and a call for licence applications. These new services, known as Local Multipoint Communications Systems (LMCS), use the radio spectrum at higher frequencies and are capable of providing television, data and telephone services. In October 1996, the Minister of Industry awarded three licences for one GHz. for 33 markets each to Cellular Vision Canada LTD., Digital Vision Communications Inc. and a licence for service in 127 small communities to Regional Vision Inc. The 193 licensed markets would serve seven million of Canada's 10 million households.

6.0 INTERNATIONAL DIMENSION

Canada is a trading nation and has an advanced open economy. Canadians have done well through trade liberalization agreements and bilateral arrangements with international partners. International economic relations today have shifted from trade issues to investment and technology flows, intellectual property rights and international standards.

6.1 Organizations

International organizations have always played a significant role in the development of telecommunications and information technologies. Since early communications relied heavily on the exploitation of hertzian waves it was essential to coordinate use of the radio spectrum. This coordination has been extended to a range of other matters with the objective of ensuring a minimum level of compatibility between national systems. The International Telecommunication Union (ITU) has been the key player in this area for many years and as technological developments allow even greater use of the spectrum, the ITU role will become more important in the next decades. However, as telecommunications and the associated information flows become the basis for international commerce and economic development, organizations such as the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC), OECD and others are also playing an important role.

To adapt to emerging technologies and the changing telecommunications environment, the ITU adopted a new Constitution and Convention and has made important structural changes to enable itself to plan and manage its operations in a more strategic manner. The ITU now comprises a Plenipotentiary Conference, a Council, a Radiocommunication Sector (ITU-R), a Telecommunication Standardization Sector (ITU-T), a Telecommunication Development Sector (ITU-D) and a General Secretariat.

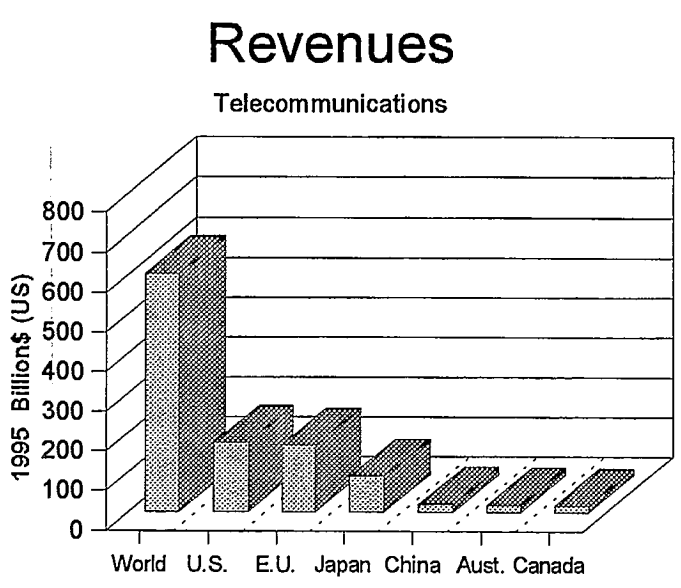
Canada, through the high level of participation of the Canadian National Organization for the ITU-T (CNO/ITU-T), continues to significantly influence the development of ITU telecommunications standards which has contributed to the evolution of a world-class Canadian telecommunications system. It also enables the Canadian telecommunications industry to incorporate internationally accepted ITU standards in their products and services to ensure their competitiveness in the global marketplace.

6.2 Trade in Services

On a global basis, the international telecommunications services revenues represents a $600 billion (U.S.) market. The role of telecommunications as a tradeable service and as an essential infrastructure for the delivery of other information-based services makes this sector a key element in future trade agreements. Canada has one of the most open telecommunications markets in the world.

The General Agreement on Trade in Services (GATS) came into effect on January 1, 1995. Recent negotiations were held to allow more competition in the provision of basic telecommunications services and to establish a framework for trade and investment in these services.

The chart on Telecommunications Revenues provides a good indication of the relationship of Canada with other major trading partners.(Source: ITU).[38]



For telecommunications, the current focus is on access to and use of public telecommunications networks but in the future the focus will shift to investment and the provision of basic networks and services.

Under the World Trade Organization (WTO), a series of meetings were held to come to an agreement on basic telecommunications services under the framework of the General Agreement on Trade and Services. This included discussions related to areas associated with market access

38 "Telecom pact hard to reach", *Globe and Mail*, January 30, 1997, B14.

and competitive supply of telecommunications services and infrastructure as well as foreign ownership, international services and satellite services. In a recent pact under the World Trade Organization, countries agreed to liberalize their domestic markets in telecommunications services,[39] and be bound to a dispute-settlement mechanism governed by the WTO. Canada will maintain foreign ownership restrictions in telecommunications, which remain at 46.7 percent direct and indirect ownership.

Other items under the pact include the following:

- Teleglobe Canada Inc.'s monopoly on overseas telephone traffic will end October 1, 1998.
- Ownership restrictions that prohibit investment in Teleglobe by foreign carrriers will end as well as limiting the investment of Stentor.
- Allowing 100 percent foreign ownership and control in the resale sector.
- Telesat Canada's monopoly on fixed satellite services will end March 1, 2000.
- Canada agrees to allow foreign ownership and control of overseas underwater cable landings as of October 1, 1998.
- Foreign satellites will be allowed to provide services to Canadians as of March 1, 2000 except for direct-to-home (DTH) and direct-broadcast-satellite (DBS) services.
- Canada agreed to remove traffic routing rules for all international services and satellite services by March 1, 2000.
- Canada has agreed to maintain its open, competitive market and existing transparent regulatory regime.

As a result, Canadian telecommunications firms will benefit by gaining improved access to the United States, Europe, and other markets as well as developing country markets. Canadian consumers will benefit from lower international telephone rates and enhanced services from an emerging global telephone system.

There is a significant potential in developing nations as "Two thirds of the world's population have never made a phone call. Lack of access means that no less than half of the earth's inhabitants cannot make a phone call even if they want to".[40]

International competitiveness for Canadian telecommunications and information service providers in a global trading system will depend on the level of competition within Canada and a clear strategy to develop international markets.

Increasingly, with the high degree of international commerce and worldwide market potential for radiocommunication services, information and broadcasting programming services, the spectrum

---

39 "Telecom pact widens access to the world", *Globe and Mail*, February 17, 1997, B1, and Government of Canada, *Canada Welcomes Telecom Deal*, News Release, February 17, 1997.

40 "Telecom pact is said to unlock global industry potential", *Insight - Regulatory Trends*, Stentor Telecom Policy Inc., February 25, 1997.

is being viewed as a strategic resource for the future trade in radiocommunication services and products to the consumer. The consumer market is no longer regional or national, it is now worldwide.

6.3 Global Information Highway

Canada is at the forefront in establishing important elements of the global information society. Along with partners in the other G-7 nations, the federal government is developing networks to help manage international emergencies, deal with major maritime issues and promote joint R&D.

The global information infrastructure is being driven by economic and political changes. This is spurring the demand for services such as wireless, facsimile, electronic mail and access to the Internet. The global market for telecommunications services was estimated at more than U.S. $500 billion in 1995 and growing at double-digit rates, to double by the year 2000. In the United States alone, information products and services as a share of personal consumption expenditures increased from 9.9 percent in 1980 to 12.5 percentin 1992. Worldwide demand for wireless services grew by about 45 percenta year between 1989 and 1992. And the number of Internet hosts worldwide has nearly doubled every year since 1990, and now totals more than ten million.[41]

In the United States in February 1993, the Clinton-Gore Administration initiated a technology policy *Technology for America's Economic Growth, A New Direction to Build Economic Strength* intended to create jobs, strengthen America's technological and industrial leadership and boost the standard of living. The policy recognized that industry is the primary creator of new technology and the main engine of sustained economic growth. It developed an action plan for the National Information Infrastructure (NII) that clarifies private and public sector responsibilities and makes clear the fundamental requirements for universal citizen access and commercial sector benefits.

Mercury Communications in the U.K outlined a vision within the next ten years: the union of computers and communications, ubiquitous integration of services-data, voice, image and video, and the integration of office, mobile and home communications, personal digital assistants and notebooks access to all communication networks (PSTN,PCN,ATM,Leo), smart card use, multimedia support (full video, sound, animation and data). Applications include insurance, financial, entertainment, real estate, bill payment, credit checking, clubs and societies, order entry, cash services. The network is transparent to the user. Innovative services include messaging and e-mail, video jukebox, video mailbox, catalogue/supermarket information, library information, medical/images/travel, home banking, hotel reservations, vehicle breakdown, home and car insurance, emergency services.

---

41 Baer, Walter S. , "Will the global infrastructure need transnational (or any) governance?", in Kahin, Brian and Ernest J. Wilson III, eds., *National Information Infrastructure Initiatives*, MIT Press, Cambridge, 1997, p. 534-535.

As part of Japan's guidelines for R&D in telecommunications, a prime benefit is to enjoy an affluent and comfortable life. Cooperation is essential in the establishment of a telecommunications infrastructure among common carriers, manufacturers, academia and government for standardization and interconnectivity. Future construction will promote efficient and flexible systems where image and sound are integrated through digitalization and new processing functions can be added through B-ISDN (Broadband Integrated Services Digital Network) and ISDB (Integrated Services Digital Broadcasting). Digital technology provides the common use of hardware and software among multimedia such as telecommunications, broadcasting, recording, motion pictures, printing, etc.

In Japan, an experimental info-communications infrastructure using FTTH (fibre to the home) is being developed as a solution to a number of problems: revitalization of manufacturing industry, introduction of more advanced information and communication services and equitable accessibility to information between big cities and rural areas. The services to be provided include bilaterally communicating advanced cable TV, high definition TV, video on demand, visual telephone, and video conference.

The OECD has reaffirmed the priority of multilateral trading systems and trade liberalization as well as supporting the development of a comprehensive policy framework on the global information infrastructure. In February 1997, agreements were reached on developing new measures for the information economy, a new regulatory framework based on market forces , a new focus on the use of ICTs applications by households, businesses and governments and work related to cryptography and electronic commerce.

The Global Standards Conference is scheduled for the third quarter of 1997. Canada is participating with other G-7 countries in a number of pilot projects.

6.4 International Benchmarking

The information infrastructure in Canada has been evolving at a rapid pace and has become more and more important in the Canadian economy. This underlies the necessity to develop statistical indicators which will allow the benchmarking of information infrastructure development and other key indicators of Canada's progress as an information economy in relation to other countries.

The establishment of reliable performance indicators are not only necessary to guage Canada's progress in building the information infrastructure but also as an indispensable tool for effective social and economic policy development.

In Annex B, a conceptual framework is proposed which provides a set of key indicators to benchmark Canada's information infrastructure. Current efforts by the federal government, through Statistics Canada and through international organizations such as the OECD, are directed toward developing a system of "national accounts" based on key economic and social indicators. For Canada, particular attention should be directed toward those relating to investment in

information infrastructure, growth of information and communication technology services and the diffusion of these technologies.

7.0 FUTURE EVOLUTIONARY IMPERATIVES

This chapter addresses a series of imperatives which are considered as necessary to ensure the future evolution of the information infrastructure in Canada.

7.1 A "Vision"

The future development of the information infrastructure in Canada must be based on a "Vision" of what that infrastructure must be and what or whom it is to serve. As stated by Marc Raboy,[42]

> "Because of its historic tradition of policy intervention in the cultural and communications arenas, Canada has an established set of institutional practices for policy making that may be particularly appropriate for addressing infrastructure issues in a variety of settings. Among Canada's policy particularities are the principles that communications infrastructures constitute a cornerstone of the national cultural heritage, that the main instrument for carrying out cultural and communications policy is a mixed system of publicly owned and publicly regulated public and private industries, and that the participation of social groups is a central part of the policy making process."

In view of this approach, the government is the engine that drives industrial development as well as the organiser and facilitator of sociocultural development. Canada must continue to develop the infrastructure according to national guidelines and objectives, in accordance with a "vision."

7.2 Technology Policy

With respect to the continuing development of technology policy, there is a need for a coordinated approach to ensure the advancement of Canadian technologies, taking into account the increasing convergence between communications and information technologies and multimedia policies, their interaction and the new era of liberalization and competition on the horizon.

7.3 Financing and Funding

Even though Canada has one of the best R&D tax incentives in the world, there is a need to consider and promote private sector investment in areas that encourage innovation and promote long-term research. These should include capital expenditures associated with hardware and software development and capital ventures for SMEs. The downside of relying on developments

---

42 Raboy, Marc, "Cultural sovereignty, public participation, and democratization of the public sphere: the Canadian debate on the new information infrastructure", in Kahin, Brian and Ernest J. Wilson III, eds., *National Information Infrastructure Initiatives*, MIT Press, Cambridge, 1997, p. 190.

in private networks for infrastructure upgrades is that private parties, because they are normally concerned with their own benefits, are unlikely to fund upgrades or promote interconnectivity to the level required from a public policy perspective. Regulations should encourage private sectors to use the PSTN through interconnection.

7.4 Access and Strategies

Local loop competition raises many questions that have yet to be resolved. It may be feasible in only large metropolitan areas where calling volume is sufficient to allow a number of competing companies to realize economies of scale. To the extent that this is true, subscribers in major urban areas will be the only ones to realize the benefits of an advanced information infrastructure, if we rely on competitive markets for infrastructure upgrades. Questions of who will be allowed to participate must still be sorted out.

However, competition is more likely to ensure that technological opportunities are exploited. The way to ensure cost-effective technologies within the infrastructure is to encourage competition at all levels.

7.5 Infrastructure Policy

The future evolution of the information infrastructure is increasingly dependent on the capital and human investments by industry and government. This should be maintained as a high priority due to the significant multiplier effects in the Canadian economy: technologies, services, jobs and overall economic growth. These investments should be related to a) ensuring that the capacity continues to expand to meet the growing needs and user demands on the information infrastructure, b) promoting advanced services and applications to spark innovation and development of household, business and government growth and development, and c) supporting information content development to enhance Canada as a high knowledge-based economy.

7.6 Bridging the Gap

At the present time, information and communications technologies that make up the Information Highway are the links that provide citizens, households and businesses the opportunity to participate in the information society. These technologies are the tools which can expand an individual's income, time and convenience. This raises the need for a new measure of access and capacity, based on demand, of the information infrastructure. This would define access by the capacity required to provide the mix of applications purchased by the average households, business (small, medium and large) and government departments, rather than main lines and extensions (used by most countries). The emphasis of the measure would be based on "consumer usage" or "information content", rather than on the supply of technology by various service providers. It would also be technology neutral and take into account wireless and wired applications.

THE CANADIAN INFORMATION INFRASTRUCTURE INDUSTRY

(Note: The information and statistics contained in this annex are based on the most current available at the time of preparation of this document. A large portion of the updating of the data occurs in the March to May time period each year. For the latest information on these areas, one should consult the Telecommunications Policy Branch and the Information Technologies Industry Branch of Industry Canada or Statistics Canada).

The Telecommunications Industry

Telecommunications in Canada has traditionally been comprised of two major components: the telecommunications carriage industry which ensures that voice and data signals reach all Canadians' homes and businesses and radio and television programming and its distribution to homes. The services provided by these industry groups respond to distinct needs of the population. The advent of new technology is eroding this traditional division as the same technology can now be used for transmitting voice, data, video and television programming. In addition, there is a further integrating of computing and intelligent technologies into both the telephone and broadcasting areas.

There are four national telecommunications systems in Canada: AT&T Canada Long Distance Services (Unitel Communications Inc.), Stentor Alliance, historically derived from the telegraph and telephone industries, respectively, Telesat Canada, and Sprint Canada. Stentor is an association of the largest telephone company in each province. The networks of all member companies are completely interconnected in an integrated system for providing telecommunication services. In addition to the four national telecommunications networks, there are 50 independent, generally smaller telephone companies, although six of them are relatively large. Also, there are approximately 40 resellers in Canada that lease transmission capacity from telecommunications carriers to provide a variety of competitive network services.

To obtain an appreciation of long distance market share, the following is based on an estimate by Stentor:[43]

---

43 *Network Letter*, Evert Communications, December 2, 1996, p .4.

Long Distance Market Share (%)

	1995	1996	1997 (Forecast)
Stentor Companies	78	71	66
AT&T Canada LD	8	11	12
Sprint Canada	8	11	14
Other facilities-based carriers	2	3	3
Resellers	4	4	5
Total Competitors	22	29	34

There is also Teleglobe Canada Inc., Canada's carrier for overseas telecommunications services and Telesat Canada, also a member of Stentor, which operates Canada's domestic satellite communication system. Together these companies offer a myriad of services such as the local and long distance services to business and residential customers, data network services and private line services which are dedicated to the needs of the customer and are leased from the carriers. In addition several electronic message and information retrieval services are available as well as an international teleconferencing capability and voice messaging services.

A wide range of wireless telecommunications services are also offered on a competitive basis. One segment provides cellular telephone services by two national carriers, Rogers Cantel Inc. and Mobility Canada, an association of telephone companies affiliates. There are some 200 licensed radio common carriers (RCCs) in Canada. They provide various mobile radio and radio paging services, mainly in urban areas. Mobile satellite services are available through Telesat Mobile Inc. Eventually, it is expected that wireless networks will become increasingly competitive with local telephone networks. Canada has moved into new services, such as Personal Communications Services (PCS) and Local Multipoint Communications Systems (LMCS).

The Broadcasting Industry

The broadcasting system is a complex array of public and private networks, stations and services. It has been described as a public-private, mixed-ownership structure. The public component of the television and radio segments of the industry has three main systems. The Canadian Broadcasting Corporation operates national AM and FM radio networks, over-the-air television networks, and a 24-hour cable news service in English and French. TVOntario has one French and one English station and there is also Télé-Québec. Private sector radio and television operate competitively wherever market conditions allow and are entirely funded by advertising revenues.

The cable television segment of the industry is the primary vehicle for sending television signals to the home. Canada is a pioneer and world leader in cable television and Canada is one of the most highly cabled countries in the world. There are approximately 2,000 cable TV systems coast-to-coast which receive signals by microwave, satellite or over the air technology and distribute them to their subscribers. About 81 percent of Canadian households subscribe to basic cable TV

receiving traditional television stations and networks, specialty services, and cable-originated programming.

Unlike the telephone industry, the cable industry has a large number of systems and companies. Of the total licensed and operating systems, only 8 percent have more than 6000 subscribers. There is however some concentration of ownership in the cable industry, 73 percent of all subscribers receive service from the top ten. Three cable companies currently capture 47 percent of total subscribers. By contrast, there are 9 major telephone companies, with Bell Canada accounting for 56 percent of the total operating revenues.

Canadian Satellite Communications Inc, (Cancom) was licensed in 1981 to provide TV and radio services to remote regions in Canada. It provides TV and radio services to individual homes and cable systems serving households.

The Information Technology Industry

The Information technology industry comprises telecommunications and electronic components, computers, instrumentation and consumer electronics. Statistics Canada figures indicated that: the industry output grew to 7.6 percent of GDP for 1995; revenue expanded to almost $64 billion; Canadians exported $17.2 billion worth of computers, communications equipment and electronic components but imported $35.8 billion with a resulting deficit of $18.6 billion.

The Economic Importance of the Information Infrastructure

Statistics

Cellular telephone service had 2.6 million subscribers at the end of 1995.

The most current statistics on the Canadian cable television industry include the following:[44]

---

44 Canadian Cable Television Association, *Cable Statistics*, 1995.

Current Canadian Cable Television Statistics

TV Homes	10,388,000
Homes Passed by Cable	10,025,251
Cable TV Subscriptions	8, 101,480
Homes Passed as a percentage of all TV Homes	97%
Cable TV Subscriptions as a percentage of Homes Passed	81%
Headends	1, 996
Number of Employees	9, 385

Source: MediaSTATS September 1995
Statistics Canada estimate

Investments

This infrastructure requires continual and large capital investments for updating and modernization. The bulk of these investments are made by the public telecommunications networks. The Stentor companies spent $3.05 billion in capital expenditures in 1995, or 28 percent of their total revenues of $14.6 billion. The total telephone plant (at cost) before accumulated depreciation for only the telephone industry in 1995 was $47.5 billion.

As of 1996, Bell Canada had digitized 100 percent of its long distance network and 97 percent of its local access lines network and had plans to upgrade services in rural areas through a condensed Switching Equipment Modernization Program (SEM). Bell Canada's capital spending in 1997 is expected to be about $1.7 billion.

Bell Canada and five other telephone companies (TELUS, NBTel, Maritime Tel and Tel, NewTel Communications and BC Tel) filed separate proposals to restructure their rate schedules for basic local telephone service This rate restructuring consolidates rate groups and involves "geographic de-averaging" whereby urban and rural rates move closer to their respective costs.

The cable industry invested $0.4 billion in 1992 in capital investments, or 20 percent of their total revenue. In 1994, capital expenditures were $504 million, while total revenues were $2,336 million. Vidéotron is investing $230 million in the next three years to upgrade the capacity of its cable network, which links 1.9 million homes in Quebec and Alberta.

Wireless industry investments to date exceed $2 billion; $3 billion will be spent in the next two years on infrastructure development for PCS, LMCS, two-way paging, etc.[45]

45 CWTA, Annual Conference, May 1996.

Economic Aspects

In 1995, the telecommunications service industry had total revenues of $19.4 billion comprised of $14.1 billion by Stentor, and $5.3 billion by the other telcos and carriers (including Teleglobe and Telesat). Resellers, leasing bulk facilities from regulated common carriers generated an estimated $200 million in revenues in 1995. The cable television industry generated revenues of $2.4 billion.[46]

In 1994, residential and business services accounted for approx. $14 billion of the telco's estimated operational revenues. Telco's residential and business public long distance voice telephone service accounted for $6.2 billion. Basic local residential and business telephone service generated $7.8 billion in 1994.

Typical charges for basic service on a residential line are about $18 per month, while business users typically pay about $65 per month.[47]

In 1995, the telecommunications carriers accounted for almost 70 percent of the $26.2 billion value added by the information and computer technologies (ICT) service industries to the total economy. The computer services industries accounted for 21 percent and the broadcasting industries for the remaining 10 percent. In 1995, the telecommunications carriers provided 144 551 jobs. The computer services industries provided 123 312 jobs and the broadcasting industries provided 50 023 jobs.[48]

The wireless industry is growing at an annual rate exceeding 30 percent. By the end of the decade, $50 billion in revenue will be generated, 5 000 direct and 15 000 indirect jobs will be created on top of the current level of approximately 10 000 jobs.[49]

---

46 Industry Canada, *The Telecommunications Service Industry: Trend Analysis, Canada-United States 1980-1995*, January 1996.

47 Greiner, Brian, "Telecom reform takes on air of religious conflicts", *Computing Canada*, March 3, 1997, p. 30.

48 Government of Canada, *Measuring the Global Information Infrastructure for a Global Information Society*, September 1996.

49 CWTA , Annual Conference, May 1996.

ANNEX B

KEY INDICATORS FOR BENCHMARKING THE DEVELOPMENT OF CANADA'S INFORMATION HIGHWAY

Introduction

The emergence of a knowledge economy and society underscores the need to develop statistical indicators allowing measurement of Canada's progress in comparison with other countries. Such benchmarks can provide both governments and companies with an assessment of the effectiveness of policies and strategies in facilitating this transition.

Despite cooperative endeavours at international fora such as the Organisation for Economic Co-operation and Development (OECD) and individual efforts by many countries - including Canada - work on such key indicators is still in its early stages. One obstacle is the absence of agreement on the characteristics of the new economy and society and thus on what indicators might reflect progress. Cross-national comparisons also pose difficulties because data are not always comparable between jurisdictions. For this reason, the study of key indicators for a knowledge economy and society on a cross-national basis is still in a rudimentary state of development. This annex provides a preliminary exploration of a few of the key indicators that are available.

The key indicators relate to the general economic situation, government policies and regulations, supply, demand and employment. These are further divided into a primary set of key indicators: gross domestic product (GDP), competitiveness, competition/deregulation, investment, modernization, pricing, overall technology penetration and employment.

Figure B-1 outlines the proposed key indicators that could be used to assess the status and evolution of the information economy. Further details on these key indicators and their components are provided later in this report.

Figure B-1

Conceptual Framework of Key Indicators and Components of the Canadian Information Infrastructure

I. General economic situation
- knowledge-based economy
- information economy

II. Government policies and regulations related to Information Highway infrastructure indicators[a]

III. Information economy

A. Supply	*B. Demand*
Investments	Penetration rates and usage - households and others (business/government)
Network modernization	Technology diffusion
Pricing Subsidies Interconnect charges	Price sensitivity - consumer price indices - business price indices

Employment

a. See Government of Canada, *Measuring the Global Information Infrastructure for a Global Information Society: Concepts and Performance Indicators,* submission to the OECD Committee for Information, Computer and Communication Policy, September 1996.

Source: Max Melnyk & Associates, 1997.

INFORMATION INFRASTRUCTURE DEFINITIONS

Melody[1] identifies the specific components of the information infrastructure in the development of information society policies as consisting of the telecommunications facility system, information content and value-added communications services, equipment sector, skills and policies. A recent government report defining the information economy for measurement purposes includes the information and communication technologies (ICT) as well as the arts and culture industries.[2]

As an initial step, the information infrastructure can be considered as consisting of the telecommunications networks - a collection of telecommunications mediums or technologies, services, features and capabilities available to users - and technologies and services (software and hardware) - which allow the delivery of information services.

Table B-1 shows an initial detailed list of potential key indicators and their components, while Table B-2 provides an initial assessment of where these statistics may be sourced and some indication of the nature of the extent of the data available; that is, by specific country or by years for Canada. The primary set of proposed key indicators includes the following: gross domestic product, competitiveness, competition/deregulation, investment, modernization, pricing, overall technology penetration and information infrastructure employment. The following provides the rationale for selecting these key indicators and also Canada's relative performance in these areas.

---

1 William H. Melody, "Toward a framework for designing information society policies," *Telecommunications Policy* 20, (4): p. 243-59.

2 Government of Canada, *Measuring the Global Information Infrastructure for a Global Information Society: Concepts and Performance Indicators,* submission to the OECD Committee for Information, Computer and Communication Policy, September 1996.

Table B-1
Detailed List of Key Indicators and Components of the Canadian Information Infrastructure

Indicator	Components
General economic situation	GDP Telecommunications services share Information industries share Trade imbalance Inflation rates Competitiveness Research and development
Government policies and regulation	Deregulation* Competition* Trade* Content requirements*
Supply	Capital expenditures Modernization of network/ new products and services Network lines (residential and business) Access lines Multi-party Cellular Paging/wireless ISDN Television/radio Multimedia access Productivity Revenue/profits/ROE Consumer price index Subsidies Interconnect charges

Table B-1 (cont'd) Detailed List of Key Indicators and Components of the Canadian Information Infrastructure	
Indicator	**Components**
Demand	Penetration rates (households) Telephones Cable/TV/radio PCS/modems Fax Internet/providers Satellite Cellular/wireless Software Penetration rates (business) Services/hardware* Penetration rates (educational/others) Services/hardware* Price Sensitivity Telephone/cable charges Competitive services* Technology diffusion Telephone lines Cable TV Digitization
Employment	Education expenditures Human resources skills and training Growth of service sector employment Unemployment rates
* Not necessarily available on a comparative basis or for international benchmarking.	

Table B-2
Sources of Statistics

Indicator and components	Sources
General economic situation	
GDP	
Telecommunications services share	Canada by Years - Stats Canada
Information industries share	Canada by Years - Stats Canada
Trade imbalance (export/imports)	Canada by Years - Stats Canada Countries - OECD 1991
Inflation rates	Countries - OECD, G-7, Dept. of Finance
Competitiveness	Countries - *World Competitiveness Report* 1993
Research and development	Countries - OECD
Government policies and regulation	
Deregulation	Countries - Industry Canada, CRTC
Competition	Countries - Industry Canada, CRTC
Trade liberalization	Countries - Industry Canada, Foreign Affairs
Content requirements	Counties - Heritage, Industry, CRTC
Supply	
Capital expenditures	Canada - Industry Canada, Stats Canada, Carriers Countries - *NTIA Infrastructure Report* 1991
Modernization of network	
Network lines/access lines (residential and business)	Canada - Industry Canada Countries - AT&T: The World's Telephones, ITU, *World Telecommunication Development Report* 1994
Multi-party	Canada - Industry Canada, CRTC
Cellular	Canada - Industry Canada Countries - OECD
Paging/wireless	Canada - Industry Canada
ISDN	Canada - Industry Canada Countries - OECD

Table B-2 (cont'd) Sources of Statistics	
Indicator and components	**Sources**
Television/radio	Canada - Industry Canada Countries - Heritage, Industry Canada
Multimedia access	Countries - ITU
Productivity	Countries - OECD 1990
Revenue/profits/ROE	Canada - CRTC
Consumer price index	Canada - Stats Canada
Subsidies	Canada - Industry Canada, CRTC
Interconnect charges	Canada - Industry Canada, CRTC
Demand	
Penetration rates (households)	Canada - Industry Canada, CRTC Countries - ITU, OECD, IDC Report
Penetration rates (business)	Canada - Industry Canada
Penetration rates (educational/other)	Canada - Industry Canada
Price sensitivity	
Telephone/cable charges	Canada - Industry Canada, CRTC Countries - OECD
Competitive services	Canada - Industry Canada, CRTC Countries - OECD
Technology diffusion	Countries - OECD, AT&t, ITU
Employment	
Education expenditures	Countries - UNDP Human Development Report
Human resources skills and training	Countries - *World Competitiveness Report*
Growth of service sector employment	Canada - Stats Canada
Unemployment rates	Canada - Stats Canada Countries - IMF

THE CONCEPT OF KEY INDICATORS

Key indicators are seen as a means of measurement of a group of fundamental values that, taken together, provide an indication of the item being measured (such as the health of the economy, social well-being, etc.). In order to be relevant and indicative of a trend as well as to provide a comfortable level of validity, they must be measurable consistently over time and they must be measured using the same parameters each and every time.

National and international benchmarking have become important for planning future scenarios and public policy making (such as trade liberalization and competitiveness impacts) and to monitor trends and progress toward the achievement of goals and objectives. There is a trend internationally, with Canada as the prime architect, to modernize the statistical accounts and measurement, to assist in the analysis of information infrastructure developments.

The gathering of statistical data with respect to an information infrastructure has become more complicated today in a liberalized and competitive environment because of the elements of confidentiality in the data. In addition, in some instances, the data in the development of the key indicators are provided by different sources; the variety of the sources could include a government agency, government departments, private industry, statistics-gathering organizations, research companies, consulting firms, international organizations, etc. In many cases, their efforts are not coordinated.

Even though the OECD, International Telecommunication Union (ITU) and others[3] have acknowledged the difficulty of collecting and harmonizing a set of internationally comparable indicators for telecommunications, there is still an impetus that general intent to work toward a set of key indicators that are useful in specifying the evolution and development of the information infrastructure. This becomes even more difficult with an expansion beyond telecommunications, but a complete set of indicators, as proposed in this paper, should provide a general comparison of information infrastructure developments worldwide.

Kahin and Wilson[4] indicate that infrastructure comparisons can be made as long as there are some clarifications and specifications of the what, when, where and why of the information infrastructure initiatives in each specific country. In his recent book, comparisons of initiatives have been suggested in the following areas: technical systems (design, distribution and uses of the hardware and the software systems that comprise the national "networks of networks"), the sectors of the economy (domestic markets), government policy (generic policy issues and industry-specific policy issues), institutional structures (interlocking system of institutions), subnational groups and individuals (self-interest groups) and culture, communications and media.

---

3 For example, see OECD, *Communications Outlooks* and *Information Technology Outlooks* (Paris: OECD, annual); and International Telecommunication Union.

4 Brian Kahin and Ernest J. Wilson III, editors, *National Information Infrastructure Initiatives* (Cambridge, Mass.: MIT Press, 1997).

Key indicators can also be used to produce indices that can provide a one-time snapshot, track a parameter over a period of time, which is similar to most economic and social indicators used for country-to-country comparison, or measure some aspect of the development of a nation. Some of these include previous work done by the ITU, OECD and others; that is, indices that bear names such as teledensity, telegeography, telecompetitiveness, competitiveness, information imperative index, etc.

KEY INDICATORS AND COMPONENTS

Further elaboration of the key indicators and components in Figure B-1 are provided as follows.

General Economic Situation

The intent is to measure the overall social and economic health of the country; that is, the country's standard of living in terms of the population being able to afford services. For example, if Canada has a high standard living as measured by the United Nations Human Development Programme, this should be factored into the indicators. Others elements could relate to trade (import/export of products) and research and development (the ongoing development of new products) and overall world competitiveness as measured by a number of international organizations. As a minimum, some aspects of GDP and competitiveness would be needed. (Two important new concepts include the knowledge-based economy and the information economy.)

Government Policies and Regulation

This relates to general government policies and regulatory activities that are aimed at providing a wide range of products and services at competitive prices, with an information infrastructure capable of delivering these to the consumer. There could be elements of international trade in services and content rules. As a minimum, a competition/deregulation indicator encompassing most of these elements would be needed. (Of specific interest would be a list of the key government policies and legislation that promote the information economy. More specifically, what, if any, barriers can be eliminated to promote economic growth?)

Supply

On the supply side, it is important to determine the overall investment (capital) to allow for the growth in networks, products and services, modernization of the infrastructure (digitization, broadband services, advanced networks, etc.) and prices charged (whether subsidized or not). This should provide an indication of a high-quality information infrastructure offering excellent service to most of the population. As a minimum, an investment indicator would be needed, one related to modernization and one for pricing.

Demand

On the demand side, attention would be directed to the penetration and usage of technologies by population; that is, households, businesses and governments. There has been considerable effort in this regard internationally, and this is one area that really identifies the takeup and potential use of information and communications technologies (ICT) in the country. As a minimum, an overall

technology penetration indicator is needed, with possibly some relationship to price sensitivity and technology development. (Demands are related to the price of the ICT services and products. However, this is also dependent upon income and time available to the consumer for information and communications technologies. Other factors are also important.[5] More research is required in this area.)

Employment

Employment is a key indicator that has been widely accepted over a long period of time as an element for the comparison of national economies. This area needs some means of tracking the creation and shifting of employment related to information infrastructure developments, not simply statistics on unemployment. At a minimum, an employment indicator is required. (New research in this area has already commenced.)

The primary set of proposed key indicators would include the following:

- gross domestic product
- competitiveness
- competition/deregulation
- investment
- modernization
- pricing
- overall technology penetration
- employment

With a minimum subset of two components for each indicator, the result could include a range of eight to 16 indicators, which would then be used for information infrastructure measurement and benchmarking. These are described below.

KEY INDICATOR SUBSETS

Under each of the specific key indicators, subsets would provide the substantion for the key indicator and further precision as a measurement of the status and evolution of the information infrastructure.

General Economic Situation

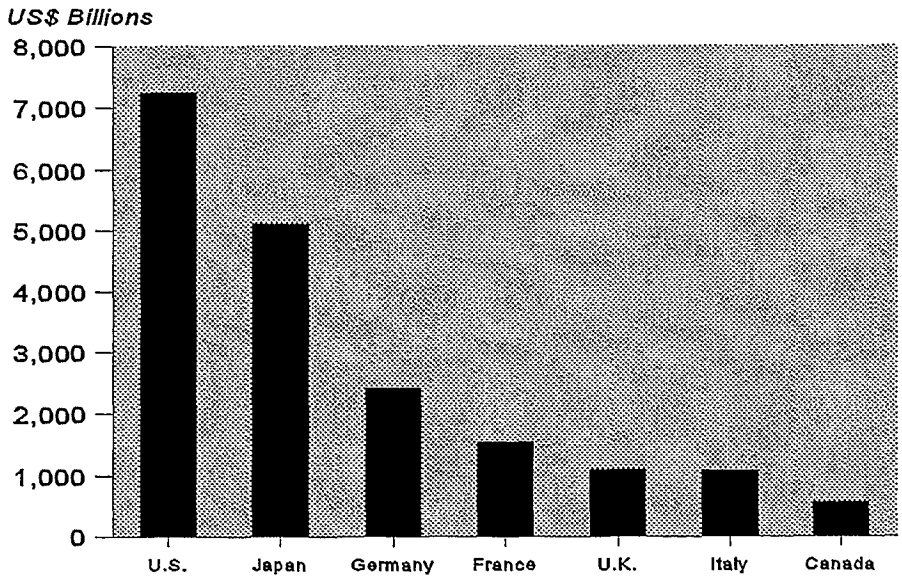
Gross Domestic Product

Gross domestic product (GDP) is the total value of goods and services produced in the economy, as measured according to statistical measures of national accounts. There have been two methods to measure the relationships between various countries, total GDP (Figure B-2) and per capita GDP (Figure B-3).

---

[5] See, for example, Paul T. Dickinson, *Access to the Information Highway: Canadian Households,* a report prepared for Industry Canada, Spring 1996, pp. ii, iii.

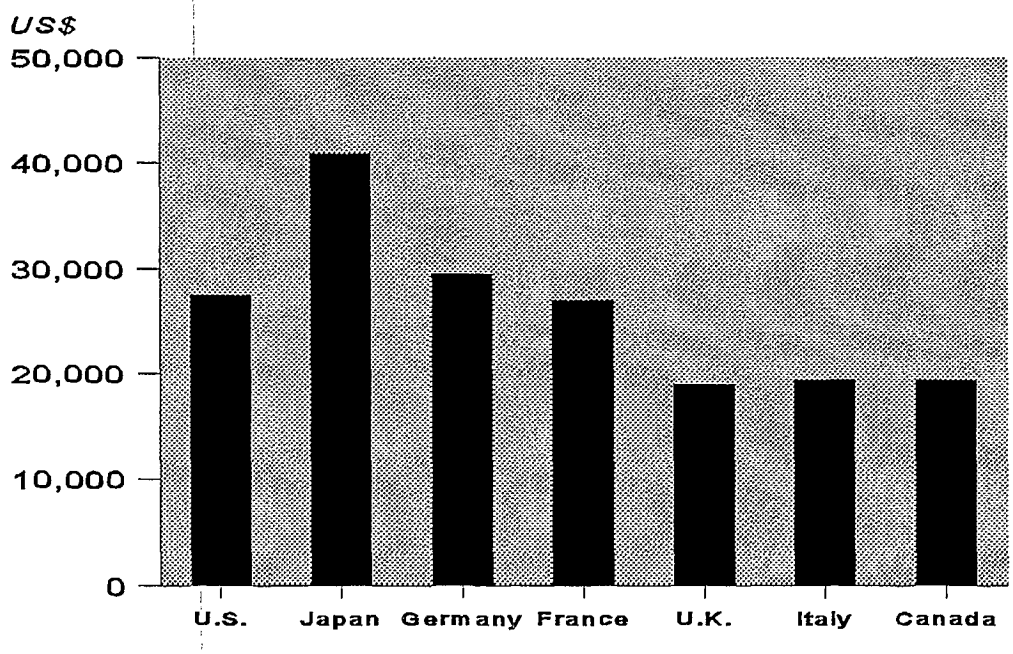
Figure B-2
Total Gross Domestic Product by Country, 1995



Source: Data provided by the World Economic Forum, 1996.

For an international comparison and perspective, it would be useful to have an indicator of the share of the information and communications technologies (ICT) of the GDP and growth in each of the countries indicated.

Figure B-3
Per Capita Gross Domestic Product, 1995

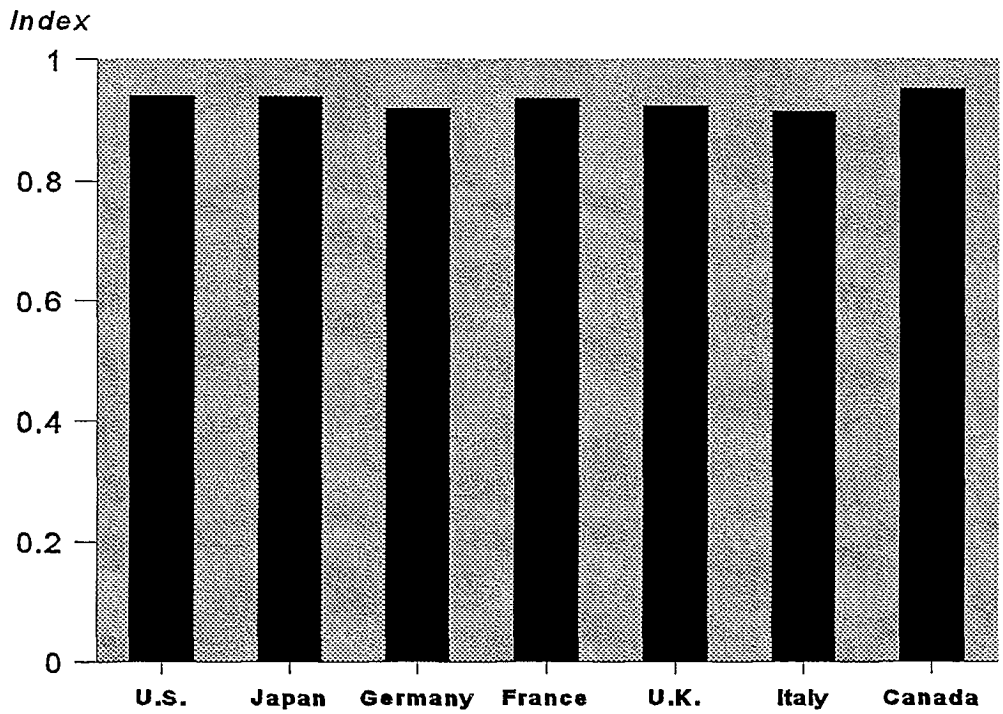


Source: Data provided by the World Economic Forum, 1996.

Human Development Index

An additional element of the general economic situation should include the measure of standard of living, as provided by the United Nations Development Programme (UNDP, *Human Development Report,* New York, Oxford University Press, annual). This provides a strong indication of the social and economic status of the various countries (Figure B-4).

Figure B-4
Human Development Index, 1996



Source: Data provided by the United Nations Development Programme, 1996.

Competitiveness

Under competitiveness, consideration should be given to overall competitiveness, as measured by international organizations, as well as elements related to trade, inflation, and research and development.

Overall Competitiveness

The International Institute for Management Development (IMD) *World Competitiveness Yearbook* (City: IMD, March 1997) defines competitiveness as "the ability to create added value and thus increase national wealth by managing assets and processes, attractiveness and aggressiveness, globality and proximity, and by integrating these relationships into an economic and social model." According to the IMD, the scoreboard among the countries of interest is as follows:

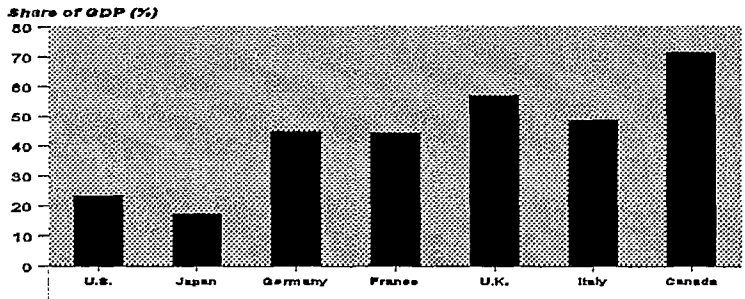
Country	Ranking
United States	First
Canada	Ninth
Japan	Eleventh
United Kingdom	Twelfth
Germany	Fourteenth
France	Twentieth
Italy	Thirty Fifth

Source: International Institute for Management Development, *World Competitiveness Yearbook*, annual.

Trade

Overall trade figures take into account the export and imports (goods and services). Breakdowns are available within Canada for the ICT sectors and internationally for specific elements (telecommunications equipment, broadcasting equipment, computer equipment). Trade data will required extensive review to ensure comparability among nations (Figure B-5).

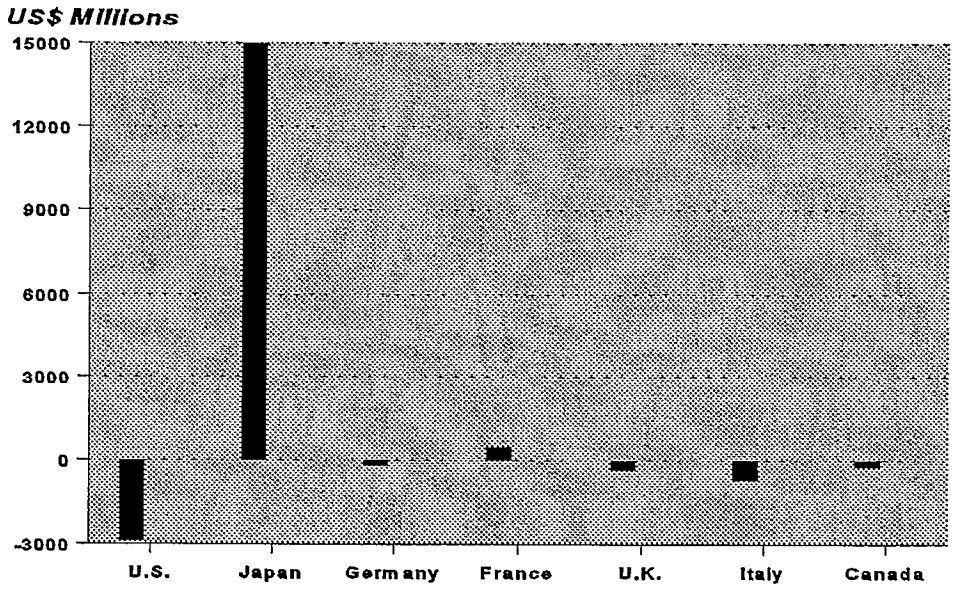
Figure B-5
Trade in Goods and Services, 1995



Source: Data provided by the Organisation for Economic Co-operation and Development.

The ITU and the OECD provide data on specific equipment areas (Figure B-6).

Figure B-6
Telecommunications Equipment Trade: Exports Minus Imports, 1993

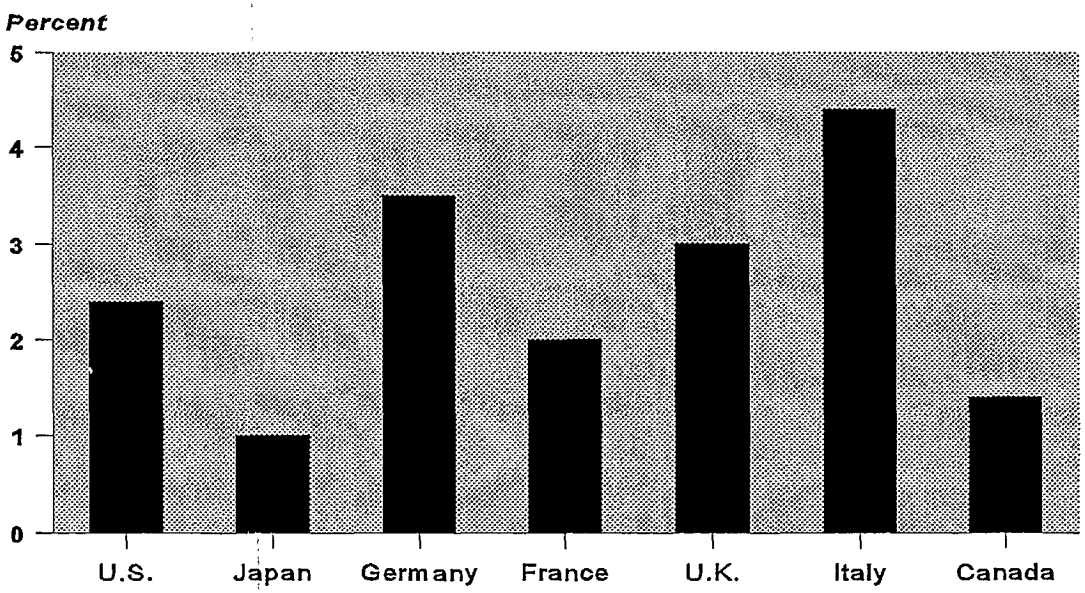


Source: International Telecommunication Union, *World Telecommunication Development Report* (Geneva: ITU, 1994).

Inflation Rates

Inflation rates provide an indication of the value of money available in the economy over time. Some statistics are available for the Group of Seven (G-7) major developed countries (Figure B-7).

Figure B-7
Inflation Rates, 1992-95 Average

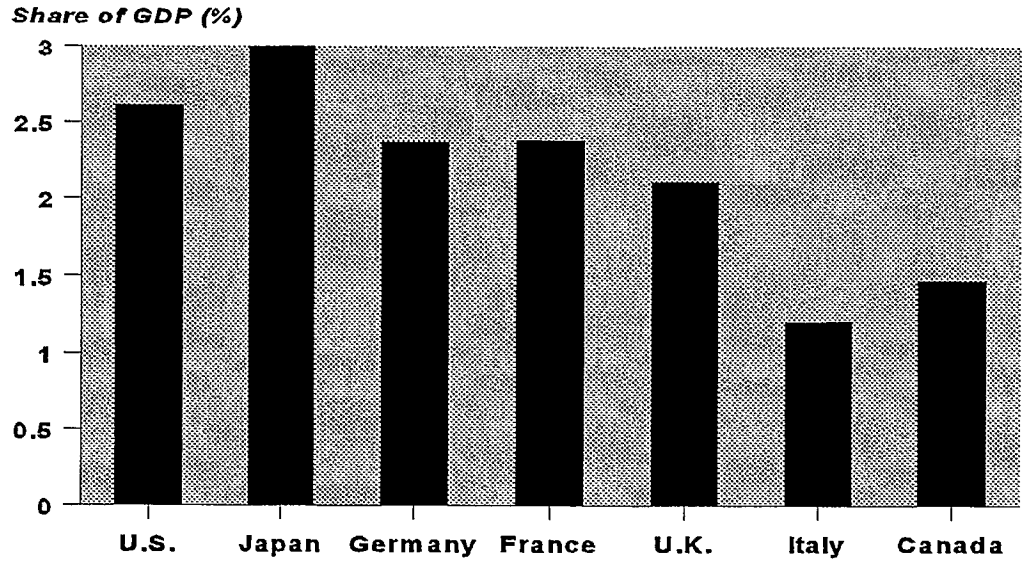


Source: Data provided by the Organisation for Economic Co-operation and Development.

Research and Development

Research and development (R&D) spending provides an indication of the innovativeness of the various sectors of the economy. Statistical data are available on overall spending on R&D (Figure B-8), but more specific data are required on ICT R&D as a proportion of the total in each of the countries of interest.

Figure B-8
Spending on Research and Development
1993



Source: Data provided by the World Economic Forum, 1996.

Based on the above subsets, an indication of the general economic situation could be developed, with appropriate weightings for each of the components:

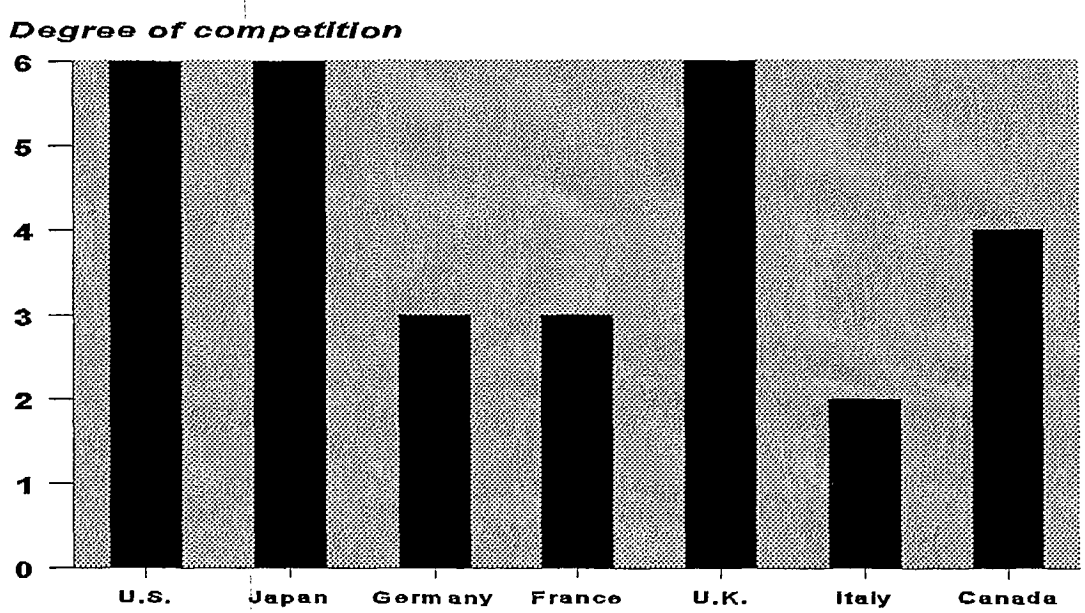
Component	Proposed weight
Spending on ICT as share of GDP	One
Human development index	One
Overall competitiveness index	One
Trade	Percentage
Inflation	One
Research and development	Two

Based on the data provided, Canada would rate moderately high on ICT spending, very high on the human development aspect, medium on competitiveness, very high on trade on inflation, and moderate on R&D.

Government Policies and Regulation

In this section, a subset could be designated as competition/regulation to measure the relative liberalization of primarily telecommunications markets. Elements of trade liberalization and content regulations could also be considered. At this time, consideration is given to competition in the following areas: local competition, long distance competition, international competition, private networks, mobile (cellular) communications and terminal equipment. Each of the countries is rated according to a weighting of one for each of the above areas of competition (Figure B-9).

Figure B-9
Levels of Competition/Deregulation, 1995



In establishing an overall weighting for the competition/regulation subset, a weighting of one would be appropriate.

Canada is in the process of liberalizing local competition in the short term and international competition in the longer term.

There are two sides to analyze the performance of the underlying information economy with respect to government policies and regulations and the general economic situation. These two main areas are the supply of ICTs by the private and public sectors and the demand for ICTs by households, businesses and governments.

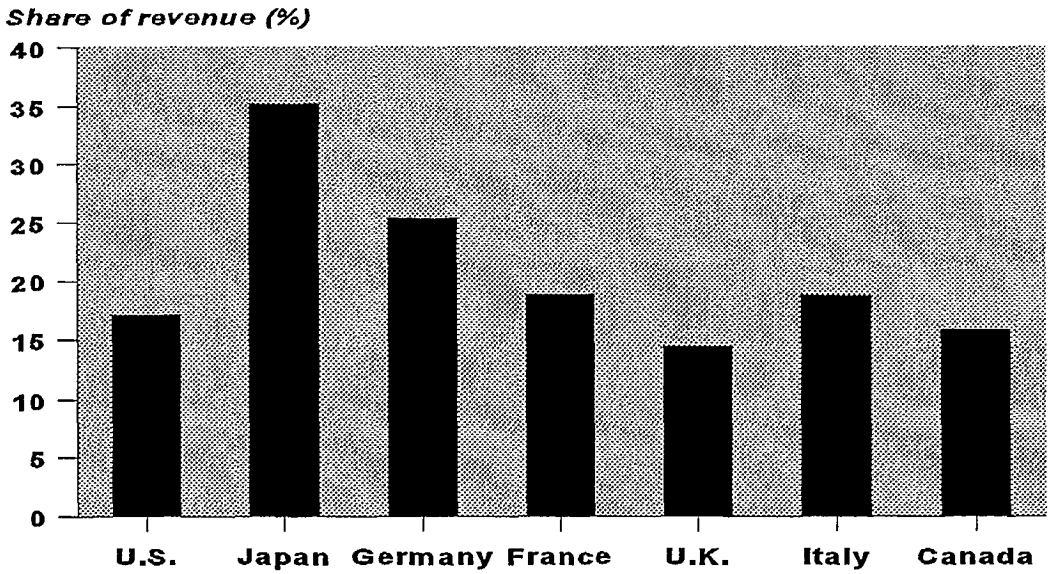
Supply

On the supply side, there were three subsets to be considered: investment, modernization and pricing.

Investment

Investment relates to the level of capital spending for network expansion, growth, maintenance and modernization. It does not take into account the rate at which capital investments are recovered through depreciation. Measures of productivity and return on equity could also be included. More international details are required on investments in the ICT areas. Public telecommunications investment figures are available from the OECD on the basis of total investment, as a percentage of revenue, per mainline, per capita and as a percentage of gross fixed capital formation (GFCF). Investment as a percentage of revenue is selected (Figure B-10), as it represents reinvestment into the infrastructure.

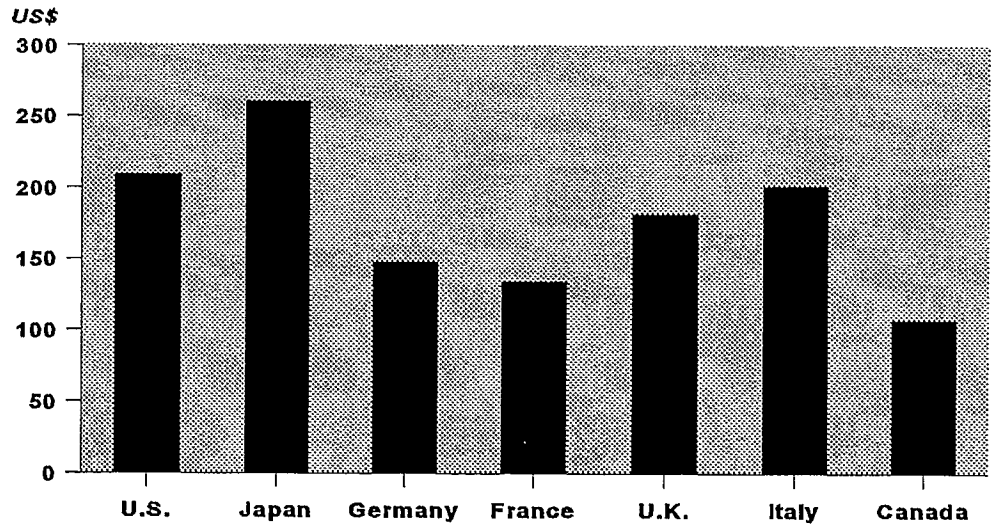
Figure B-10
Telecommunications Investment as a Percentage of Revenue, 1995



Source: Data provided by the Organisation for Economic Co-operation and Development.

One measure of productivity is the ratio of revenue per employee in the telecommunications environment (Figure B-11).

Figure B-11
Telecommunications Revenue per Employee, 1995



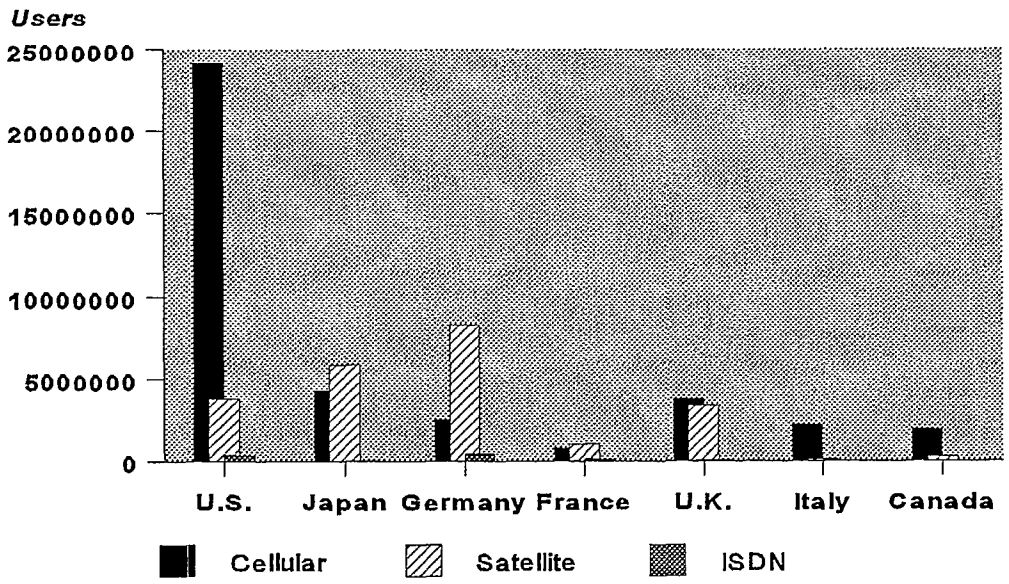
Source: Data provided by the Organization for Economic Co-operation and Development.

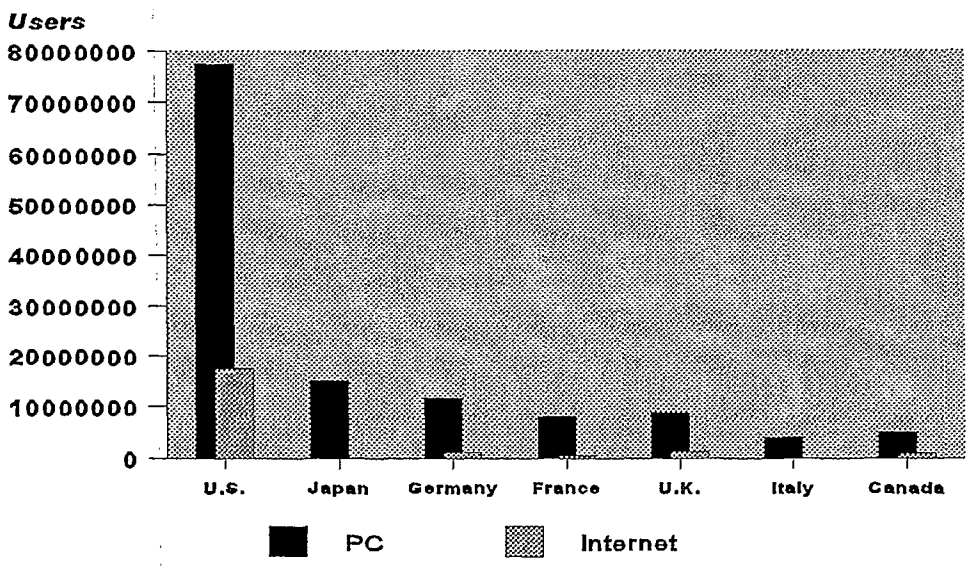
Modernization

Modernization includes areas such as digitization of networks, advanced networks and software, new products and services and their availability to the population (Figure B-12). Because of the competitive nature of many of the new services, some of these data are reported to the international agencies.

Other modernization aspects include digitization of the networks, fibre optic deployment, expenditures on switching and transmission infrastructure, and telecommunications exchanges. The latter two have scattered reportings, and the figures on fibre optic deployment are not useful when considering geographic aspects. Digitization is selected as the better indicator (Figure B-13).

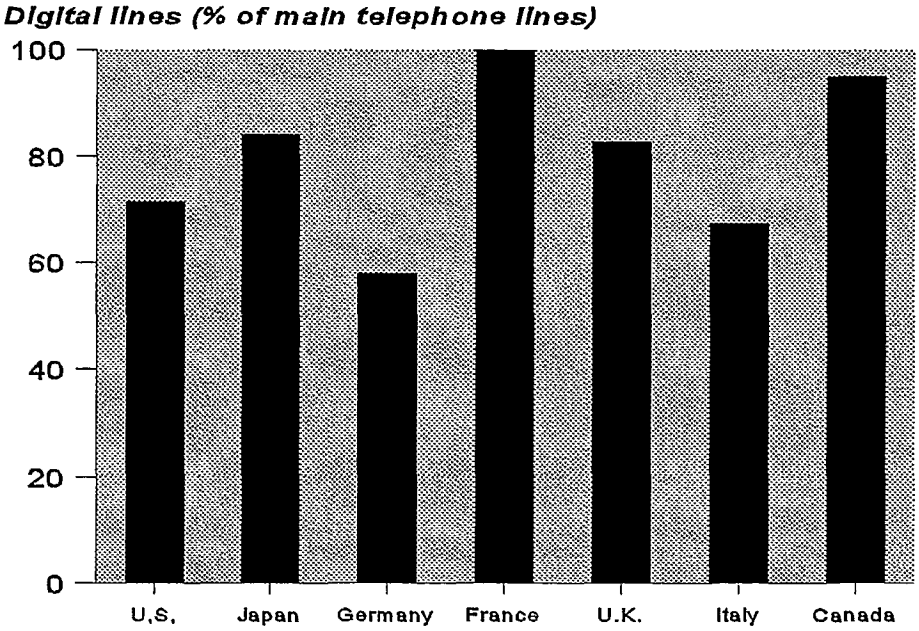
Figure B-12
Modernization of Products and Services, 1994





Source: International Telecommunication Union, *World Telecommunication Development Report* (Geneva: ITU, 1996).

Figure B-13
Digitization, 1995

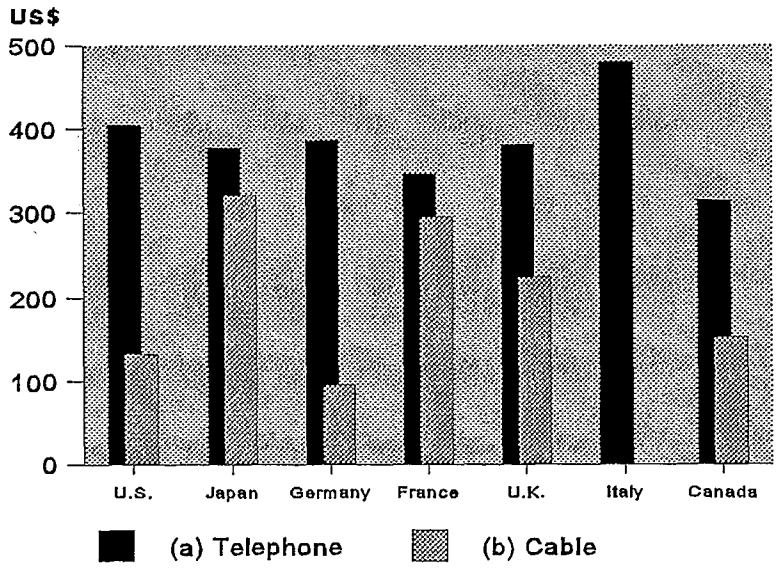


Source: International Telecommunications Union, *World Telecommunication Development Report: Trade in Telecommunications; World Telecommunication Indicators, 1996/1997* (Geneva: ITU, 1996).

Pricing

Traditionally, for the regulated industries, prices were not cost-based, nor were they set by market forces but rather by regulators. Prices vary today because of considerations of value of services, subsidies, contribution and interconnection charges. The OECD has also created a basket of prices, which provides some indication of price comparisons based on tariffs (Figure B-14). Prices can be measured with the consumer price index (CPI) and vary from year to year. However, on an international basis, these are difficult to measure because of wide changes in currencies. More precision on the measure of these prices is required.

Figure B-14
Annual Prices for Services, 1995



[a] Basket of residential service charges, January 1996.

[b] Cable television prices.

Source: Data provided by the Organisation for Economic Co-operation and Development.

In the area of pricing, international statistical data related to subsidies, interconnection charges, etc., are required.

Based on the above subsets, the supply-side indicator could be developed with the following weightings assigned for each of the components:

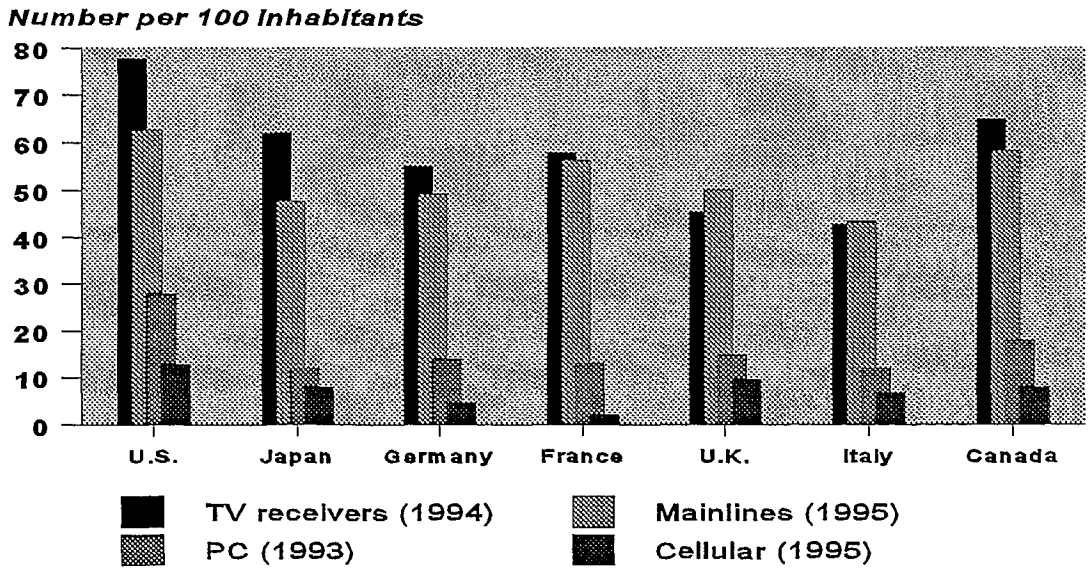
Component	Weightings
Investment	1
Modernization	Range 1 to 10
Pricing	Range 1 to 10

In terms of the data provided, Canada would rate moderate on investment, very high on modernization, and high on pricing aspects.

Demand

The primary concern of this section is penetration and use of ICTs as well as the diffusion of technologies into the household, businesses and governments of the country (Figure B-15).

Figure B-15
Penetration Rates per 100 Inhabitants



Source: Data provided by the Organisation for Economic Co-operation and Development.

These measures provide an indication of the density of communications and information technology services.

Based on the subset of components, a weighting range of 0 to 1 could be developed for the demand indicator.

Canada would rate moderate to high in the demand area.

Employment
In the employment area, there is a need for an overall employment indicator.

Consideration can be given to the following components: education, human resources skills and training, and employment in ICT areas.

Education
For education, the index developed by the UN Development Programme, based on expenditures, provides a good indicator.

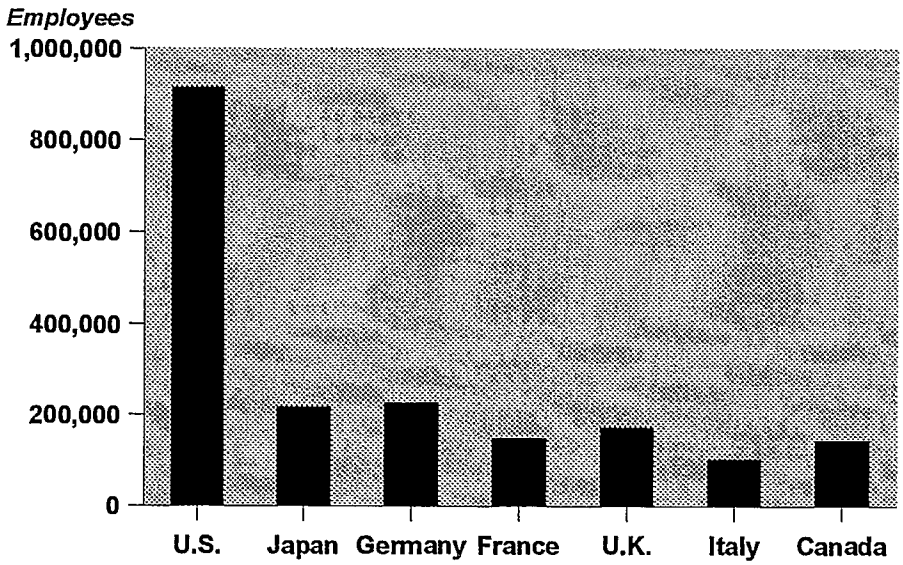
Country	Education Index
Canada	0.99
U.S.	0.98
France	0.95
U.K.	0.94
Japan	0.92
Germany	0.92
Italy	0.88

Source: Data provided by the United Nations Development Programme, 1996.

It may be more relevant to view a subset of education related to graduates in computer sciences and engineering as well as those trained in computer programming areas.

Employment
Employment in ICT areas could provide some additional information. However, information in this area is limited (Figure B-16).

Figure B-16
Public Telecommunications Operator Employees, 1995



Source: Data provided by the Organisation for Economic Co-operation and Development.

Employment is a key outcome of information infrastructure development. What is required is a measure of growth of employment in ICT as a share of total employment.

Factors to consider are:

Component	Weighting
Education	1
ICT share	1

Canada would likely rate very high in these areas.

INTERNATIONAL BENCHMARKING

A set of key indicators with weights for the components could be developed to assess the status and evolution of the information infrastructure. This provides an initial summary of those indicators that could be considered.

As an initial comparison, based on the data available, and considering the proposed set of indicators, Canada could be rated as follows:

Indicator	Components (if any)	Rating
Gross domestic product	Information and communications technology (ICT) spending; Human development	High
Competitiveness	Competitiveness; Trade; Inflation; R&D	High
Competition/regulation	-	High
Investment	Capital spending; Revenues	Medium
Modernization	Products and services; Digitization	Very high
Pricing	-	High
Overall technology penetration	-	High
Employment	Education; ICT employment	Very high

Overall, Canada rates high to very high in the majority of categories. As efforts are proceeding internationally to adopt a set of statistical indicators and to develop more precision in the data provided, Canada could adopt a set of indicators to measure the performance of the information infrastructure, with particular attention to those relating to investment in infrastructure, growth of information and content-based services and diffusion of these technologies within the economy.

PRIME CONSIDERATIONS AND FUTURE WORK

In order to develop key indicators, a prime consideration is the timing and relative comparability of the statistical data provided. For example, a considerable portion of the statistical data available is for the period 1990–95, with only updates available in March 1997 and the end of 1998. As well, the timing of data provided from international agencies, associations and private corporations is not in synchronization with those provided from central statistical agencies, other government departments and regulators.

Future and ongoing work in this area must track the following changes taking place:

- changing skills in the industry
- new and refined price indices
- accounting rate changes
- indicator of bandwidth to the home, business, government and other users
- network evolution (advanced systems, new networks, digitization)
- trend tracking (internet, electronic commerce)
- new services (ADSL, PCS, LMCS, cable modems)

Central statistical agencies have provided some cautionary comments regarding difficulties and discrepancies in the collection of statistics related to GDP, trade, R&D in telecommunications, prices and employment. Statistics related to the information infrastructure are becoming a primary area of collection -- these include more specific information on home computers (capacity, memory, use) and Internet use as part of their annual household surveys as well as those related to new technologies (i.e. PCS, etc.).

In addition, beyond the annual household surveys and initial business survey in June 1995 conducted by Statistics Canada, additional surveys are planned for 1997 in electronic commerce (financial institution survey).

REFERENCES

Canadian Communications Network Letter, Evert Communications Ltd., various issues.

Finance Canada, *Building the Future for Canadians: Budget 1997*, February 18, 1997.

Government of Canada, *Building the Information Society: Moving Canada into the 21st Century*, May 1996.

Government of Canada, *Competition and Culture Set to Gain in Convergence Policy Framework*, News Release, August 6, 1996.

Industry Canada, *Canadian Broadband - The Canadian Broadband Telecommunications Industry: A Capability Guide*, March 1995.

Industry Canada, *Science and Technology for the New Century: A Federal Strategy*, 1996.

Industry Canada, *The Canadian Information Highway: Building Canada's Information and Communications Infrastructure*, April 1994.

Information Highway Advisory Council, *Connection, Community, Content: The* Challenge *of the Information Highway*, Final Report, September 1995.

Insight - Regulatory Trends, Stentor Telecom Policy Inc., various issues.

Johnston, David L., Deborah Johnston and Sunny Handa, *Getting Canada OnLine: Understanding the Information Highway*, Stoddart Publishing Company Limited, Toronto, 1995.

Kahin, Brian and Ernest J. Wilson III, eds., *National Information Infrastructure Initiatives*, MIT Press, Cambridge, 1997.

Statistics Canada, *Canada Year Book*, 1997.

The Conference Board of Canada, *Performance and Potential: Assessing Canada's Social and Economic Performance*, Report, 1996.

World Economic Forum, *Global Competitiveness Report*, Geneva, 1996.

"The Internet: Bringing Order from Chaos", *Scientific American Special Report*, March 1997.

"The PC of the Future", *PC Magazine*, 15th Anniversary Issue, March 25, 1997.

QUEEN HC 120 .I55 C339 1997
Canada. Information Highway
Status and evolution of Cana

INDUSTRY CANADA/INDUSTRIE CANADA
126952