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# HICKLING

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FEASIBILITY STUDY OF A  
NATIONAL HIGH SPEED  
COMMUNICATIONS NETWORK FOR  
RESEARCH, DEVELOPMENT AND EDUCATION

VOLUME D:  
IMPLEMENTATION ANALYSIS



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**VOLUME D:  
IMPLEMENTATION ANALYSIS**

**Submitted to:**

**INDUSTRY, SCIENCE AND TECHNOLOGY CANADA**

**Prepared by:**

**HICKLING**

**and**

**COMGATE ENGINEERING ASSOCIATES LTD.**

**In association with:**

**THE ALBERTA RESEARCH COUNCIL**

**THE CGI GROUP**

**LANG MICHENER LAWRENCE & SHAW**

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<b>NOTE</b>
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This is Volume D of a study prepared by James F. Hickling Management Consultants Ltd. (HICKLING) on behalf of Industry Science and Technology Canada (ISTC), entitled "Feasibility Study of a High Speed Communications Network For Research, Development and Education". There are five volumes in this study:

1. Main Report
2. Volume A: Participant Needs
3. Volume B: Economic Analysis
4. Volume C: Technical Analysis
5. Volume D: Implementation Analysis

## PREFACE

This study was commissioned by Industry, Science and Technology Canada to investigate the feasibility of establishing a National High-Speed Communications Network for use by the Canadian research, development and education communities; and by the Canadian information technology industry. The Network would have greater capacity and functionality than existing networks for research, development, and education, and in addition, provide an environment for the development and demonstration of new information technology equipment and services. While the undertaking of this study is not to be construed as a commitment by the federal government to the establishment of a network, the study will provide a solid basis for such an initiative should it be found prudent.

HICKLING is indebted to Dr. Digby Williams, Director, and Joseph Padden and Rafiq Khan, Senior Technologies Advisors, of the Microelectronics Technology Office, Information Technologies Industry Branch, Industry, Science and Technology Canada, for their expert technical and managerial advice in the conduct of this study. The authors would also like to offer thanks to the more than 400 individuals who participated in expert panel sessions, in-person interviews, and surveys; the study would not have been possible without their input. Of course, any errors or omissions are the sole responsibility of HICKLING.

The report was authored by David Arthurs, Phil Kennis, and Daniel Hara of HICKLING under the direction of Dr. Verne Chant; and Roger Choquette and Antony Capel of COMGATE. Significant contributions were made by Dr. Saul Greenberg of the Alberta Research Council; Dr. Frederick Eshragh, Dr. Kalman Toth, and Dr. Samy Mahmoud of CGI; John Lawrence and Andree Wylie of Lang Michener Lawrence & Shaw; Dr. Elmer Hara of the University of Regina; and Dr. Fred Casadei.



## OVERVIEW

This volume, Volume D: Implementation Analysis, addresses the issues concerning implementation of a Canadian national high speed communications network for research, development, and education (referred to as the Network), and is presented in eleven chapters.

The first chapter introduces the need for cooperation among participants in the implementation of national networks. The second chapter then presents the mission, objectives and goals for a Canadian high-speed network which meets the needs of the Canadian research, development and education communities. The third chapter summarizes the technical characteristics of such a network.

Chapter 4 discusses the roles of network participants in the implementation of the network and Chapter 5 examines the conditions under which the participants would access and use the network. Chapter 6 outlines the services which the network would provide for participants in research, development and education, and in the development of information technology products.

Chapter 7 discusses how the network could be financed; who would provide money and services-in-kind, and how users should be charged. Chapter 8 proposes a management structure for the operation of the network.

Chapter 9 compares the ISTC network initiative to other government initiatives in the Canadian communications infrastructure. Chapter 10 examines Regulatory issues which may affect implementation of the Network.

Finally, Chapter 10 makes some recommendations for the implementation of the network.



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## 1. INTRODUCTION

Historically, research and development computer networks in Canada, and around the world, have been developed by the academic community to meet their specific requirements. The results have been exemplary given the limited funds available to the universities. Many networks, however, have limitations which prevent them from realizing their full economic benefit to the nation. These limitations include:

- Insufficient bandwidth to meet the needs of many valuable network applications,
- Fragmented development and a diversity of standards which make it difficult for networks to connect with each other,
- Lack of resources necessary to provide the management and user services necessary for a large, intelligent network, and the
- Inability to support the development of the new network equipment and services which will be required to maintain and improve the nation's competitive position.

There is a growing consensus around the world that the networks of the future can only be successfully implemented by the cooperative effort of government, industry, and the academic communities. No group, by themselves, can obtain the full benefits possible from the synergy created when all groups work together. Each group brings important resources to the venture, such as finances, technical expertise, and manpower.

While networks require collaboration, the politics involved can provide some difficult implementation problems. Each group has their own concerns, objectives and priorities. Often, the interests of each group are perceived to be in conflict with those of other groups.

Therefore, it is essential that the interests of all potential participants be considered and that a common ground be found for cooperation. The Participant Needs analysis of this study (Volume A) concentrated on discovering the interests of each of the major groups of potential network participants. These findings are summarized in Table 1.

Each of the following sections relate the interests of potential participants to the different aspects of implementation. Where there is a conflict, the interests of some participants may have to be compromised. For the most part, however, the interests of participants are not mutually exclusive and an acceptable implementation strategy is possible.

Table 1: Participant Needs Summary

CONCERNS	SERVICE USERS		SERVICE PROVIDERS			SPONSORS	
	R&D USERS	IT USERS	IT SUPPLIERS	REGIONALS	CARRIERS	PROVINCIAL GOV'T	FEDERAL GOV'T (ITC)
TECHNICAL	<ol style="list-style-type: none"> <li>1. Connectivity to Regional, National and International Networks</li> <li>2. Reliability</li> <li>3. Access to basic services</li> <li>4. Access to advanced services</li> <li>5. High capacity</li> <li>6. Capable of multi-media</li> <li>7. User Friendly</li> <li>8. Low cost access alternatives must be made available</li> </ol>	<ol style="list-style-type: none"> <li>1. Access to different levels of the network</li> <li>2. High capacity (T1 as a minimum)</li> <li>3. Access to real world Beta test</li> <li>4. Access to all transmission media</li> <li>5. Network Intelligence contained on the edges of network</li> <li>6. Migration to ISO</li> <li>7. Smooth technology migration to T3 and higher speeds</li> <li>8. Multi mode/media</li> <li>9. Connectivity</li> <li>10. Security</li> <li>11. Low cost access</li> </ol>	<ol style="list-style-type: none"> <li>1. Open to multiple vendors</li> <li>2. Beta Test site</li> <li>3. State of the art equipment &amp; services</li> <li>4. Open to third party Value-Added vendors (database)</li> </ol>	<ol style="list-style-type: none"> <li>1. Inter-operability with other regional, national and international networks</li> <li>2. Coexistence of TCP/IP &amp; OSI</li> <li>3. Only one sub-network for a region</li> </ol>	<ol style="list-style-type: none"> <li>1. Use existing transmission services</li> <li>2. Network must consist of all types of transmission media</li> <li>3. Network must interface with carrier offerings (eg. ISDN)</li> </ol>	<ol style="list-style-type: none"> <li>1. Regional Networks must continue to exist</li> </ol>	<ol style="list-style-type: none"> <li>1. Support ISO/OSI standards</li> <li>2. Trans-Canada end-to-end digital connectivity</li> <li>3. Minimum technical capacity of 1.5 Mbs</li> <li>4. State of the art protection and network management features</li> <li>5. Offer test facilities</li> </ol>
IMPLEMENTATION	<ol style="list-style-type: none"> <li>1. Elimination of Duplication /Single Initiative</li> <li>2. T1 Tariff Rates must be reduced</li> <li>3. Distance independent fees Fixed - academic Variable - industry</li> <li>4. Basic services included in user fees</li> <li>5. Advanced services paid in addition to basic fee</li> <li>7. Representation on board</li> <li>8. Access to network permitted for non-commercial purposes based on honor system</li> <li>9. Consistency with international use policies</li> </ol>	<ol style="list-style-type: none"> <li>1. Clearly defined mission statement</li> <li>2. Elimination of Duplication /Single Initiative</li> <li>3. Must be implemented quickly</li> <li>4. OSI conformance testing through accredited organizations (eg. CIGOS)</li> <li>5. Preference for usage based fees</li> <li>6. Willingness to pay preference for contributions in kind</li> <li>7. Full-time business-like management required</li> <li>8. Proprietary interests must be minimized</li> <li>9. Access to network permitted for non-commercial purposes</li> </ol>	<ol style="list-style-type: none"> <li>1. Market development is the objective</li> <li>2. Discounts on Services &amp; Equipment for Marketing purposes</li> <li>3. Interested in network management</li> <li>4. Tax credits for contributions/R&amp;D</li> </ol>	<ol style="list-style-type: none"> <li>1. Must be joint participants in management of backbone network</li> <li>2. Must recognize and take advantage of experience and expertise of existing regionals</li> <li>3. Predatory networks must be addressed</li> <li>4. Back door connections must be minimized</li> <li>5. Must meet needs of current client base</li> <li>6. Formal marketing and management structures must exist</li> <li>7. Direct connections to backbone must be minimized</li> <li>8. User fees fixed for a level of service</li> </ol>	<ol style="list-style-type: none"> <li>1. Market development is the objective for participation</li> <li>2. Would give consideration for reduced tariff rates</li> <li>3. Re-selling is a concern</li> <li>4. No commercial by-pass (policed by honor system)</li> <li>5. Voice may cause regulatory problems</li> <li>6. Interested in network management</li> <li>7. Desire formal recognition of contribution (reflected in rate structure)</li> </ol>	<ol style="list-style-type: none"> <li>1. Elimination of Duplication /Single Initiative</li> <li>2. Build on CANet, etc.</li> <li>3. Accommodate the different states and needs of provinces</li> <li>4. Regional Development</li> <li>5. Want representation</li> <li>6. Health &amp; Education Sectors represent large beneficiaries.</li> </ol>	<ol style="list-style-type: none"> <li>1. Maximized use of Canadian Technology</li> <li>2. Use of existing transmission facilities</li> <li>3. Connectivity to Regional, National, International networks</li> <li>4. Self supporting after 5 years</li> <li>5. Work jointly with Regional Networks</li> <li>6. Network will not be free (equity required from all participants)</li> </ol>

## 2. MISSION, OBJECTIVES AND GOALS

A mission statement defines an initiative. It gives participants in the initiative a sense of purpose and focuses their efforts. It also helps to identify and promote the initiative to others. The mission is broken into specific objectives which emphasize important aspects of mission. The objectives guide senior management in their policy decisions. Goals are tangible measures of achievement to strive for. They are the embodiment of the objectives and provide a target for all participants in the initiative.

The following Mission, Objectives, and Goals were derived from the views expressed to the project team by potential participants in the network.

### 2.1 MISSION

To enhance Canada's global competitiveness and improve Canadian society by providing the means for organizations engaged in the strategic areas of:

- Research and Development,
- Information Technologies, and
- Education

to connect with:

- Each other,
- Information sources,
- Special equipment, and
- International resources.

### 2.2 OBJECTIVES

The mission can be broken into the following specific objectives:

- To catalyse and accelerate the development and use of advanced Canadian network technologies and information services.
- To increase the sharing of information and the forging of alliances among government, industry, and education, within Canada and abroad.
- To enable all organizations to make valuable contributions to Canada's knowledge base, regardless of size or location.
- To stimulate and support private and government initiatives for research, development, and education in all fields and sectors of the economy.

- To provide organizations with cost effective access to special equipment and information resources which will enhance the productivity and quality of their work.
- To stimulate and support private and government initiatives in the conduct of commercialization of research.
- To provide a research environment where the full benefits of modern communication systems are understood and obtained.

### 2.3 GOALS

Goals for the next five years should include:

- **Capacity:** T1 backbone in place by the end of 1991, evolving to T3 by 1995.
- **Connectivity:** Connections to every Canadian city of population greater than 100,000, each province, each territory.
- **Reliability:** Commercial grade at a reasonable cost.
- **Services:** A broad range of user friendly applications for time-slipped communications, real-time communications, large file transfers, database access, and virtual terminal use.



### 3. NETWORK CHARACTERISTICS

The characteristics of the network should be driven by the needs and concerns of the network participants. The following list of principles, which have guided the technical design of the network, was derived from the Participant Needs Analysis portion of this study (see Volume A). The technical design issues of the national network are discussed in Volume C of this study.

#### Principles:

- High reliability.
- High capacity (initially T1) available to the end user, evolving to higher speeds as quickly as technology and costs permit.
- Transparent service for graphics, video, sound and data (multimedia) communications.
- OSI (Open Systems Interconnect) standards conformance, coexisting with other protocols as required.
- Access to all stack levels by users for information technologies development and testing.
- High functionality and user friendliness, with the intelligence of the network located at the "edges". This means that rather than the network supplying all user applications, that third party vendors can supply applications to users through the network.
- Access to many transmission media by users for information technologies development and testing; fibre, microwave, satellite.
- Provision of security against at least accidental and non-malicious loss of data integrity and confidentiality of data.
- Constructed from, and operated using, state-of-the-art Canadian products where possible.
- Connectivity and interoperability with other networks, especially the world Internet, the public telecommunications network, and the government operations network (GTN-2000).
- The use of existing transmission facilities where possible.
- Evolution from, and enhancement of, existing national and regional networks.

Technically, there are no insurmountable barriers to the implementation of the network. Operational networks for research, development and education operating at T1 speeds and faster already exist in a number of locations around the world. In the short term, there may be some problems finding Canadian suppliers of some network equipment and software. Since the OSI standards are still evolving, conformance will be a transitional process.

## 4. PARTICIPANT ROLES

The network will need to be a cooperative effort among Canadian government, industry, and the academic community in order to realize its maximum potential. Organizations participating in the establishment, operation, and use of the network can be broken into three broad groups: network users, network suppliers, and network sponsors. The feasibility of implementation is dependent on the ability of these groups to interact successfully. The role of the network management is to facilitate and optimize that interaction.

Each of the network participants have roles and responsibilities which they can be expected to fulfil. Some responsibilities are mandated, while others arise from common motivational forces.

### 4.1 NETWORK SPONSORS

Network sponsors are organizations interested in helping network users and suppliers to develop, use, and maintain the network in a manner which is beneficial to Canada. They may provide funding, expertise, or information. Technology sponsors include the following groups:

#### 4.1.1 Federal Government

The federal government has a number of departments and agencies which may be interested in sponsoring a national network to support the national interest and their own mandates. Benefits of supporting the national network of interest to the federal government include:

- Promoting national unity,
- Assisting regional interests,
- Stimulating the information technologies industry,
- Supporting research and development,
- Fostering national collaborative ventures, and
- Enhancing international competitiveness.

Particular federal agencies and departments which may be interest in federal sponsorship of the national network include:

- Industry, Science and Technology Canada
- The Department of Communications
- The National Research Council
- The National Science and Engineering Research Council
- The Government Telephone Network
- Treasury Board

#### 4.1.2 Provincial Governments

Each of the provincial (and territorial) governments has a number of organizations which may be interested in provincial support of the national network. Benefits of supporting the national network of interest to the provincial governments include:

- Promoting regional development,
- Assisting education, and
- Assisting the health care system.

It is expected that much of the provincial support will manifest itself at the regional level through funding of the regional networks and local network users.

#### 4.2 NETWORK SUPPLIERS

Network suppliers are organizations interested in providing equipment, applications and management services required for the construction and operation of the network. These are often private sector companies, but the academic community in Canada has a long history of providing excellent network management services. In some cases, such as TRIO, ATRC, and ITRC, research organizations may be in a position to act as suppliers to the network.

##### 4.2.1 Information Technologies Suppliers

The network will be dependent on the information technologies suppliers to provide Canadian products capable of fulfilling the technical and functionality objectives of the network. Benefits to information technologies suppliers of supplying their products to the network include:

- National and international advertising through association with a state-of-the-art network,
- National and international recognition for conformance to OSI standards, and
- Access to early adopters of new technologies which will result in the creation of new market opportunities.

It is hoped that in return for the benefits mentioned above, information technology suppliers will provide their products to the network at substantially reduced prices.

##### 4.2.2 Regional Networks

The regional networks have a vital role to play in the operation and management of the network. They have experience not available elsewhere. They also have a developed, experienced user base which will form the initial and for a long time predominate user base for the national network. Benefits to the regional networks of participating in the national network include:

- Increased connectivity and capacity,

- 
- Access to new applications and equipment as it is developed, and
  - Assistance in network marketing and management.

It is hoped that in return for the benefits mentioned above, the regional networks will conform to the network policies developed jointly by all network participants.

#### 4.2.3 Telecommunication Carriers

The network will depend on the carriers to provide the transmission facilities on which the network will operate. Benefits to the carriers of participating in the network include:

- Creation of new markets for telecommunication services, and
- Greater use of existing telecommunication capacity.

It is hoped that in return for the benefits mentioned above, the carriers will support the network in obtaining approval for tariff reductions from the CRTC. The possibility of tariff reductions is discussed in Section 10.4.

### 4.3 NETWORK USERS

Network users are organizations and individuals interested in applying network services to improve the efficiency, effectiveness, and competitiveness of the work that they do. There are two types of network users, as follows:

#### 4.3.1 Research and Development

Research and development users of the network are those organizations which use the network to communicate with their colleagues, information sources, and special equipment, regardless of their field of interest. Benefits to research and development users of the network include:

- Improving research quality and productivity by promoting communication and collaboration,
- Shortening the time for the transfer of research results into the economy,
- Allowing more efficient use of resources, and
- Providing opportunities for participation in research by organizations which are small or remote.

The research and development users will create the traffic on the network necessary for the operational and market testing of products developed by the information technology users described below.

#### 4.3.2 Information Technologies

Information technologies users of the network are those organizations which use the network to help develop new network equipment and services. Information technology users may also



be research and development users as described above. Benefits to information technologies users of the network include:

- Promotes and supports the development of future oriented technology by Canadian industry,
- Promotes the development of equipment and services by Canadian industry which meets international standards,
- Provides a means to assess user needs and acceptance of new information technology products, and
- Provides a showcase for Canadian technology in international markets.

#### 4.4 VIABILITY AS A NATIONAL PROJECT

A wide variety of organizations from across Canada have expressed strong interest in participating in The Network. The form of this participation varies among organizations, for example:

Organization	Potential Role
Federal Government	Funding, Policy, Services
Provincial Governments	Funding, Education, Regional Development
Universities and Public Research Organizations	Management, Operation, Use
Information Technology Companies	Operation, Supply, Use
Regional Networks	Operation, Management, Policy
Carriers	Operation, Supply

Many organizations in a position to supply equipment, services, or expertise to the Network, are willing to do so at a substantial discount. Users of the network are willing to pay for services, but in the case of academic institutions the ability to pay is constrained, and in the case of private companies a trial period is necessary to prove the value.

If funding for the Network is approved by the federal government, extensive discussions will be required among potential participants to further define their roles and degree of commitment. However, there is little doubt that the Network is a viable national project with sufficient support expressed by government, industry, and the academic community.

## 5. USE AND ACCESS

### 5.1 USE

The maximum benefit of the network will be only be derived if the maximum use is made of its capabilities. However, because the network will be partially publicly funded, at least initially, there must be some restrictions on use to protect private interests.

There are three general principles which should be applied when deciding what uses of the network are acceptable:

- The network is to be used to support research, development and education,
- The network shall not be used for commercial activities, and
- The network shall not compete with commercial offerings.

There is, however, a large degree of latitude available in the interpretation of these principles. The following paragraphs examine some of the issues pertaining to the use of the network.

#### Research, Development and Education

It is intended that research, development and education be used here in their broadest sense. But, that sense is still not all inclusive. How can an acceptable activity be differentiated from an unacceptable activity? One distinguishing characteristics which can be used to help determine whether an activity is acceptable research, development or education is its place in the technology development process.

Figure 5.1 shows a simplified version of the technology development process. A new product evolves through two parallel streams of activities, one involving the technical aspects of the product and the other involving the marketing aspects.

The process begins with the education of the people who will be responsible for each stage; an activity vital to every aspect of technology development and application. Market Analysis identifies problems and Research creates technological solutions. Needs Analysis defines how technologies should be implemented in specific applications and Development carries out the implementation. Engineering creates a marketable product and Product Trials ensure that the product will be accepted in the marketplace. Advertising informs potential customers of the products benefits to create a demand and Production manufactures and distributes the product to customers.

In general, Advertising and Production would be considered commercial activities and therefore inappropriate for the use of the network. It is acknowledged, however, that there is a grey area between appropriate and inappropriate use of the network where a degree of discretion will be required.

**Figure 5.1: The Technology Development Process**

MARKETING ACTIVITIES	E D U C A T I O N	Market Analysis	Needs Analysis	Product Trials		Advertising
		Research	Development	Engineering		Production
TECHNICAL ACTIVITIES						

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### Field of Application

The field in which the research, development and education are performed is not important. For example, all of the following fields make useful contributions to our nation which would be enhanced through use of a high-speed network:

- The physical sciences,
- The biological sciences,
- The social sciences, and
- The humanities.

The development of information technologies equipment and services is a specific part of the physical sciences which should be given explicit and special consideration in all aspects of this network. Specific technical implementation issues associated with the support of this policy are discussed in Volume C.

### Commercial Services

The provision of commercial services is an important exception to the restrictions on commercial use of the network. Value Added Suppliers (VAS) should be allowed to provide research, development and education participants with services for a fee. These value added services would supplement the basic suite of Network services. Such an arrangement between the Network and the VAS will provide Network users with applications which the Network by itself could not afford to develop or maintain.

### Competition with Commercial Offerings

As a matter of policy, the Network should not compete with public service offerings available from the carriers. By the very nature of telecommunication services, the Network will in fact be providing, in some cases, equivalents to those services available on the public networks. However, the purpose of the Network is to make networking capabilities available and affordable to the research, development, and education community, not to provide a by-pass to public offerings. It is also within the Network's mandate to provide innovative services in advance of when such services are available commercially with a view to promoting the development and eventual use on the public networks. To achieve this goal, the carriers must be encouraged to participate in the Network's implementation and the Network must maintain a position of capacity and functionality which is a step ahead of what is implemented in the commercial environment.

### International Guidelines for Use

The principles outlined above conform to the informal guidelines for acceptable network use which have evolved internationally. Such conformance is important since it is vital that Canadian networks be connected to the world Internet.

### **Policing Use**

It is essentially impossible to directly police the content of traffic which flows over a network. For this reason, use of the network will have to be controlled primarily by the honour system.

## **5.2 ACCESS**

Open access is essential to achieving the ubiquitous connectivity necessary to achieve the maximum benefit from the network. Access to the network should be made available to anyone performing research, development and education, and to anyone providing a service which supports research, development and education. This includes scholars, industry and government.

There are two general principles which should be applied when deciding who should have access to the network:

- Anyone with a legitimate use for the network should be able to obtain access, and
- There should be no impediments to access caused by an organizations size, location or class.

The following paragraphs examine some of the issues pertaining to network access.

### **Access Mechanisms**

To meet the access needs of the many different participants, a variety of access methods will be required which differ in technology, capability, and cost. These will include:

- Dedicated access through a regional network.
- Dedicated access through the backbone.
- Temporary access through publicly offered connections such as the PSTN (e.g. dial up) or PDNs (e.g. Datapac).

The proposed Network architecture, described in Volume C, accommodates these access alternatives.

Access mechanisms should be tailored to meet the needs of a wide range of potential users, with special consideration given to the needs of the small user.

### **Security**

The privilege of open access must be accompanied by both a high ethical standard of conduct by network users, and an appropriate level of security on the part of the network to make it



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resistant to intentional or unintentional attack.

The primary obligations of the network are to ensure data integrity and to prevent misuse of the network. The confidentiality of information transmitted over the network should be the responsibility of the sending organization, although the network may provide a security service as user needs develop.

#### **International Access**

The network will provide connections to international networks through the Internet. In addition, the network should negotiate reciprocal agreements for access to international sources of information and special equipment. Such agreements are important because research, development and education are international activities.

#### **Education**

Networks were first developed for the use of the academic community. In Canada this has meant almost exclusively the large universities. In the short term, the academic involvement should be extended to the smaller, general arts universities and the community colleges. Eventually, the network should be accessible to high schools, and public schools.



## 6. SERVICES

Services must be developed and provided for two types of network users as described in Section 4.3: research, development and education users; and information technology users.

### 6.1 RESEARCH, DEVELOPMENT AND EDUCATION

Existing research and academic networks provide three principle types of network services: electronic mail and messaging, file transfer, and connection to remote host computer systems. To meet future needs, these services must be improved in capacity, connectivity, functionality, and usability. Plans for services on the national network must anticipate and provide for a capability which is matched to the rapid pace of development in the computers and high performance workstations connected to the network.

The services which should be available to RD&E users will be of two types: those available as a basic service on the network, and those available as an enhanced service provided by a third party (Value Added Supplier or VAS). The basic services will be included in the network connection fee. The enhanced services offered by VAS will be charged for at the discretion of the service provider or provided free of charge for development and promotional reasons.

The following table gives some examples of different categories of services. Those in category A are fundamental capabilities essential to the operation of the network and will necessarily be provided. Those in category B are not essential to the network, but are generally expected by most users and will therefore be provided. Those in category C require additional resources and expertise. They will be supported, but not provided by the network. They will be provided by VAS, possibly at additional cost. Those in category D are services which will be available in the future, but it has not been determined whether they should be offered as a basic service or by a VAS. These lists are not meant to be exhaustive.

A Services	B Services	C Services	D Services
File Transfer	Electronic Mail	Databases	Video
Remote Login	Bulletin Boards	Digital Libraries	Multi-media
Directory Service	User Support	Education	Other Research
Network Management		Enhanced Security	
Basic Security		Special Equipment	
Access to other Networks			

The development of OSI based services as well as the development of targeted Enhanced service offerings should be encouraged through the appropriate use of Network funds and resources. The implementation plan must recognise the requirement for the funding of third party service development as well as the development of a service development program to

which permanent staff have been dedicated. The proposed Network budget has recognised the importance of service development in the Network's implementation. Approximately 10% of the Network recommended staffing requirement over the five year implementation period is dedicated to service development. In addition, service development funding represents roughly 10% of the Network's annual operating cost budget.

## 6.2 INFORMATION TECHNOLOGIES

In recent years Canada has lost much of the international lead it had in telecommunications technology. It is critical that necessary research be initiated now so that advanced network facilities can be deployed during the next decade to meet rapidly growing network demand. Failure to move aggressively in this important technology area will not only jeopardize our ability to conduct advanced research in all scientific disciplines, but it will likely lead to loss of international competitiveness and markets for high speed communications equipment as the well funded programs of other nations outstrip those of Canada.

The Network implementation plan should recognise the Network's mandate to foster the development of information technologies products and services.

The services available to information technologies users should include all of the RD&E services described above. In addition, services of interest in the development of information technologies equipment and applications should be made available, including:

- Access to all network stack levels,
- Access to real traffic loads,
- The ability to interface and test hardware on the network,
- The ability to access varying subnetwork technologies, including fibre, satellite, and microwave,
- Provision of conformance testing facilities,
- Network performance information,
- Access to a trial community of users, and
- Opportunity to participate in network operations and management.

The potential conflict between providing a highly reliable network and providing the capability to test new information technologies is an important implementation issue. Procedures and facilities should be established which allow both of these objectives to be met. The proposed Network architecture explicitly provides for the co-existence of a service and IT development mandates. As discussed in Volume C, IT user access to the Network's communications mechanisms should be restricted in order to minimise interference with the ongoing operation of the network. A Network Emulation Facility should be provided to

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permit off-line testing of initial products and services to address the needs of IT users wishing to experiment with products which could interfere with the network.

On-line operational testing and evaluations may be carried out on the network itself after obtaining the approval of the network that the proper safeguards are being taken.

The Network Emulation Facility should be a purpose built facility, separate from the network. The Facility will simulate the operation and traffic of the real network, providing a test bed for experimentation. When new products have been adequately demonstrated in the Facility, permission may be obtained to prove the products on to the network.





## 7. FINANCING

In addition to federal dollars expended on networking research and operations, there are significant amounts, largely undocumented, being spent by individual institutions and research organizations to modernize campus networking and communications facilities, including both capital expenditures for equipment, as well as increased annual operating budgets for networking and data communications. In total, the rapidly growing expenditures at campuses with active networking programs are estimated to exceed current federal and provincial network funding by a substantial margin.

These network costs, both campus and extra-campus, are part of significant new investments in computing to support research and instruction programs. It is widely recognized that the benefits to be derived from these computing investments are dependent upon the effective networking of the machines and their faculty, research and student users to each other, to research apparatus and facilities, and to national electronic databases.

### 7.1 FUNDING SOURCES

All participants should have equity in the network. There are five groups of participants who can be expected to provide some degree of funding. These are: the federal government, the provincial governments, the regional networks, the carriers, and the suppliers of network products.

Determining the amount of funding each group will contribute will require further negotiations among the groups. The following paragraphs examine some of the rationales for funding levels which can act as a starting point for negotiations. The intent is to provide a relative measure of funding, but in order to provide a sense of magnitude, the contribution from each group has been calculated assuming Option III costs of \$58M over five years. The total cost the network over 20 years is expected to have a present value of \$157M.

#### Federal Government

National backbone networks throughout the world are heavily subsidized, if not entirely funded, by government. Networks are seen as vital to national interests and, for a number of reasons, worthy of public support.

The lead Canadian federal department with significant interest in the implementation of this network is Industry, Science and Technology Canada (ISTC), however it should be considered a government initiative in which other interested departments, particularly the Department of Communications and Treasury Board, are significant players.

The Network will contribute significantly to the achievement of many ISTC objectives. In

particular, the benefit to the academic community should be of interest to NSERC, SSHRC, and MRC, the benefit to the research community should be of interest to the National Research Council, and the benefit to Canadian industrial performers should be of interest to ISTC as a whole.

It is proposed that the federal government contribute 60% of the cost of the network in the first five years. This represents approximately \$35M, or \$7M per year.

### **Provincial Governments**

The network will have significant regional benefit by helping to remove the barriers of size and distance. The primary role of the provinces should be support of their regional networks. This support is active in most cases where regional networks already exist. Provinces which do not already have a network should work quickly to implement one.

It is proposed that the provincial governments pay for half of the capital cost of the physical connections (routers, processors etc.) in their province. This will vary by province according to the number of nodes. Larger provinces will require more nodes and will pay a higher proportion of the total cost. In total, the provinces will pay approximately \$2.5M over five years, or \$0.5M per year.

### **Regional Networks**

The national network will make the regional networks much more valuable to their users by providing higher speed connectivity to other regional and international networks. Also, the national network will support the regionals in operating their network and developing new applications.

It is proposed that the regional networks contribute the amounts currently budgeted for backbone service which is approximately \$100K per year per regional network. Assuming that there will be ten regional networks in the near future, the total regional contribution will approach \$4M over five years.

### **Carriers**

Communications costs are the largest cost for the network, representing approximately 50% of total expenditures. The carriers will benefit from the creation of market demand for new services which the network will cause.

It is proposed that the carriers lease lines at cost to the network. This approach has been broached with the carriers and is considered feasible. Assuming that cost is about half of the tariff rate, this would represent a contribution of approximately \$15M over five years, or \$3M per year. Appropriate approaches to deal with the regulatory implications of such a strategy are discussed in Section 10.4.

### Industry

The Network will provide significant experience and marketing benefits to companies which supply equipment and services for the construction and operation of the network.

It is proposed that industry contribute equipment to the network at a 50% discount of list price. This represents a contribution of approximately \$2.5M over five years, or \$0.5M per year.

## 7.2 USER FEE STRUCTURE

Ideally, most users will connect to the national network through a regional network. In such cases, user fees would be paid to the regionals, who would in turn pay a portion to the national network. However, there are two reasons why the national network must address user fees. First, some users will want or need direct access to the backbone. Second, the structure of user fees is important to some of the objectives of the national network.

There are four general principles which should be applied when deciding the user fee structure:

- Users should, in the short term, not pay more for the network at T1 speeds than they are currently paying for 56 kbs speeds.
- The user fees for dedicated access basic service should be fixed for a given speed of service.
- The user fees for non-dedicated dial-in or PDN access users should be determined by the carriers.
- The amount users pay should be independent of distance.

### Fee Levels

The academic community is a large and important user group for the network. Due to funding constraints, they will be unable to pay more, in the short term, for a higher speed network, in spite of the additional benefits. Small users will most likely access the Network through non-dedicated connections provided by the carriers. The fee structure for these connections will be determined by the carriers.

### Fixed Fees

It was primarily the academic community who demanded fixed fees. They have a number of concerns:

- For budgeting purposes, they need to know what their networking costs are

ahead of time. Usage based fees would not allow this.

- They feel that usage based fees will inhibit use, when use should be encouraged.

Industry, especially small users, expressed a preference for usage based fees. Their concerns are:

- They wish to optimize cash flow. Paying a usage based fee overtime is often preferable to paying a fixed fee ahead of time, even when there are net savings.
- They hesitate to commit themselves to an expense when they are unsure of the benefits.

The fixed user fee has been recommended over the usage based fee, in the short term, for the following reasons:

- The academic community will initially be the largest user group.
- Industry, including small users, will accept a fixed fee as long as there are low cost options.
- Use should be encouraged as much as possible.

In the long term there may be justification to move towards a usage based fee, at least in part. There is some concern that under a fixed fee, the network will be perceived as a free good and that usage growth will be uncontrolled. This is not totally accurate as there are many significant costs associated with using a network which the user must bear, other than the connection and transmission costs. Therefore if usage increases dramatically, it suggests that users are obtaining significant benefits which will accrue to the nation as well as themselves.

In any case, in the short term usage growth is desired and should be promoted. If there comes a time when network use grossly exceeds the networks ability to grow, it may become necessary to implement pricing mechanisms to control use.

### **Distance Independence**

One of the primary objectives of the Network is to encourage people to collaborate with others, and use special equipment, which are remote. This can only be accomplished if there are no penalties for the distance of communications. As a result, even if a usage fee is developed in the future, it is not recommended that any distance component be built into it.

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### 7.3 LONG TERM FINANCIAL VIABILITY

The economic analysis conducted for this study (Volume B) showed that the Network would become self supporting in approximately nine years. This analysis assumed that 1) the Network will be maintained at the highest practical speeds and technology, and 2) the fee structure will be set aggressively to promote use. These assumptions were dictated by the objectives of the Network. If these objectives were relaxed, financial viability could be reached more quickly.

It should not be surprising, however, if the Network were to continue to meet all of the objectives described in this study, that ongoing government assistance would be required. Justification for such assistance has been outlined in Volume B: Economic Analysis.





## 8. MANAGEMENT STRUCTURE

The following general principles should be applied when determining the Network management structure:

- The Network must implement the policies of its Owners,
- All participants should have a voice in the Network,
- Network operations experience should be open to all interested organizations,
- The operational management structure should build on existing capabilities,
- Network management and operations should be performed by a dedicated full-time organization, and
- All networks should ultimately be part of a unified management structure.

### 8.1 MANAGEMENT HIERARCHY

The recommended management hierarchy builds on the hierarchy of existing networks.

At the bottom are individual users within an organization. They may use isolated workstations, but are more likely to be connected to their organization's internal network. The organization's network may be local or wide area, within an office, through a building, across a campus, or across the nation.

The first level of management is provided by the users' organization to operate its network. The users interact with this first level of management.

The second level of management operates the regional network. Users and users' organizations' networks interact with this second level of management.

The third level of management operates the national backbone. The regional networks interact with this third level.

This third level of management reports to the national network board of directors.

### 8.2 NETWORK OPERATING COMPANY AND BOARD OF DIRECTORS

It is recommended that the Network operating entity be incorporated as a company. This would provide a well-defined structure in concept and in law within which to operate.

The Network "Company" would operate the Network. It would also own any Network assets that are not owned by other entities (primarily regional networks). Fair and equitable sharing of the assets of the Network Company would then be accomplished through the normal company shareholding structure. It is possible that there may be only one shareholder.

It is proposed above that several organizations share in the costs of establishing the Network. It is suggested that these organizations who will have significant financial (and perhaps non-financial) interest in the Network should negotiate a Memorandum of Understanding (MOU) outlining the roles, responsibilities and funding arrangements among themselves. Such an MOU should also specify the shareholding arrangement and the composition of the Board of Directors. For example, it may be agreed that representation from the user group (large or small) is appropriate even though such representatives may not have any Company ownership. It may also specify a procedure for election of the Board of Directors if such a procedure is different from the normal shareholder voting procedure. All parties with significant interest in the Network should be parties to the MOU, and all shareholders must agree and sign the MOU. With this vehicle, all parties will have assurance as to the participation, roles and responsibilities of other parties, and can act accordingly.

The Board of Directors would perform the normal functions for an incorporated company, i.e. set policy, approve budgets, and hire and direct company management (President or Executive Director).

### 8.3 NETWORK STAFF

#### Executive Director

The Executive Director (Director) and his staff should be responsible for implementing the policies approved by the Board of Directors on a day-by-day basis. The Executive Director should also be responsible for influencing external organizations in the implementation of policies consistent with the Network's policies.

#### Planning and Acquisition Staff

The Planning and Acquisitions Staff, under their manager, are responsible for Near and Long term Network planning, and the acquisition and installation of new Network equipment. The staff for this function should be assembled at the earliest time.

Network planning will involve the development of strategic plans to manage the development of the Network over both the near and long term. Near term planning would generally deal within a time horizon of one to three years, and would deal with proposals to implement specific Network expansion by the purchase or lease of equipment and services. Long term planning would generally deal beyond the two year horizon, and would deal with more general strategic plans based on a judgement of evolving technologies. Planning must include the development of the communications components of the Network and the Services offered over the Network.

The acquisition of new equipment or services will require technical input to ensure that the products meet the approved requirements. This will include the issue of specific requests for proposal, the evaluation of bids, the technical recommendation for purchase, any technical writing required, the incoming inspection and acceptance of equipment or services, and the arrangements necessary for the installation and commissioning of the equipment or services. It is expected that some acquisitions may follow a standing plan for the purchase of ongoing products or services which are general 'consumable' items. This function will operate in conjunction with the business' purchasing agent.

This function would operate closely with the maintenance function (to be discussed below), and the actual installation and commissioning of equipment would be carried out by personnel from the vendor, a third party contractor, or by Maintenance staff.

#### **Maintenance and Operations Staff**

The Maintenance and Operations Staff, under their manager, are responsible for the day-to-day operation of the Network. The equipment owned or leased by the Network must be monitored, controlled and maintained. Where third party contracts are being issued, or where equipment or services are being leased, this function must monitor the performance of these other parties and take any actions necessary to resolve any difficulties.

Maintenance services may be contracted to third parties. This is a particularly good idea considering the national scope of the proposed Network. Many communications and computer companies will supply maintenance services for third party equipment. A difficulty may arise if the equipment in service is considered by its supplier as being leading edge or in other ways proprietary. It will be important to coordinate the selection of the maintenance service supplier so that this does not become an impediment to the introduction of leading edge equipment or services.

Maintenance and operations will not only involve the monitoring and control of owned and leased equipment but will also entail the monitoring and potential control of the services provided by the long haul carrier. Thus many types of equipment and service must be monitored and controlled, and the need for a centralized facility with a uniform interface is required.

This function shall also include the management of foreign interfaces, the Network sensitive components of client interfaces, operational services offered by the Network itself, and any required Billing functions.

#### **Marketing and Service Development Staff**

The Marketing and Service Development Staff, under their manager, is responsible for the development of services offered by the Network as discussed in the Service Development section of this report. This will include the development of Directory and electronic mail services. The Network Marketing and Service Development Staff will work closely with the Client Services Staff and the Technical Centre.

**Client Services Staff**

The Client Services Staff, under their manager, will operate the Technical Centre. The first line of contact for clients is preferred to be a Regional network. This would reduce the manpower requirements of the Client Services Staff. However, the Regional networks themselves will need support, and some users may not have access to Regional networks, thus a basic Client Support staff shall be required for the Network.

The Technical Centre is responsible for the distribution of technical information to clients, the promotion of the Network, and the establishment of a strong user community. It is suggested that this function be separated from the Maintenance functions since the Technical Centre will have some conflicting objectives compared to the Maintenance functions.

Client Services Staff will distribute information to the Network's clients, and will generally promote the development of products and services, both to R & D Users and Information Technology developers. It would reproduce or create documents to describe Network use, would arrange for seminars or conferences to promote areas of mutual interest, etc.

The Technical Centre should also have a strong input to the long term planning process, and may also provide advice regarding near term planning.

The Technical Centre may also operate the Network Emulation Facility, although cooperation with the Maintenance and Operations Staff would be essential in this area.

**Finance and Administration Staff**

The Finance and Administration Staff, under its comptroller, would provide administrative support to the Network's staff.

## 9. RELATIONSHIP TO OTHER GOVERNMENT INITIATIVES

There are a number of other initiatives currently underway which also address aspects of the Canadian communications infrastructure and industry:

### **Government Telecommunications Network**

GTN is a federal agency which provides communications services (primarily voice) to federal government departments. GTN will be able to connect with the Network in much the same way that carrier commercial offerings will be able to. Anticipated changes in the mandate of GTN may allow it to participate actively in the management and operation of the Network, however its involvement must be limited within its current mandate.

### **Vision 2000**

Vision 2000 is an initiative promoting the joint efforts of the Canadian communications industry to develop future oriented products "for the year 2000". The project was started by the Department of Communications, but is now being actively pursued by the cooperative efforts of a large number of Canadian firms. The concept is to enable communications anywhere, anytime, any place and will realize the dream of ubiquitous connectivity among all communications equipment.

The goals of the Network can be considered as a subset of the goals of Vision 2000, though Vision 2000 is oriented more towards personal communications. There is no planned intention to join the two initiatives, but both are being kept actively aware of the other's progress to avoid duplication and ensure cooperation.

### **CAnet**

CAnet is an initiative to create a national backbone network to connect existing regional networks. It has been promoted by the academic community with the support of the National Research Council. An operating company composed of The University of Toronto, IBM, and INSINC has been formed and is awaiting Treasury Board approval for implementation. CAnet will operate with a linked dual-ring topology at 56 kbs and use the TCP/IP protocol initially. The provision for supporting development of information technology products is not one of its goals. The objective of CAnet is to achieve connectivity and speed improvement over existing networks at a low cost.

The network examined in this study differs from CAnet in some significant respects, including:

- The use of 1.5 Mbs links,

- OSI standards conformance,
- Support for the development of information technology equipment and services,
- Participation by all interested Canadian information technology companies for supplying and operation, and
- More intensive marketing to industry.

However, the network examined in this study meets all of the objectives of CANet. The Network increases the scope of CANet providing enhanced capability and should be considered as a natural evolution from CANet.



## 10. REGULATORY ISSUES

The Search 20 forum last year suggested that the future policy for regulation in telecommunications should be based on a competitive model with the backbone players of satellite, cellular, radio, the existing telephone network and cable. The forum also indicated that the current patchwork of regulatory jurisdiction is a strong impediment to investment in communications R&D and to the realization of the vision as defined at the forum.

The current regulatory model in Canada is predominately one of regulated monopoly spread over both federal and provincial jurisdictions. However, the regulatory environment is currently undergoing significant change. The impact of these changes on the feasibility of establishing the Network could be far reaching. Two major issues have been identified for initial review.

The first issue is jurisdictional. Under this issue, the possibility of unitary federal regulation throughout the country is assessed. Because of differences in regulations associated with terminal and network interconnection between federal and provincial jurisdictions, this issue will impact a user's ability to carry out research over the network regardless of his geographic location. This issue may also impact the projected costs for both network termination equipment and local interconnect channels. The latter cost would most probably be higher in that, without network interconnection, a provider of public data services would be required to provide his own local channels. Interconnection to the monopoly local carrier's network would not be permitted.

The second issue revolves around the degree of interexchange competition permitted throughout the country. This issue will most likely impact the availability of competitively priced broadband data services and facilities to the extent that competition influences the development of national competing fibre networks. This issue could significantly affect the projected costs for broadband data services in the future.

Fibre is a key technology associated with the provision of voice services for existing monopoly carriers as well as potential interexchange voice market entrants. It is also a key technology in the provision of broadband data services. Although the development of more than two competing national fibre networks is not foreseen, the development of a competitive interexchange voice market could significantly alter the market power of today's dominant carriers resulting in a more competitive broadband data market.

### 10.1 FEDERAL AND PROVINCIAL JURISDICTION

Telecommunications is not a matter expressly assigned to either exclusive federal or provincial jurisdiction under the Constitution Act 1987. As a result, until August of last year, jurisdiction over the major telecommunications carriers in Canada was shared between the federal government and the governments of the provinces depending on whether a carrier



operated exclusively within one province, or was either declared to be a federal undertaking in its incorporating statute or was operating beyond the limits of one province.

Thus, of the major telecommunications carriers, only Bell Canada (Bell), British Columbia Telephone Company (BCTel), Northwestel Inc., CNCP Telecommunications (CNCP), Telesat Canada (Telesat) and Teleglobe Canada were regulated by a federally empowered independent tribunal, the Canadian Radio-television and Telecommunications Commission (CRTC, the Commission). These companies represented together some 70% of the Canadian telephone industry, measured in terms of revenues, assets or numbers of network access services.

The other 30% of the telephone industry in Canada was under provincial jurisdiction and included the telephone companies serving Alberta, Manitoba, Saskatchewan and the four Atlantic provinces. They were regulated provincially, generally by a provincial utilities commission or board and, in the case of Saskatchewan, by the provincial government directly. All three prairie telephone companies are, moreover, the property of the Crown in right of the relevant province. In addition, there were some 100 independent telephone companies situated mainly in Ontario and Quebec and generally regulated by provincial boards in those provinces.

The regulation of telecommunications in Canada, whether federal or provincial, has followed a similar approach which is dictated largely by the fact that most of the services of the carriers are offered on a monopoly basis. The aim of regulation in a monopoly situation is to ensure, in the absence of the interplay of the usual market forces, that the interests of the shareholders are balanced against those of the subscribers of a carrier. In this context, it is the duty of the regulator to ensure that rates for the carrier's services are just and reasonable and non-discriminatory. For this purpose, all rates must be filed with, and approved by, the regulator. In addition, the regulator is required to approve all contracts or arrangements among carriers for interconnection and related matters affecting their respective systems and is empowered to order interconnection among carriers upon such terms and conditions as it deems just and expedient. The regulator must also prescribe generally applicable terms and conditions under which services are to be provided including the basic rights and obligations of the carrier in providing service.

Despite the existence of individual monopolies in each area across Canada, significant differences in regulatory approach did not arise. In fact, the major result of the approach taken over the years by the carriers, and endorsed by the regulators, was the attainment of universal service with a penetration level for Canada as a whole of 98.5% in 1987. Customers did not have any appreciable choice in the kind of service they received but they did have service, virtually everywhere in Canada.

Technology innovation and events in the United States in the 1970s led to pressures for change, particularly the introduction of competition in the provision of telecommunications services. There had been a measure of competition in Canada prior to the 1970s, provided by the predecessor companies of CNCP, but mostly in the data field and on a non-interconnected basis.

Beginning in the late 1970s, competition has gradually been introduced in Canada at the federal level. As a result, at the federal level, competition is now permitted in all telecommunications markets except facilities-based public local voice, public long distance

voice and pay telephone service. As a consequence, CNCP (in the public data and private line voice market), terminal equipment suppliers, enhanced service providers, radio common carriers, cellular radio companies, resellers and sharers and local facilities providers of data and private line voice service can compete with Bell and BCTel in Ontario, Quebec and British Columbia. In the provinces, however, competition in these markets either does not exist or exists on a much more restricted basis.

The market in Canada is relatively very small (1/10 of the U.S. and 1/2 of the U.K. markets). Thus competitive suppliers of telecom services and equipment, who have had to deal with at least eight regulatory agencies in order to reach the starting line of competition on a national basis, have been frustrated in their efforts to gain the market size and momentum they need in Canada to succeed. At the same time, from the standpoint of business users and consumers, the choice of services and equipment available in the prairie and Atlantic provinces had been appreciably more limited than in Ontario, Quebec and British Columbia.

Apart from the situation arising out of the introduction of competition in Canada, the carriers have, to a large degree, achieved for themselves what divided jurisdiction has impeded. They have done so by banding together under the aegis of Telecom Canada to share the expenses and revenues related to the construction, maintenance and operation of a network capable of offering the growing panoply of local, interprovincial and international telecommunications services that Canadians have come to expect. Telecom Canada is not a legal entity and is therefore not regulated as such. It is a consortium of the major domestic carriers except CNCP and Teleglobe. Its members are bound by contractual and commercial arrangements which permit the integrated provision of services across jurisdictional boundaries.

## 10.2 RECENT REGULATORY EVENTS

The Canadian telecommunications regulatory landscape is undergoing significant changes of importance to telecommunications users. Recent regulatory events provide an indication of the significance and importance of these changes.

### 10.2.1 The Supreme Court of Canada Decision

On 14 August 1989, the Supreme Court of Canada ruled that Alberta Government Telephones (AGT), heretofore regulated provincially as the local telephone undertaking serving Alberta, is an interprovincial undertaking extending beyond Alberta and is therefore subject to federal jurisdiction. As such, ruled the Supreme Court, AGT would be subject to CRTC regulation but for the fact that, as an agency of the Crown in right of a province, it is not bound by the Railway Act as currently enacted.

Ironically, the Supreme Court's characterization of AGT as an interprovincial undertaking was based, in large part, on the fact that, through its participation in Telecom Canada, AGT plays a crucial role in the national telecommunications system and provides its local subscribers with interprovincial and international services. The consequence of this reliance on AGT's participation in Telecom Canada as the ground for federal jurisdiction is to bring all the other members of Telecom Canada previously regulated provincially within the federal regulatory

net. The four Atlantic telephone companies have already filed their tariffs with the CRTC thus acknowledging that they are subject to federal jurisdiction. A minor, though politically charged, amendment of the Railway Act has already been given first reading in Parliament with a view to bringing the prairie telephone companies under CRTC's regulatory jurisdiction.

#### 10.2.2 The Growing Participation of Rogers Communications Inc.

The CRTC has a dual mandate. It regulates telecommunications under the Railway Act and broadcasting, including cable television systems, under the Broadcasting Act.

Most populated areas of Canada have available to them two separate infrastructures for the delivery of communications services: a twisted copper pair system for the delivery of voice and data communications and a coaxial cable system for the delivery of programming services, which now comprise predominantly broadcast programming. The two systems may share the same poles or underground conduits for the delivery of their services but each infrastructure has its own configuration or architecture suited to the purpose for which it was intended. With advances in technology, particularly increasing digitization and the use of optical fibre, the underlying facilities used to deliver telecommunications and broadcasting services are in the process of converging.

The convergence between telecommunications and broadcasting is reflected at the corporate level in the growing participation of Rogers Communications Inc. (Rogers) in the telecommunications industry. Rogers is the largest player in the cable industry. Its subscriber base represents more than one third of cabled households in Canada. Rogers also owns Cantel Inc., the company licensed by the Department of Communications (DOC) to provide cellular radio service across Canada in competition with Telecom Canada members who are licensed to provide cellular service in the province or territory in which they provide telephone services. In the past year, Rogers has acquired a 40% interest in CNCP, which had announced its intention to apply to the CRTC for entry into the public long distance telephone market.

#### 10.2.3 Bell's Intervention in the Rogers Rates Hearing

As a consequence of convergence, both the telephone companies and major cable companies, such as Rogers, are deploying optical fibre for the purpose of upgrading and modernizing their systems. Fibre to the home or office will enable both to provide the same kinds of service - video, text and data - to customers both residential and business. While fibre to the home is a phenomenon unlikely to be significantly widespread until the first decade of the next century, investments in fibre plant are needed now by both cable and telephone company protagonists in order to prepare for the future.

After selling its cable assets in the United States, Rogers announced plans to invest some \$500 million in cable plant over the next few years. Under the current CRTC regulations applicable to cable companies, expenditures for upgrading and modernizing cable plant can be passed on to subscribers in the form of increased cable rates. Rogers gave formal notice to the CRTC of its planned capital plant expenditure increases early last year which, on the basis of the CRTC regulations, would have taken effect on September 1. In a precedent-

setting initiative, the Commission suspended the increases, and called Rogers to a hearing on November 21 to enquire into whether the proposed expenditures "related to more than the reception, processing or distribution of the basic (cable) service". This proceeding was in the nature of the construction program review to which Bell is subjected each year by the CRTC. Essentially what is in issue in such proceedings is whether subscribers of a company's monopoly services are going to benefit from the expenditures proposed to be made by the regulated company.

Bell intervened in the Rogers proceeding questioning whether the expenditures proposed were to be used by Rogers to facilitate its participation in the provision of telecommunications services in competition with Bell and noting that, if so, Rogers' monopoly cable subscribers would be cross-subsidizing such competitive activity by Rogers. Bell pointed out that the CRTC rigorously scrutinized potential cross-subsidy activity by the telephone companies subject to its jurisdiction and has adopted elaborate cost separation methodologies to detect and prevent cross-subsidy activity in telecommunications. Similar regulatory treatment should be imposed on Rogers if it is to be permitted to provide telecommunications services.

A further hearing scheduled by the CRTC is to take place in February of next year at which time it will reconsider the regulatory regime it instituted in 1986 relating to cable company rates. This hearing will also consider a proposed change in the treatment of capital expenditures and the institution of a cost separation methodology to prevent the cross-subsidy of unregulated, largely competitive non-programming services, including telecommunication services, by regulated, monopoly provided programming services.

#### 10.2.4 An Assessment of Recent Events

In so far as the AGT case is concerned, if the federal government proceeds, on the basis of that case, to assert federal regulatory jurisdiction over all Telecom Canada members, it is expected that the level of competition that now exists at the federal level in Canada, that is, in British Columbia, Ontario and Quebec, will be extended to the other provinces. There might be some regional variations in the application of some aspects of the federal competitive regime by the CRTC but such variations would depend on the presentation of convincing arguments in their support. The CRTC has been responsive to regional differences, for example, refusing to permit BCRail Ltd. (BCRail) to provide interconnected public data and private line voice service in the part of northern British Columbia served by Northwestel Inc. and instituting a considerably less costly and complex costing system for smaller federally regulated companies, such as Northwestel Inc.

It must be stressed that the extension of the presently-existing federal competitive regulatory regime across the country, as envisaged above, is dependent on the assertion by the federal government of federal regulatory authority over all members of Telecom Canada. This is the publicly-stated position of the Minister of Communications at this time. If, however, some other approach to telecommunications regulation were to be taken, in which the provinces would continue to play an important regulatory role similar to that played by them prior to the AGT decision, continued balkanization of regulatory approaches would have to be envisaged. The outcome of the political process that will determine this question is still unknown although there are significant indications that the federal government intends to continue to assert and implement unitary federal jurisdiction.



With regard to the public long distance voice market and the significance of Rogers' acquisition of an interest in CNCP, the CRTC has thus far refused to permit competition either in the context of a facilities-based proposal made by CNCP in 1984 or in the context of resale and sharing. CNCP's proposal was turned down in a decision in 1985 for a variety of complex, interrelated reasons, including the viability of its business plan, while the CRTC has consistently refused to permit any form of resale and sharing that would erode revenues derived from the message toll service (MTS) market. A proceeding currently under way is examining whether the rules applying to resellers should be relaxed to enable some entry into the MTS market but entry into the WATS (wide area telephone service) market is specifically excluded from the scope of the proceeding.

CNCP's 1984 application to enter the public long distance voice market was not perceived to have been a strong one. Rogers much-publicized purchase of a substantial interest in CNCP, coupled with Ted Rogers' personal, publicly-stated commitment to enter the long distance market and Rogers' long history of success in winning CRTC approval of ground breaking and far reaching proposals in the field of broadcasting, are widely considered to bring considerable strength and regulatory savvy to CNCP. This should significantly enhance the possibility that CNCP will succeed in obtaining CRTC approval for its announced, but not yet filed, further application to enter the market.

It is too soon to assess the likelihood of CNCP being permitted to enter the public long distance voice market. While the outcome of the AGT case may enable an application to be made to the CRTC for entry into a Canada-wide MTS/WATS market, it is not clear whether or not this would put CNCP in a more favourable position. And generally, in so far as the regulatory process is concerned, CNCP's chances of success will depend almost entirely on the strength of the case it presents to the CRTC, the strength of the case made by those who oppose its entry and the degree to which, in consequence, the CRTC is satisfied with regard to the many complex and interrelated matters that it gave as the reasons for its previous refusal.

With regard to the issue of convergence, the recent regulatory initiatives of the CRTC have been outlined above. This issue has also been the subject of strategic initiatives at the DOC, one short term and the other longer term in nature. In the short term, the Department envisages two rules that would apply to cable companies:

1. No cross-subsidy between monopoly programming services and non-programming or telecommunications services; and
2. Access on a non-discriminatory basis by telecommunications service suppliers to the cable companies' infrastructure.

The purpose of these rules would be to establish a minimal level playing field between cable companies and the telephone companies. The Minister has stated his intention to include provisions setting out these rules in the new telecommunications bill which is currently in the process of being drafted.

The Department's longer term strategy involves a public consultation process that was initiated by a Canada Gazette notice in September 1989. In this notice, the Department has taken an initial position favouring a competitive environment for locally distributed services.

In this context, the Department has stated its support of local duopolies for this competitive service "unless it can be shown that such duopolies would result in economic hardship for the service providers or service users". Submissions on the issues raised in the notice are to be made to the Department by January 1, 1990 and comments on the submissions are required by February 28.

Notwithstanding the Department's initial position favouring the duopoly provision of locally distributed services it is much too early to be confident that this will emerge as the final policy position of the federal government. There are too many variables that will be in play in the decade or more before significant competition will be possible at the local level, including particularly economic, commercial and political considerations. There will be considerable sound and fury surrounding this issue over the years before a policy position is established. Business users of telecommunications services should maintain a continuing surveillance of the evolution of this issue particularly in the middle and latter years of the 1990s.

### 10.3 RELEVANCE TO THIS STUDY

The purpose of this section of the paper is to identify the potential effects of the changing regulatory scene on the Network and to draw some preliminary assumptions.

#### 10.3.1 Issues Related to Jurisdiction

From the perspective of the Network Study, specific jurisdictional issues related to recent regulatory events directly impact Study assumptions in the following areas: Terminal Interconnection, Network Interconnection and Resale and Sharing.

##### Terminal Interconnection

Regulatory bodies have permitted the attachment of customer-provided terminal equipment, including private branch exchanges (PBXs), to the facilities of all companies except Saskatchewan Telecommunications, Manitoba Telephone System and Newfoundland Telephone Co. Ltd. These latter companies, however, permit attachment of residence extension sets and network non-addressing devices. In Nova Scotia, terminal equipment activities except in respect of single-line rental sets have been removed from the telephone company's rate base and revenue requirement. The Newfoundland public utilities board was in the process of conducting an extensive terminal attachment proceeding at the time of the AGT decision. The proceeding was suspended and business user groups have announced their intention to apply to the CRTC for open terminal attachment in that province. Similar regulatory action before the CRTC relating to Manitoba and Saskatchewan will likely occur if the federal government proceeds with a unitary federal regulatory regime.

From the Network Study's perspective, terminal attachment translates into user ability to lease or purchase the most modern terminal systems available irrespective of the nature of the network to which it is attached i.e. public or private. These systems would include both user

terminals as well as customer premise channel deriving equipment. Terminal attachment also translates into lower terminal system costs for both lease and buy options. Cost estimates required as part of the Study's economic analysis should assume a competitive terminal attachment scenario in all jurisdictions.

### Network Interconnection

CNCP, Telesat and BCRail have been permitted by the CRTC to interconnect to Bell and BCTel (BCTel only for BCRail) to provide public data and private line voice service in competition with those companies. The issue does not encompass interconnection for the purpose of providing public interexchange voice services.

Further extension of network interconnection to other telephone companies across the country will likely occur if there is a unitary federal regulatory regime. From the Study's perspective, it be assumed that public data services currently available in federal jurisdictions on a competitive basis, to be available in all Telecom Canada jurisdictions within the next few years.

Historically, carriers such as CNCP have been at a serious disadvantage vis a vis their Telecom Canada rivals due to the company's inability to interconnect to the public networks in the Prairies and Atlantic Canada. As a result, companies such as CNCP would most likely be more efficient competitors under the interconnection scenario. The probable impact on the Study results of the network interconnection assumption will be a reduction in long run network costs for services and facilities.

### Resale and Sharing

Resale and sharing to provide non-MTS/WATS services, including resale and sharing to provide primary exchange voice service, except public pay telephone service, has been permitted by the CRTC in the servicing areas of Bell, BCTel and Northwestel. In addition, resale of MTS to provide MTS is also permitted by the CRTC, and by certain provincial authorities for hotels and specialty network-connected mobile radio services. The facilities and services of CNCP and Telesat Canada may also be shared and resold, as appropriate, throughout the country.

The issue of resale and sharing could have some impact on Study recommendations related to the Network's corporate structure and billing arrangements. The Study should assume that resale and sharing for the purposes noted above will be permitted throughout the country. As a result, the study's economic and implementation analysis will need to consider current tariffs on resale and sharing in order to establish whether a sharing or resale arrangement would be permitted for the Network and if so, the resulting benefits, if any. A proceeding currently underway at the CRTC may further relax the rules related to the resale and sharing of MTS as noted in the previous section 3 of the paper.



### 10.3.2 Issues Related to Competition

As noted earlier, the CRTC turned down CNCP's 1984 application to provide public interexchange voice service. The reasons for this refusal are identified in Interexchange Competition and Related Issues, Telecom Decision CRTC 85-19 (85-19).

In 85-19, the Commission indicated that it did not oppose competition per se finding that benefits such as lower interexchange rates, greater customer choice and supplier responsiveness and faster diffusion of new technology, would probably accrue from competition in the public interexchange voice market. Further, the Commission pointed out that lower interexchange rates would result in increased productivity and reduced costs which would have a positive impact on the whole Canadian economy.

However, according to the Commission, the 1984 CNCP application would not result in the benefits cited above. In fact, the Commission pointed out that approval of that application could have threatened universality of service. The Commission felt that this threat was real in that the telcos would no longer be able to maintain low primary exchange service rates. Further, in the Commission's view, CNCP would be able to offer only limited price discounts and serve only a limited number of routes. Consequently the CRTC concluded that:

- i) Benefits such as increased customer choice and supplier responsiveness would be available only to those interexchange subscribers along CNCP's chosen routes.
- ii) Those routes not subject to competition would probably have a lower quality of service than they now enjoy.
- iii) Competitive pricing on routes selected for entry by CNCP would mean that pricing on other routes serviced by the telcos would be subject to price increase pressures.
- iv) CNCP's entry would actually mean increased reliance on regulatory intervention.
- v) Price discounts would not be available to customers on a ubiquitous basis throughout the territory; therefore any positive impact on the Canadian economy, resulting from competition in this market, would be reduced.

The above summarizes the Commission's position in 1985. A further report on the subject of interexchange competition was published three years later. In December 1988, the Federal-Provincial-Territorial Task Force on Competition in Public Long Distance Service in Canada published a report prepared at the request of federal, provincial and territorial Ministers responsible for communication. The Task Force included representatives from the CRTC, and from telecommunications bodies and/or governments of all provinces and territories. Notwithstanding that the report has been severely criticised in some quarters, it does provide some information and analysis of a broad range of issues involved in determining the desirability of long distance competition.

The Ministers identified the maintenance of universal availability of affordable telephone service as a major policy issue in the Task Force's terms of reference. In its analysis of interexchange competition the Task Force noted that lower interexchange rates would force local rate increases in order to compensate for reduced interexchange contribution to subscriber access costs. The Task Force identified a number of approaches which could be used to ensure the continuance of universality of services. These approaches included:

- **Carrier Contribution Charges.** To maintain low local rates, competing carriers could be required to contribute through explicit charges set by regulators.
- **Obligation to Serve.** If regulators obligated telephone companies to continue providing services in low-density, high-cost areas, these carriers could be compensated for such an obligation through additional contribution payments from competitors.
- **Pricing Mechanisms to Minimize Adverse Effects on Users.** To compensate for increases in local telephone service, mechanisms such as lifeline services, budget services and local measured service could be used. Lifeline services would provide local service to low-income households on a subsidized basis. Low-cost budget services such as multi-party service would enable those affected by higher local rates to retain some basic service. Local measured service is an option in which subscribers are charged for each local call. In this way, users can control local services charges by choosing the number of calls they make.

The Task Force Report suggests that when and if competition in the interexchange voice market occurs in Canada, some form of regulated pricing will probably be enforced in order to minimise the impact on local service rates.

Current DOC policy statements as well as increasing activity by potential entrants in the lucrative MTS market suggest that some form of competition in the interexchange voice market is likely to occur. From the Study's perspective, some form of competition in the interexchange voice market should be assumed.

As noted earlier in the paper, the advent of competition in the public interexchange voice market will most likely impact the availability of competitively priced broadband data services and facilities to the extent that competition influences the development of national competing fibre networks. Although the development of more than two competing national fibre networks is not foreseen, competition should nonetheless apply downward pressure on prices in the broadband data market by reducing the market power of today's dominant carriers. As a result it is expected that the competition assumption will significantly impact the projected costs developed by the Study for broadband data services and facilities in the future. The extent to which prices would be reduced in a regulated competition scenario is difficult to assess. The Study's economic analysis will have to deal with this matter.

Other more general effects of the competition assumption on Study results, such as the possibility of increased R&D activity in the telecommunications sector, are left for discussion in the report on user needs and requirements.

#### 10.4 REGULATORY ISSUES IN CONNECTION WITH IMPLEMENTATION

Implementation of the proposed research and development communications network (the "Network") will require the leasing of services and facilities, especially T1 Megaroute channels, required to link the Network and its subnetworks with the public switched network. Such services and facilities will be leased from the members of Telecom Canada and/or CP Telecommunications ("CNCPT"). The cost of these services and facilities will represent a large proportion of the expenses of operating the Network. Important savings could thus be achieved by the Network if the required services and facilities were made available by the carriers at special or reduced rates, or at cost, in recognition of the Network's special research and development role and function.

Since the services and facilities offered by the regulated carriers are required by law to be offered at tariffed rates, any departure from the tariffs approved for them raises regulatory issues. These issues will be reviewed briefly. A number of possible options that could be pursued with regulated companies and the regulator to meet the Network's requirements will then be examined. A preliminary assessment of their likely success will also be made.

This analysis will be made in the context of regulation by the federal regulator, the Canadian Radio-television and Telecommunications Commission ("CRTC", the "Commission"), pursuant to the Railway Act (the "Act") since the Commission regulates Telesat Canada, the satellite carrier, CNCPT and all the terrestrial carriers who are members of Telecom Canada, except those who provide telephone service in the three Prairie provinces.

The Act requires that all rates to be charged by a carrier for the provision of services and facilities be filed with, and approved by, the CRTC. The Act also requires that such rates be just and reasonable and be charged equally to all persons, under substantially similar circumstances and conditions. It prohibits a carrier from engaging in unjust discrimination against any person or company or from subjecting any person or company or any particular description of traffic to undue or unreasonable prejudice or disadvantage. It also prohibits a carrier from according any undue or unreasonable preference or advantage to any person or company or any particular description of traffic.

These legislative provisions have been interpreted by the Commission, in approving rates for competitive and optional services and facilities, as requiring that all such rates not only be compensatory, but also make a profit (termed "contribution" in the industry) and that they be charged to all persons equally for the same services and facilities supplied in similar circumstances. This approach has not foreclosed certain variations in the tariffs, such as those based on volume discounts. The test of the acceptability of such variations has been largely whether they are made available to any party who meets the eligibility norms established for them in the relevant tariff.

##### 10.4.1 Special Facilities Tariffs

The requirements of the Act have not precluded the approval of rates for services and facilities which are customer-specific or designed for unique needs. The resulting tariffs are referred to as Special Assembly or Special Facilities Tariffs ("SFT"). They are approved using much the same criteria as those used to approve general tariffs although, by definition, the

rates established are customer-specific.

The threshold question whether a party can rely on a SFT is the extent to which his requirements cannot be accommodated by generally applicable tariffed services and facilities. In some cases, questions are raised by the Commission whether the configuration of the facilities and services characterized as special assembly, if broken into its constituent components, could not be in fact tariffed in the normal course.

The level of the rates involved in SFT are determined on the basis of costing information. The tests employed for competitive and optional services and facilities as to whether the rates are compensatory and make a contribution are used.

It may be possible to argue with success that what is proposed by the Network is the use of underlying facilities and services in a unique technical configuration and for a unique purpose. It may be difficult however to make a convincing case. The Network itself may be unique but it may not be easy to demonstrate to the Commission that the services and facilities of the carriers necessary to link its components or interconnect it with the public switched network are unique, especially if such services and facilities are already included in the carriers' general tariffs. Secondly, the level of SFT rates are determined, like tariffs for competitive and optional services and facilities, by reference to whether they are compensatory and make a contribution. The Commission will not easily depart from applying those tests in setting SFT rates, for the reasons discussed earlier.

#### 10.4.2 Trials

The Commission has authorized the carriers to carry on technology or market trials of new applications of technology or of proposed new services or facilities, without establishing tariffed rates for them in the normal course. Usually, tracking information with respect to the revenues and costs associated with the trial must be filed while it is conducted, in order to allow the Commission to monitor whether the related losses, if any, may have an impact on the revenue requirement of the carrier, with a consequent effect on the rates charged by the carrier for other services.

Technology or market trials, by definition, are authorized for a limited period. They generally last one or two years. At the end of the authorized period, the proposed innovation or the proposed new service is abandoned by the carrier or is tariffed as a permanent service offering or a part thereof. Alternatively, an extension of the trial period may be granted.

It may be possible to argue that the network's proposal constitutes a technology trial in that it represents a new configuration of telecommunications resources for a new and unique function never served before. On that basis, the carrier and the Network could request that the necessary underlying facilities be made available at cost or at a discount.

There are two important regulatory problems with this approach. First, market or technology trials have been 'in-house' trials. They are considered necessary by the regulator to foster innovation, encourage the development of new technology and avoid the full-scale introduction of services without testing them adequately first. They are arguably carried on for the indirect benefit of the general body of subscribers and, as such, to be encouraged.



These considerations are not valid in the case of the Network, despite the broad social implications inherent in its stated goal. The Commission might, however, be able to be convinced that a novel approach to non-commercial trials is warranted in the circumstances of this case and that it is authorized by the Act. It may be easier to make a convincing case if the carrier itself plans to use the Network to test new technologies and standards.

A second problem is the fact that a trial implies a term at the end of which either the trial terminates or the offering becomes an item in the carrier's general tariff. This problem may be insurmountable.

#### 10.4.3 Treatment of the Network as a Charity

It may be possible to constitute the Network as a non-profit organization and to have it claim charitable status with Revenue Canada as a non-commercial organization devoted to educational and research goals. The carriers may then be convinced to make donations to the Network for which they would be eligible for a tax credit, while tariffed rates are charged for the services and facilities leased from them by the Network. This approach would not require Commission approval. The Commission does not scrutinize the corporate donation policies of the carriers under its jurisdiction.

#### 10.4.4 Experimental or Special Use Tariffs

The requirements of the Act with regard to the setting of rates on an equitable basis to all persons (set out more fully above) are not absolute. The Commission has some discretion in assessing whether a discount from tariffed rates for certain purposes is justifiable under the Act.

A fairly recent example of discounts authorized for certain purposes are the discount rates authorized by the Commission in 1985 for RF Channels leased from Telesat Canada.

In the early 1980's, pursuant to its broadcasting jurisdiction, the Commission licensed a number of satellite-to-cable programming services. Telesat Canada had available channels on its 6/4 GHz and 14/12 GHz satellites but most of the fledgling programming services could ill afford the rates charged for them in their early years of operation. The Commission approved an application from Telesat Canada for a revision of its tariffs so as to permit, for a period of two years, the leasing of partial RF channels or whole unprotected preemptible RF channels, at discount rates, for experimental purposes. Telesat stated as its objective the encouragement of the development of new satellite telecommunications services, thereby increasing space segment utilization. The program was referred to as an experimental services program. It was renewed for a further similar period at its expiry.

The experimental program authorized by the Commission had the stated aim of benefiting the carrier rather than according preferential treatment to particular users. However, in practice, the benefits of the discount would obviously accrue only to a certain narrow class of users, if not to predetermined parties. Nevertheless, the discount was theoretically applicable to any party who could satisfy certain criteria. Those criteria were set out in the tariff and were based largely on the requirement that the user's service be 'new'.

Another example of a special use tariff was a special discount rate negotiated between TV Ontario ("TVO"), the educational television authority in Ontario, and Telesat Canada in the early days of TVO's development. This approach may have interesting potential for the Network. The Commission may be prepared to authorize discounted rates for research and development purposes, on an experimental basis, although this could well be possible only for a limited period.

The Commission may also be open to discuss special discounts on a continuing basis for facilities and services used for research and development as defined in a tariff. Eligibility for the discount could be spelled out in the tariff. Although, in practice, no other party but the Network may be in a position to satisfy the criteria established, the exception would remain, in theory, generally available. There are of course many arguments to be advanced to support the contention that discounts to foster research and development do not constitute unjust discrimination or undue or unreasonable preference or advantage within the meaning of the Act. They range from promotion of the development and introduction of new telecommunications technologies and standards to improvement of research and development at large.

## 11.0 RECOMMENDATIONS

1. The ISTCnet concept should be implemented quickly.
2. There should be only one national R&D data communications initiative.
3. The fee to the users should be no higher than present initiatives. Fees should be independent of geographic location and distance. Fees should be independent of data volume (fixed). Fees should be structured such that there are low cost methods of access; cost should not be a barrier to entry.
4. The network should move as quickly as practical to ISO standards.
5. The network should use a wide variety of Canadian products to the extent possible.
6. The network should promote the widest possible participation by industry, government, and the academic community.
7. The network should promote the development of next generation network technologies and services.
8. The network should use commercially available carrier offerings to the extent possible. The network should promote the development of commercial communication services by the carriers as public offerings where they have been shown to be commercially viable on the Network.
9. The network should constantly evolve to higher capacity and higher functionality, while maintaining conformance to international standards, so that it maintains a position at the leading edge of similar international networks.





GLOSSARY
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CCITT	Comite Consultatif International Télégraphique et Téléphonique.
CANET	Canadian network initiated and organized by NRC, formerly called NRCNET.
CDNnet	Canadian network based at University of British Columbia - started as NSERC - supported research project to implement EAN software.
CERN	Centre European des Recherches Nucleaires.
CRTC	The Canadian Radio-television and Telecommunications Commission. The agency responsible for regulation of the broadcast industries in Canada and the federally incorporated telecommunications common carriers.
DEC	Digital Equipment Corporation
DECnet	A proprietary network for Digital Equipment Computers.
EAN	Software package implementing ISO X400 service; in Europe a network which uses this software.
GARR	Gruppo Armonizzazione delle Reti per la Ricerca.
IBM	International Business Machines.
ISDN	Integrated Services Digital Network. A fundamental feature of ISDN is the use of "out-of-band" signalling, signalling that is transmitted independently and simultaneously with communications traffic.
ISO	International Organization for Standardization; responsible for publishing the Open Systems Interconnection Reference Model.
kb	Kilobyte: 1 kb = 1024 bytes (accurately), a thousand bytes (colloquially). Also used as an abbreviation for kilo-baud.
Mb	Megabyte: 1 Mb = 1,045,576 bytes (accurately, 1024 x 1024), one million bytes (colloquially, and more

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	usually).
<b>NACISIS</b>	National Centre for Science Information Systems (JAPAN).
<b>NJE</b>	IBM communications protocol "Network Job Entry".
<b>NREN</b>	National Research Education Network.
<b>OSI</b>	Open Systems Interconnection. A model of communicating processes established for use in the definition of inter-machine protocols.
<b>PDN</b>	Packet Data Network.
<b>PSTN</b>	Public Switched Telephone Network
<b>RARE</b>	Réseaux Associés pour la recherche Européenne
<b>SNA</b>	Synchronous Network Architecture
<b>TCP/IP</b>	Transmission Control Protocol/Internet Protocol
<b>T1 Carrier</b>	A designation of a transmission circuit, referring to its capacity. T1 Carrier has a bandwidth of 1.544 Mbps and T3 Carriers operate at 45 Mbps.
<b>UBC</b>	University of British Columbia.
<b>VENUS</b>	European High-Speed Networking Initiative.
<b>X.25</b>	A commercial packet network access protocol that specifies three levels of connections. The X.25 physical level, link level, and packet level correspond to the first three layers of the ISO/OSI model.
<b>X.400</b>	CCITT standard message handling service

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