1. Canada. Dept. of Communications

THE DOC RESEARCH PROGRAM: MEETING THE INFORMATION TECHNOLOGY CHALLENGE

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THE DOC RESEARCH PROGRAM:
MEETING THE INFORMATION TECHNOLOGY CHALLENGE

INTRODUCTION

In the past decade, the development of faster, cheaper and more powerful microelectronic devices, higher capacity transmission media and sophisticated software has given rise to an extraordinary family of new products and services for creating, processing, storing, accessing and displaying information. This family of electronic techniques is referred to as information technology. In the judgement of the Science Council and many other observors, it will transform our society by the end of the century. These products and services are tied together by communications technology, the central nervous system of the information society. Taken together, these products, systems and services represent a new communications infrastructure, which will play as vital a role in our future economic and social development as rivers, canals, railways, highways and air links did in the past.

The rapid advancement of information technology based services has facilitated the use of increased amounts of information in new forms and for new purposes. It has transformed the way in which business is conducted and is becoming a strategic tool in the increasingly competitive international marketplace. These technologies are also playing an important role in the delivery of essential social services such as health care and education, and in the growth of our cultural industries. So pervasive is information technology that it is becoming a pre-requisite for the creation of an economic, social, cultural and educational environment favourable to innovation and growth. **There is a clear consensus among the senior decision-makers in the private and public sectors that Canada's social and economic future will depend in no small measure on our ability to develop technological know-how in communications and information technology and to translate this know-how into marketable products and services.**

51 pages

Canadians' ability to develop and apply this know-how is directly related to the level and quality of the basic and applied research and development efforts in Canadian industry, universities, and governments. When it was created in 1969, the Department of Communications was given a mandate to ensure the orderly development of communications in Canada, on the basis of a research effort that was adequate to the national need. Recognizing the importance of adopting a communications and information technology strategy, in June 1987 Cabinet instructed DOC to put in place a research program appropriate for the needs and aspirations of Canada as we move toward the information age.

In response to this directive, the Department of Communications has re-oriented its research program toward this new national goal. This paper describes initiatives that are being put in place immediately to meet Canada's need for communications and information technology research. It also analyses existing and potential relationships between these research initiatives and industrial, university and provincial research in this area, and identifies the resources that will be needed to fully implement this plan.

NEED FOR GOVERNMENT ACTION IN INFORMATION TECHNOLOGY R&D

Although Canada's overall R&D effort is weak, the communications and computer sector appears to be an exception. The communications industries account for about 30% of total industrial R&D expenditures. However, this is largely due to Bell Canada Enterprises (BCE) which spent some $623 million on R&D in 1986. BCE was by far Canada's largest R&D spender accounting for 22% of all annual R&D expenditure by Canada's private sector.

TABLE 1

Major Canadian Communications and Computer R&D Spenders

	1986 $ million
Bell Canada Enterprises	623.0
IBM Canada	89.0 (1985)
Mitel	51.8 (1985)
DOC Research Program	**44.0**
B.C. Telephone	27.5
Control Data Canada	25.0
Gandalf Technologies	13.1
Spar Aerospace	12.0
ITT Canada	8.4
Cognos	6.8

Source: Financial Post, October 25, 1986 and DOC ADMTT Management and Plans Branch

It is abundantly evident that apart from the handful of major companies identified in Table 1 above, the vast majority of firms are too small to mount sustained R&D efforts. Furthermore, the overwhelming presence of Bell Canada Enterprises means that Canada's information technology R&D efforts are concentrated on the needs of the telephone industry. As a result, Canada's R&D effort in other dimensions of information technology has been significantly below those of our major trading partners. In view of these factors, a 1986 report by **the Canadian Advanced Technology Association (CATA) concluded that there is a disproportionate requirement in Canada for government laboratories to develop and maintain the knowledge base needed to keep Canada's small and medium sized industries current with rapid technological advances.**[1]

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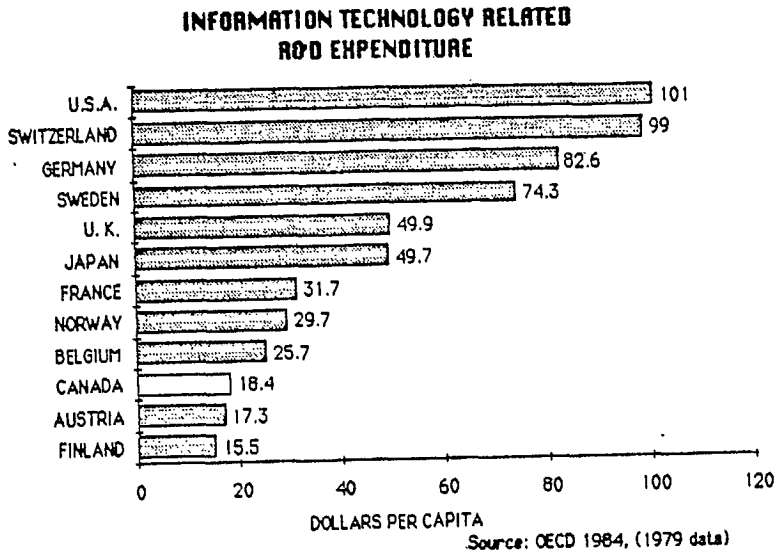
[1]The Canadian Advanced Technology Association, The Report of the National Technology Policy Roundtable, (September, 1986), p. 22.

Figure 1



The need to increase Canadian research effort is confirmed by a 1984 OECD report which ranked Canada 10th in terms of per capita expenditures for research and development in information technology related areas, behind all of our major trading partners. According to the available data, we spend about $20 per capita on R&D in information technology, compared to $100 in the U.S. and $50 in Japan. We are the only major industrialized nation without a national information technology strategy. The low level of R&D effort in Canada and the overriding importance of information technology for social and economic growth, drove Cabinet to the conclusion that it was necessary to consider developing a national communications and information technology R&D program equivalent in scope and scale to the programs adopted by other advanced industrial nations and consistent with Canadian needs and capabilities.

Research at Canadian universities could also contribute significantly to the development of the knowledge base which will ultimately lead to commercialization of new product ideas. A number of Canada's universities are already major communications and information technology R&D performers. A good example of Canadian accomplishments in this area is the University of Waterloo which is recognized world wide for its achievements in computer software engineering and networking. However, despite the excellent technological strengths in many of Canada's universities, their capabilities remain under-utilized. In its recent policy statement, The Information Technology Association of Canada (ITAC) emphasized the need to increase collaboration between industry and universities. It concluded that "Government funding to improve university and industry research collaboration is specifically required to offset overhead and infrastructure costs."[1] **Measures must be put in place to better exploit this valuable national resource so that expertise at Canadian universities could be put to use to advance innovation and to resolve technology problems in the user industries.**

It is evident that Canada has the ingredients for a solid R&D capability in communication and information technology. While it would be unrealistic to think that our national effort could be multiplied two, three or five times in order to match the dollars spent per capita by the other major OECD countries, it is clear that the research efforts of industry, universities and governments must be better focused and applied to meet Canadian needs. Governments in all other advanced industrial countries have put in place strategies to achieve this linkage.

WHY THE DOC?

The DOC Research Program is the fourth largest body of communications and information technology R&D expertise in Canada. These R&D activities are carried out in two research centres:

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[1]The Information Technology Association of Canada, Canada's Comperative Advantage: Science, Technology and Education Policies in the Information Age, p. 12.

- **The Communications Research Centre (CRC)** near Ottawa; and
- **The Canadian Workplace Automation Research Centre (CWARC)** near Montreal.

Traditionally, the main objective of the DOC research program has been to support the Department's statutory mandate for telecommunications policy, international spectrum allocation, standards negotiations and cultural industries development. In pursuing this objective, the program has evolved two specific roles which position it to take on the more general objective of catalysing a national information technology R&D effort:

- **First, as an important source of longer-term research, it is a key intermediary in the R&D spectrum between university and industry research. Most industrialized countries have deployed their government laboratories in this strategic role.**

- **Second, the program has an important role in monitoring technological developments in other countries and in disseminating information about these developments to public policy-makers, industry and university researchers.**

DOC's laboratories have achieved an enviable reputation for the excellence of their work in communications technology research and related applications.

- Pioneering work at the Communications Research Centre in the early 1960s led Canada to become the third country (after the Soviet Union and the United States) to venture into space and the first country to establish a domestic geostationary satellite system in 1972. Its achievements in the development of direct to home satellite broadcasting technology has drawn international acclaim;

- Worldwide standards for videotex were formulated in DOC laboratories as part of the Telidon program;

- The Communications Research Centre has had many notable achievements in optical communications, and mounted the world's first operational system for delivering telephone, broadcasting, and interactive electronic information services over a fibre-optics based integrated broadband distribution system.

Other significant technical achievements of the research program include:

- the design and construction of Canada's first satellites, the Alouette-ISIS series; two of the ISIS satellites can still be operated some 15 years after initial launch;

- successful development in conjunction with DND of satellite-aided search and rescue system, resulting in the saving of more than 300 lives;

- development of a range of communications devices, resulting in successful transfers of technology to industry and the issuing of 60 invention notices and 20 patents;

- international leadership in the development of standards for Open Systems Interconnection (OSI) which allow different computer and communications systems to communicate with each other;

- the development of technology for digital processing of data from synthetic aperture radar for measuring the thickness of fresh-water and sea ice and of the water content of soil;

- leadership in the understanding of Arctic atmospheric effects on terrestrial and space communications and in the effects of precipitation on communications between earth and space;

- development, and successful transfer to industry, of competitive High Frequency (HF) communications systems for radio telephony and data, including a mobile radio data terminal.

While these achievements are formidable in their own right, the effectiveness of DOC research should not be measured on technological grounds alone. Throughout its history, the DOC research program has devoted significant effort to the transfer of these advanced technologies to industry. As a result, the program has an outstanding record in the area of technology transfer and contracting out.

Firms such as SED, SPAR, Gandalf, Microtel, Comdev and numerous small and medium sized companies have benefited from DOC research programs. It is because of achievements such as these that, a Science Council Study cited DOC as one of the best examples of an organization which employs technology transfer.[1] Other studies by the Economic Council[2] and by the Ministry of State for Science and Technology[3] also cited DOC as a model for successful technology transfer programs.

Clearly, the DOC research program has been successful in advancing our knowledge base in communications and information technology and in transferring this knowledge into the marketplace where innovation and entrepreneurial talent can best make use of it. However, **in an environment where technological advancements and the needs of industry are rapidly changing, the Department of Communications must continue to evolve by establishing new research objectives and by putting in place new research structures that will improve its operational effectiveness.**

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[1]Arthur Cordell and James Gilmour, The Role and Function of Government Laboratories and the Transfer of Technology to the Manufacturing Sector (Science Council of Canada Background Study No. 35, April 1976), p. 227.

[2]Economic Council of Canada, The Bottom Line: Technology, Trade and Income Growth (1983) p. 46.

[3]MOSST, Technology Transfer by Department of Communications, p. i.

MISSION AND PRINCIPLES GUIDING THE EVOLUTION OF DOC RESEARCH

Inevitably in a fast-changing area like communications and information technology, public sector research activities must be reviewed in an independent context by recognized experts. DOC acknowledged this need by conducting a major review beginning in 1983. A central objective has been to develop a new approach to communications research which would enable the DOC Research Program to better serve its clients and partners both within and outside the federal government.

Three leading figures from the private sector were involved in the review: Don Chisholm, then Chairman of Bell Northern Research; John MacNaughton, Vice-President of Spar Aerospace; and Laurent Nadeau, then President of Bytec-Comterm, and currently President of Xicom. The review concluded that the DOC Research Program represents a significant national resource which must be nurtured, developed and more effectively exploited. It recommended that DOC research capabilities should be deployed in the strategic middle ground between university research, which focuses on the long term generation of knowledge, and industrial research, which focuses on product development. The mission of the DOC Research Program is to play a catalytic role in our national communications and information technology R&D effort by focusing on applied research and creating the vital links required to concentrate university, government and industry research efforts on the achievement of strategic national objectives.

Achievement of this mission requires a substantial re-orientation of DOC's existing research efforts to build stronger linkages with industry and university research activities. By establishing a clear sense of mission and by adopting sound principles for research management, the DOC Research Program is now better equipped to deal with the new and dynamic challenges of communications and information technology.

THE CHALLENGES OF COMMUNICATIONS AND INFORMATION TECHNOLOGY

During the past two decades, much of the emphasis in communications and information technology has been on the development of advanced communications infrastructures. For example, the strategic goal of the Japanese and the Europeans has been two-fold: to upgrade their telecommunications systems to the service levels established by Bell Canada and other North American leaders through the incorporation of new technologies; and to position their domestic industries to compete in the rapidly growing international market for information technology products. Canada has fared relatively well during this era - we enjoy one of the best telecommunications systems in the world and are supported by a strong domestic industry.

Although efforts to advance the capabilities of the communications infrastructure must continue, there is growing awareness that hardware in and of itself cannot fulfill the promise of information technology. **If Canada is to reap the benefits of information technology, we must develop the technologies and cultivate the know-how needed to design and to make use of communications and information systems more effectively.** In striving for this goal, three challenges stand out:

1. **The need to promote more effective means for electronic information transfer.** Fundamental to this is the requirement for a better understanding of the technical and economic parameters of new communications media, such as optical fibers, that can extend the information carrying capacity of communications systems. Also essential is the vast array of communications devices and components that structure and process information for transmission, storage and display. Central to the development of these communications technologies and devices is the pivotal need to overcome interconnectivity impediments. Interconnectivity concerns the compatibility, interworking and standardization of equipment and systems. National and

international standards negotiations, crucial to the development and commercialization of information systems, are strengthened by research in this dimension.

2. **Increased emphasis must be placed on developing effective and affordable software that can extend human information handling capabilities.** The term software refers to the instructions which direct the operation of a computer. As the cost of information technology falls, there is a growing demand to develop software programs which take full advantage of the power of existing technology as well as the rapidly expanding capabilities of new computer architectures and communications media. A major challenge is to develop a better appreciation of new software engineering technologies that are turning software writing from a time-consuming, labour intensive craft into an efficient industrial process. As software programs become larger and more complex, computer assisted software engineering (CASE) techniques are being developed to ensure timely and cost effective software production and to ensure that the final product is effective and error free. The Canadian research effort in information technology must address this need to develop a better understanding of new software engineering techniques.

3. **There is a need to focus on applying information technology to increase the pace of commercialization of new product ideas and to resolve technology problems in user industries.** The importance of information technology stems from the pervasiveness of its application in all sectors of the economy and industry. As the Economic Council pointed out in its recent study Making Technology Work, Canada's ability to benefit from information technology will depend on increasing the rate at which it is adopted by users and applied to their specific needs. In order to accomplish this, it will be necessary to

understand the complex communications processes that characterize individual applications domains. For such applied research efforts to be successful, they must be based on substantive participation by equipment and service providers and by end user organizations. Suitable mechanisms must be established that will encourage collaboration in applied research and in systems development.

These challenges in system engineering, software development, and applied research are being addressed by the DOC Research Program.

MEETING THE CHALLENGES: A THREE COMPONENT PLAN

It has become clear that if the potential of communications and information technology is to be realized for Canada, strategic initiatives must be taken to establish a nation-wide effort that includes all sectors of the research community and senior decision-makers. As a major player in information technology research, the Department of Communications has a responsibility to contribute towards this national effort. Based on a clear recognition of the new challenges that Canada faces in this area, the DOC has put in place a three component plan for communications and information technology research and development.

Component One: Strengthen Research in Core Technology Areas

Achievement of Canada's potential in information technology depends first and foremost on our ability to understand and make use of strategic enabling technologies. Meeting this challenge, and respecting the principle of establishing research environments that foster creativity and intelligent risk taking, the resources of the Communications Research Centre (CRC) near Ottawa have been regrouped into three core research program areas; namely, Communications Technologies, Communications Devices and Components and Broadcast Technologies. These core activities

constitute a national storehouse of expertise that other players can draw upon in applying technology and to provide guidance for basic research in universities.

The **Communications Technologies Research Branch** brings together into a single unit the research activities related to a number of major techniques used to transport information, i.e. satellites, radio, and optical fibres. This combination will facilitate studies of the appropriate mix of these transmission technologies to meet Canada's expanding communications requirements.

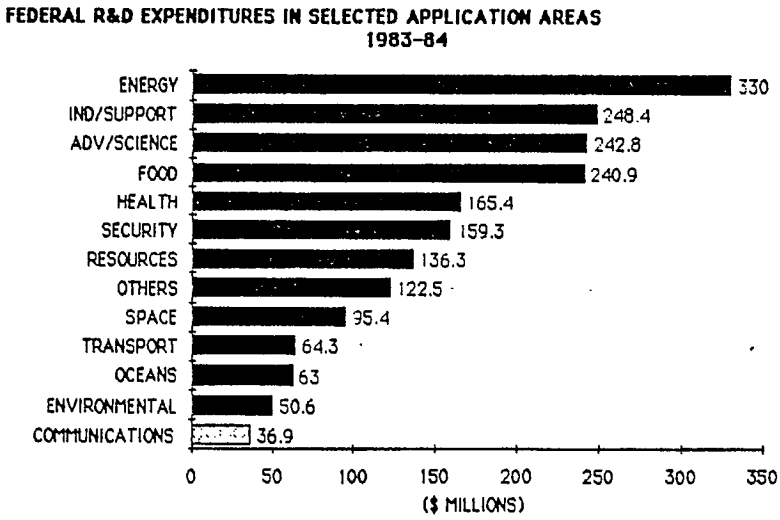
The **Communications Devices and Component Research Branch,** which is one of Canada's leading centres of expertise in gallium arsenide technology, is concerned with the need to process, structure and manipulate electronic signals for civil and military communication systems. It will be responsible for carrying out research and development activities on devices, circuits, and components for applications in spectrum effective communications, radar systems and high-speed data processing.

The **Broadcasting Technologies Research Branch** is concerned with research and development into technical aspects and related human and cultural issues of television, sound and data broadcasting; interactive video services; and video program and film generation. In recognition of the fact that boundaries between traditional transmission media are fast disappearing, it is also concerned with the interconnection of information systems. Investigations are also being carried out into broadcast systems concepts and configurations for harmonization and integration of future advanced entertainment and information services, and their interworking in a variety of network arrangements. Fundamental concepts relating to interconnectivity, compatibility and standardization are of particular concern.

Advisory Boards are being created to guide the work of each of these research program areas. They will be structured to function like corporate boards of directors and be responsible for recommending priorities and workplans. They will be composed of representatives from private industry, universities and other client groups. As the first order of business, the Advisory Boards will be asked to examine the adequacy of the existing resource base for the challenging tasks before it. Three key issues will have to be addressed.

1. The current allocation of research resources appears to be out of line with the government's stated priorities. Innovaction, the federal strategy for science and technology, identifies communications and information technologies as strategic technologies for Canada's future growth and competitiveness. However, the government spends less in communications R&D than in any other area. This is particularly disturbing, since other countries are significantly increasing their commitments to this type of research. The rest of this paper proposes significant new increases in expenditures in a number of areas to remedy this problem. The Advisory Boards would be asked to recommend on the adequacy of these measures for strengthening DOC research in core technology areas.

Figure 2



SOURCE: MOSST, 1985

(Excludes Salaries)

2. The need for new investments in communications and information technology is compounded by the fact that the equipment and facilities of the Communications Research Centre have run down over successive years of fiscal restraint. It is estimated that over the next five years, $27.5 million would be required to modernize and upgrade existing research facilities and provide major pre-competitive national test beds. Details of this capital plan are given in Appendix A.

3. Missing within the existing resource base is the means to create **a core research program area devoted to computer software engineering research.** One of the major challenges Canada faces is the need to develop first-class know-how and capabilities in new software engineering technologies. Other nations have already recognized this need and have put in place ambitious research programs in software engineering. For example, $300 million, or one-fifth of the $1.5 billion budget of ESPRIT, a ten year program for pre-competitive information technology R&D in the European Economic Commission, is devoted specifically for software engineering research. In the United Kingdom, software engineering is one of four areas sharing their $340 million Alvey program. Similar research programs have also been put in place in Japan and in the United States. Apart from the government sponsored programs, 14 leading software firms in the U.S. have banded together to form the Software Productivity Consortium with an annual research budget of $14 million.

   These international initiatives could seriously undermine the competitiveness of the Canadian software industry in the international and domestic markets. A recent study identified 2000 software firms in Canada, but 88% of total software revenues are attributed to the top 12 firms. More revealing is

the statistic that 80% of the firms have fewer than 10 employees. It is becoming evident that these firms do not have the capability to develop and adopt advanced software technologies essential for their long term survival. In view of the strategic importance of the software industry, government has the responsibility to ensure that firms have access to new software engineering technologies. **For Canada to develop its strength in information technology, it must have a major world-class pre-competitive computer software laboratory.** As a first step towards the creation of this essential research capability, the DOC has estimated that $15.5 million would be required over the next five years, largely to fund pre-competitive research consortia. Details are provided in Appendix B.

Component Two: Creation of Strategic Research Partnerships

The second component of the DOC Research Program is rooted in the conviction that close links between the core research efforts of DOC and other sectors of Canada's research community are essential for effective management of scarce research resources. In an area as wide and challenging as communications and information technology, the development of specializations in expertise and in research equipment and facilities is inevitable. Strategic partnerships between research organizations with complementary skills, which will allow the sharing of research results and resources, will generate needed synergism within the research community. This will ensure that work being carried out in the laboratories of DOC will benefit from, and add to, the national effort in communications and information technology R&D.

These strategic partnerships will be founded on the recognized strengths of participating organizations. Through its many years of research efforts, the DOC has developed excellence in a number of scientific and technical areas essential for the future of information

technology. These strengths will be shared with interested research organizations in industry, universities, and provincial governments. The details of the partnership arrangements will vary, depending on the research activity involved and on the desires of the potential partners.

An example of the kind of partnerships DOC intends to pursue are found in the components and devices area. DOC has developed considerable expertise in gallium arsenide-based monolithic microwave integrated circuits (MMIC's) and is exploring several opportunities for partnerships to share and further develop this technology. In Ontario, two such opportunities are with the Ottawa Carleton Research Institute (OCRI) and with the Telecommunications Research Institute in Ontario (TRIO). This expertise is also the stimulus for prospective research partnerships with the Alberta Research Council and the Alberta Telecommunications Research Centre.

For these partnership arrangements to be effective, DOC must be prepared to contribute its fair share to funding joint research projects in areas of mutual concern. It is estimated that, over the next 5 years, new money amounting to $35 million will be required to establish a contracting fund for joint research projects. Potential projects are described in more detail in Appendix C.

Component Three: Creation of Applied Research Institutes

The third component of the Research Program addresses the overriding need to support the application of communications and information technology in the commercialization of new product ideas and in resolving technology problems in user organizations. The productivity and competitiveness of Canadian industry and the efficiency of its social

services will depend not only on the development of technology, but on utilizing these technologies as effectively as possible. Such an applied research effort must be supported by industry and must have strong user participation.

The Department of Communications has had substantial experience in this type of research activity. For over fifteen years, the DOC Research Program has emphasized the importance of communications technology applications and the pioneering work carried out at the Communications Research Centre has received world recognition. In the 1986 meeting of Commonwealth countries, Canada was called upon to provide guidance and leadership in the application of communications and information technology to meet national health care and educational needs. Applied research in cooperation with industry has also achieved considerable success with the development and commercialization of many communications devices and systems. This type of applied research activity will continue to be carried out by the Communications Research Centre.

DOC's commitment in applied research was again demonstrated in 1982 with the creation of the Canadian Workplace Automation Research Centre (CWARC) near Montreal. This centre is responsible for research and development in the areas of automated office systems, and for ensuring that the research results are transferred to both the public and private sectors so that the potential for enhanced productivity are realized. One of the founding principles of this research centre is the importance of industry support and participation in all aspects of its activities. Today, about one half of CWARC's staff is from the industrial and university sectors, and the centre will continue to conduct studies concerning the technological, socio-economic, behavioural, and organizational aspects of office automation both from a pure applications and from an applied research point of view.

With the creation of CWARC, the DOC Research Program was able to make substantive contributions to the application of information technology into the office environment. Because of the pervasiveness of

information technology in all sectors of the economy and society, similar research efforts must be put in place to ensure expeditious and effective utilization of the technology in other areas of national concern. Although these efforts may not need to be of the same magnitude as was appropriate for CWARC, the basic principle of strong industry and user participation will again be adhered to. **Accordingly, the Department of Communications has begun work to increase its emphasis on applications development and to establish a number of regionally based Applied Research Institutes to address issues and problems associated with the application of communications and information technology in specific use domains.** Areas currently under consideration include the use of instructional technologies in education and training, communications and computer technologies to improve safety in the mining industry, and the use of integrated communications networks in office buildings. Although these Applied Research Institutes will be regionally based and independently administered, they would be national in scope and will draw on the research capabilities of DOC laboratories and associated research partnerships.

It is estimated that the establishment of these applied research institutes will require the expenditure of $20.5 million over the next five years. Resources will be sought from the various regional development funds being created by the government. Further details are given in Appendix D.

CONCLUSIONS

Canada's R&D efforts in communications and information technology are strong in comparison to some other areas of strategic importance to Canada's future. However, even in this research sector problems exist. First, although communications R&D represents a bright spot on the spectrum of general industrial R&D expenditures, Canadian efforts in this area pale when compared to spending in other OECD countries. Second, apart from two or three major private sector players, the vast majority of

companies are too small to mount sustained R&D efforts. And even the large players tend to concentrate on short-term objectives, rather than devote significant resources to basic R&D. In other words, while the major players do dedicate financial efforts to research, their own particular interests and objectives may not square with the needs of Canada as a whole. The Department of Communications' Research Program has been successful in maintaining the needed level of research in advanced communications technologies and will continue to do so in the area of information technology.

In recognition of the new challenges Canada faces in communications and information technology, the Department of Communications has put in place a new Research Program that better matches its research capabilities with industrial and regional research strengths and aspirations. The thrust of this new research program is to focus on applications of technologies to meet Canadian economic and social needs. Although useful research activities are already ongoing, additional resources will be required if these efforts are to achieve their full potentials. It is estimated that, over the next five years, an investment of $125 million would be needed to sustain DOC's Research Program.

For DOC's efforts in communications and information technology research to be successful, it is essential that the program's implementation is carried out prudently; that the required time and resources are given; that strong scientific and business skills are employed; and that it is supported by all sectors of Canada's research community.

In this spirit, the Department of Communications welcomes the views of interested parties for the Research Program outlined in this paper.

APPENDIX A

APPENDIX A

CAPITAL REQUIREMENTS FOR DOC RESEARCH PROGRAM

The DOC Research Program is expected to contribute significantly to the demanding challenges of emerging national requirements in communications and information technology. To support this goal and meet obligation, the DOC laboratories must have readily available, state-of-the-art, sophisticated electronic and laboratory equipment. Specifically, the Research Program's augmented capital requirements are made prominent by three major considerations:

i) maintenance of a world-class research presence;
ii) undertaking more diversified partnership arrangements;
iii) establishment of new test bed facilities.

1. Equipment Replacement at CRC

At the present time, approximately 30% of the equipment inventory at the Communications Research Centre is more than ten years old. Only about one-third of the inventory is five years or less. Since 1980-81, the rate of replacement has been about 6%, a rate insufficient to keep the laboratories functioning at an acceptable level and highly inadequate to undertake a strong lead in Canadian communication and information technology research.

In its report of 1981-82, the Communication Research Advisory Board (CRAB) expressed its serious concern "...that the Department of Communication Research base is eroding". The condition of the Capital base has become worse since that report was issued.

Because of the variety of laboratory equipment and its specialized nature, technological obsolescence is difficult to predict. This factor is highly dependent on the rate of development of particular equipment technologies at particular times.

Indeed, only a very small portion of laboratory equipment is ever replaced with identical hardware. The greater proportion becomes technologically obsolete and must be replaced by a newer generation with inherently greater capability and sophistication and which, in general, is relatively more expensive. Although much of the equipment is commercially available, a significant portion of the laboratory hardware is custom made and unique. Not only would these facilities advance DOC's research capabilities, they would also be made available to Canadian researchers in industry and universities.

Scientists and research personnel at the DOC laboratories indicate that while general-purpose equipment has, on average, a useful life of about ten years, the more specialized research equipment, which incorporates up-to-date micro processors and data manipulation capabilities, has a shorter useful life, approximately five to seven years. University and industry researchers generally support such a view.

Clearly, a long term capital plan is needed to support the research objectives of the centres at Shirley Bay and Laval. In a decision of 29 January 1979 regarding the establishment of rates for cost recovery for the David Florida Laboratory at CRC, the Treasury Board accepted that the useful life of equipment was as follows:

Buildings	20 years or 5%
Regular laboratory equipment	10 years or 10%
Specialized equipment	7 years of 14%

In the November 1980 study, "Cost recovery rates for the High-Reliability and David Florida Laboratories", carried out by Systemhouse on behalf of the DOC, these same equipment lifetimes were recommended.

It is estimated that $5.5 million per year, over the next five years, will be required to augment the present Capital allocation in order to carry out the proposed program.

2. Research Partnerships

A key element to the success of the DOC initiatives in communication and information technology will be research projects undertaken in partnerships with universities, industry and other research establishments. The DOC will be expected to contribute its fair share to this initiative. Collaborative arrangements will require the augmentation and enhancement of DOC's present research facilities and infrastructure to accommodate visiting partners at its existing research laboratories and at the new research institutes that are being established.

Equipment and related capital cost requirements are incorporated into the estimates for individual potential projects described in Appendix C.

3. National Test Bed Facilities

In maintaining its lead role in the precompetitive stage of technological development, the DOC has undertaken to provide the infrastructure and support for specific test bed facilities for manufacturer to test their products for compatibility and conformance with standards. Two test bed facilities are proposed at this time.

i) Open Systems Interconnection Test Bed

The term "Open Systems Interconnection (OSI)" has been adopted internationally to describe a layered architecture model for informatics systems interconnection. Standard protocols for all layers are being developed to enable systems from different manufacturers to be interconnectable.

The objective of the Canadian initiative is to develop, establish and operate the required national OSI test facility, in close collaboration with foreign organizations. One project has already been initiated with the National Computing Center in the United Kingdom.

Leading to establishment of this test bed facility is the need for preliminary investigation into methodologies suitable for multi-layer OSI testing such as test structures and implementation techniques. In addition, formal notations for test specifications need to be developed and tools for automated implementation of protocols and test suites investigated.

A national test bed, for both hardware and software, will be established based on the integration of techniques and tools developed. Particular emphasis will be placed on performance issues such as implementation sizes, efficiency, etc. This test bed will be used for further research and development of enhanced OSI protocols and conformance testing of protocols developed by both the private and public sectors.

The strong industry interest in OSI should enable a significant leverage for this activity, a factor of three is expected. Financial requirements to support this initiative is estimated as follows:

88/89	89/90	90/91	91/92	92/93	Leverage Factor
			(Million $)		
1	1	1	.5	.5	3

ii) Advanced Television Test Bed

With the emergence of enhanced and advanced broadcast television systems, there will be a need to ensure that various components of such systems will operate harmoniously together in a broadcast center. Furthermore, with the move toward automation and the utilization of expert

system concepts, there will be need to modify or to introduce entirely new operations procedures in a broadcast center.

It is unreasonable to expect individual Canadian companies, given their relatively small size, can afford to establish a test bed of their own to evaluate new broadcast hardware and software. A national center that can be shared by industry, government and university would provide an efficient and cost-effective means of furthering advanced television development. In addition, such a facility would provide a means to demonstrate to potential clients new hardware and software operating in a near live environment.

The details of the facility would in part be determined by the partnership arrangements developed with respect to the Advanced Television Systems project described in Appendix C, however, cost requirements are estimated to be:

88/89	89/90	90/91	91/92	92/93	Leverage Factor
			(Million $)		
.5	.5	.5	.5	.5	2

APPENDIX B

APPENDIX B

SOFTWARE RESEARCH

A critical component of information technology is software. Software can refer to both the instructions that direct the operation of a computer as well a the information content that computer systems manipulate and communications systems transport. Indeed, software has become a major ingredient of microelectronic or microprocessor based products and is often found embedded within hardware, such a read-only memory chips. Configured in this manner, software has become an intimate part of traditional hardware. Moreover, software is often more complex and, in certain situations, it has become more dominant than its associated hardware.

The cost and time taken to produce reliable software for a wide variety of applications is directing a concerted effort in many countries to improve the productivity of programmers. The term "software engineering" is often used to describe the investigation into and the formulation of new ideas and approaches for creating, developing and utilizing complex software packages. More specifically, the stages of developing a software applications program include prototyping, coding, testing and validation. Each stage requires effective tools and techniques in order that significant programmer productivity increases can occur. Feedback from programmers to tool designers and evaluators can be most valuable to further improve the software creation cycle. Thus, software engineering research is critically important and can cover a wide range of activity, from theoretical work on the nature of computer programming to understanding human interaction with computer systems and applications programs.

Software and software engineering have been recognized by Japan, United States and the countries of the European Economic Community as a key element of information technology. These three economies, with their strongly established industrial infrastructures, have launched major

precompetitive research programs covering a variety of software dominant subject areas. The cohesiveness of other countries' programs in software engineering is a major threat to future Canadian opportunities in the world's software industry.

Therefore, Canada does indeed require its own software research initiative if its influence and role in information technology is to be sustained in the future. Realistically however, Canada can only hope to embark on more modest software research endeavours. Thus, Canada must be more selective and focus on area which take advantage of its past accomplishments, present strengths, determined needs, and offer the best potential industrial pay-off in world market niches. But a key issue is to focus Canada's software initiatives in order to minimize our present strong dependence on imported software products.

Canadian universities have established a world-wide reputation in investigating improved software tools and techniques, selected artificial intelligence topics, networking, an communications protocols. Many of the achievements have matured into specialized commercial products. Meanwhile, Canadian industry has been at the forefront of developing software based telephone switching systems and has contributed to advancing the office automation field.

However, each industrial initiative is more often than not determined by corporate market strategy; there is no overall national guiding focus to these academic and industrial endeavours.

A rationalization of precompetitive software research in Canada must take place before any aggressive and mobilized program is considered further. Thus, a review of a possible software research program with respect to Canada's objectives should be undertaken, particularly a setting out of the strategies to be pursued and the main thrusts of a possible national research effort.

Therefore, as the first step in a Canadian action plan for software research the DOC has started an investigation which would establish:

- the guiding strategy for software research in Canada;
- the key areas to pursue;
- the mechanism for collaboration among industry, academia and government;
- the level of support and involvement of key sectors;
- the exploitation of results.

This investigation would draw on software expertise from industry, universities as well as the Department's own experiences in software engineering research. The DOC Research Program has carried out a number of software intensive projects in support of the Department's mandate, leading to enhanced and improved communications facilities and services. This type of research projects will continue and the present paper suggests the launching of additional specific software-based research activities which have a strong user emphasis. Detailed descriptions of these projects are contained in the accompanying Annex.

Although oriented to the Department's overall role, the software-intensive elements of DOC's Research Program could provide the focus for much of the precompetitive software and software engineering research in Canada. The DOC Program could become the genesis for the integration of software research capabilities in Canadian industry, universities and other research establishments. Furthermore, the Department could also be prepared to take the initiative to expand its present commitments to include the establishment of a general test bed facility in support of software engineering research.

Annex: Proposed Software Projects for the DOC Research Program

As the cost of information technology falls, a major challenge is to develop software which takes advantage of the power of existing technology as well as the rapidly expanding capabilities of new computer architectures. This Annex describes five research projects aimed at developing software products to meet Canada's cultural and communications needs. While these projects will ensure better utilization of advanced software techniques in selected areas, they alone will not be sufficient to sustain a precompetitive software research effort in Canada. Additional software research projects will be prepared following the investigation on a Canadian action plan for software research.

1. New Tools for Creative Expression - $1.25 Million

Software extends the human hand and mind by providing new tools for creative expression. Software for creation of cultural products is beginning to have a dramatic effect because it is becoming more available with the advent of micro-computers; because the software makes it possible for those without extensive experience to be creative; because the process of creation is changing as the technology does much of the mindless labour, leaving the human mind and hand free to create; and because the process of education for creation is changing as the tools allow faster feedback and means for exploration. A new cultural renaissance is possible in many fields from music to the image arts to the performing arts.

In addition, new means of storage of cultural products implies new methods of sales and distribution, replacing the older patterns or creating new ones. For example, as videotape recorders have done for the film industry, CD-ROMs and digital audio tape appear poised to revolutionize the music recording industry. Dance notation systems will eventually make possible distribution of choreographers' art. Distribution of interactive fiction with alternate endings, participative design of images and other tools are possible.

It will be important for Canadians to be at the forefront of these developments in order to take advantage of them both culturally and commercially. At present, modest initiatives are underway in many parts of the country. A focussed activity is developing in Manitoba, as a result of a joint DOC/NFB/provincial study.

88/89	89/90	90/91	91/92	92/93	Leverage Factor
			(Million $)		
.25	.25	.25	.25	.25	2

2. Expert Systems - $2 Million

Since Japan commenced a concerted national program in the research development and commercialization of Artificial Intelligence many other industrialized nations have followed suit driven largely by a fear of falling behind. Similar programs were initiated in the EEC, the United Kingdom, the Netherlands, West Germany and the United States. All these programs have a number of common characteristics. They all:

- stress strong cooperation among governments, universities and industry;

- have a long term and broad scope with current levels of funding in each country ranging from about $100 to $300 million per year over a 5 to 10 year period;

- have short-term, sub-optimal goals with commercial exploitation in mind.

To date, experimentation with artificial intelligence has produced some outstanding results which range from potentially improving programmer productivity by a factor of 30 to 1, all the way to solving ill-defined

problems and as well as providing some relief to the overall language translation burden. The potential market for artificial intelligence products is poised to explode over the next five years.

It is proposed to increase the effort currently being devoted to the development of artificial intelligence-based applications in order to provide a higher degree of focus and coherence to the currently fragmented efforts within Canadian industry and universities.

This effort will center around the work in Knowledge Based Management Systems (Natural Language Processing and Office Based Expert Systems) and Database Management Systems (Deductive Database Management Systems and Universal Interfaces to Database Systems) currently being undertaken at the Canadian Workplace Automation Research Centre at Laval, Quebec.

These applications are commonly viewed as being among those for which Canada has the highest base of technical expertise.

88/89	89/90	90/91	91/92	92/93	Leverage Factor
			(Million $)		
.4	.4	.4	.4	.4	2

3. Computer Assisted Training - $2.25 Million

It has been demonstrated that the training issue is by far the most important factor in the implementation of information technology products and services. In fact, training is very costly and involves a tremendous amount of effort and is very costly both in term of the trainers and the trainees. The solution is to create user friendly software and to develop interactive computer assisted tutorials that can be accessed directly by the trainees, thus reducing the costs associated with delivering training materials. Research must therefore be undertaken on the pedagogical

content of the software, on the medium used to deliver the courseware (video-disc, video-cassette, etc.) and on the interactivity of the software (expert systems).

It is proposed to create an environment in which programmers/cognitive researchers/pedagogues collaborate in order to develop practical solutions to the problem of training.

An Atlantic province university-industry consortium based in Halifax is a potential partner for this activity.

88/89	89/90	90/91	91/92	92/93	Leverage Factor
			(Million $)		
.25	.5	.5	.5	.5	2

4. Computer Assisted Translation - $7.5 Million

As an officially bilingual country with linguistic minorities present in all regions of the country, Canada has a natural need for translation services. More globally, the need and demand for translation has increased dramatically, due to the following factors:

- improved telecommunications;
- the emergence of literary, scientific and technical publications in a variety of non-traditional languages;
- the increasing determination of governments to guarantee their people cultural development opportunities in their own languages; and
- pressure from the international market is forcing businesses to translate their technical and commercial documents into the languages of their clients.

Within this environment of growing interdependence of world economies and the desire for maintaining cultural independence, the need for language translation continues to grow. Because of the limited supply of qualified translators, the cost and time delays of translation, and ever-increasing workloads, there is an obvious need for improvements in the productivity and efficiency of the translation.

The Computer Assisted Translation program will focus on these translation needs though a tiered research and development program which comprises:

- the development of a translation workstation prototype within the near term;

- the identification of sub-languages to which current and emerging technology can be applied with a high degree of translation efficiency; and

- the identification of longer term general automated translation solutions.

Partnership arrangements are possible with university and industry players in a number of provinces, including Quebec, Manitoba and New Brunswick.

88/89	89/90	90/91	91/92	92/93	Leverage Factor
			(Million $)		
1.5	1.5	1.5	1.5	1.5	2

5. Computer Assisted Animation - $2.5 Million

Animation has been used for a long time in film and television production. While electronic technology has begun to provide tools for labour and cost reducing production techniques for animated programs, it

still remains a highly labour intensive industry and its viability in Canada is therefore threatened by lower cost off-shore labour.

The animation research program has the goal of providing new tools for animation program producers. These tools would take advantage of higher resolution video technologies such as HDTV, increasing processing power and speed of computers as well as new concepts in computing such as the use of parallel architectures in order to approach real time processing of complex animated sequences. In addition, the development of powerful and user-friendly software will be a major goal of this research. The objectives would be to free the creators of animated programs from mundane tasks and permit the devotion of more of their time to artistic creativity.

Animation techniques are increasingly being used in teaching and training materials. Despite this fact, there is not sufficient knowledge of how the effectiveness of animated images compared to still images in the learning process. Empirical and theoretical research will therefore be conducted so that guidelines to creators of computer-aided learning material can be provided for the most effective use animated sequences in learning, training and education.

Partnership arrangements are possible in a number of provinces, with particularly strong interest already identified in Ontario and Manitoba.

APPENDIX C

APPENDIX C

RESEARCH PARTNERSHIPS

The DOC Research Program is fourth among the major Canadian communications and computer R&D spenders. As such, DOC plays a critical role in spearheading the Canadian research effort in a field whose industrial value is measured in the tens of billions of dollars annually, and whose social impact pervades our entire society. In fulfilling its role, the DOC laboratories must work closely with federal clients, private industry and the Canadian international scientific communities in building a strong base of competence and expertise in Canada.

Nor should this federal expertise and competence be concentrated in Ottawa as it presently is. Partnerships with industry, provincial laboratories, and universities are the most effective way of diffusing and developing expertise across the nation. To this end a large number of research partnership possibilities based on the generic technologies required in the information society have been identified and are being actively explored. Initial contacts indicate great interest across the country in such partnerships and the concurrent availability of funds to support them. Provincial and industrial funds are available to support them.

The key to establishing partnerships lies in the readiness of the federal government to make available funds to match the contributions of provincial, industrial and university partners. In what follows in this appendix are a number of specific opportunities for partnership that are being pursued in consultation with industry, universities and the Provinces. These activities would be developed almost exclusively outside the Ottawa region, with a view to achieving good regional balance in the location of research and development on the information technologies.

These partnership opportunities are of two basic types. The first two initiatives are aimed in a general way at encouraging interactions

between DOC and universities and between universities and industry, as well as enhancing the interchange of researchers between such institutions and the international community. The rest of the proposals are aimed at developing specific pre-competitive generic research activities in regions of the country where there is industrial and provincial interest and support.

1. Industry and University R&D Collaboration Fund - $15 Million

The objective of the industry and university R&D contracting fund is to promote the development of strategic alliances between universities, industry and government. It would have two components. The first would be used to fund joint projects between DOC and universities on fundamental issues of communications research, involving the physical, social and cognitive sciences. The second component would promote joint projects between industry, universities and government on medium-term pre-competitive R&D projects.

Because of the number of disciplines necessary to develop information technology products and services, and the need to involve the end user, it is believed that the most effective way to undertake R&D in the area is through collaborative efforts. These projects, in addition to developing strong linkages, would ensure that the results of the research are rapidly translated into practice. By putting the thinkers, the developers and the users of research together, it is believed that the objective of the program can be more quickly realized.

These projects could be undertaken in all parts of the country and would therefore help to overcome existing regional disparities in R&D spending.

88/89	89/90	90/91	91/92	92/93	Leverage Factor
	(Million $)				
1	2	3	4	5	2

2. Exchange Program between Universities, Governments and Industries - $20 Million

If Canadian industry (hardware, software, services, etc.) is to take full advantage of DOC R&D to improve its competitive posture, there must be a continuous and efficient transfer of research results to industry. This requires establishing good communications with industry, and mechanisms to ensure the rapid transfer of technology. In discussions with industry, there is a clear consensus that by far the best mechanism for transferring technology is the interaction between people. It is therefore proposed to open the DOC Research Program so that industry and university researchers can work in DOC laboratories for one to three years. This will provide a mechanism by which researchers can interact and share knowledge. Such an approach is very attractive to larger companies in Canada, but could present problems for smaller organizations who may have only a small number of researchers and therefore it would be difficult to spare any of them an extended period. In such cases, DOC proposes to arrange for the secondment of personnel from the DOC to these small companies. Under either of these options, the cost of researchers' salaries would be shared 50-50 between government and industry. Such a program is now in place at the Canadian Workplace Automation Research Centre (CWARC), and has proven to be very successful. It is also important that this exchange arrangement be broadened to permit Canadian researchers to work outside Canada and to attract researchers from other countries for periods of one to two years in Canadian laboratories.

88/89	89/90	90/91	91/92	92/93	Leverage Factor
(Million $)					
1	2	4	6	7	2

3. NEW COMMUNICATIONS SYSTEMS - Total $13.25 Million

Canadian industry is strong in the technologies related to telecommunications networks for the provision of traditional telephone and data services. Bell Northern Research, an establishment many times greater in size than CRC, deals effectively with near-to-medium-term R&D on related systems. The prime focus of DOC research has been radio and satellite communications and R&D in optical communication. Studies are conducted on the most appropriate mix of these communications technologies on the basis of economy, radio spectrum efficiency and operational flexibility. This will provide solutions to Canada's expanding communications needs and help build a national information network into the next century. R&D activity in this area is essential to achieving DOC's mandate in formulating telecommunications policies and in setting regulations and standards. Moreover, there is no financial incentive for a private company to carry out such work because its R&D is market-driven rather than mission-or policy-driven as is the case with public sector research. Research in these areas could be carried out on behalf of DOC by industry and universities.

4. Optical Communications - $5 Million

In a little more than a decade, optical fiber technology has emerged from the laboratory into the communications networks of all developed nations. Thus, the telecommunications network in Canada is undergoing a fundamental change from using technology based on electrons to one based on photons (light) for the transmission of information. In the emerging photonic network, even other traditional electronic functions will be replaced by their photonic equivalents. Optics technology will be used increasingly not only in the transmission of information, but also for such functions as the switching (optical switches), the storage (optical discs and tapes) and the processing (optical computers) of information. A major objective of the optical communications and electrophotonics research program would be to build on the expertise the department has developed in certain aspects of electrophotonic technology in order to

help position Canada to play in the coming optics-based information age.

Potential partners for the activity have been identified in the British Columbia and in Quebec.

88/89	89/90	90/91	91/92	92/93	Leverage Factor
(Million $)					
1	1	1	1	1	2

5. Wireless LANS - $1.25 Million

Local area networks (LANs) link together telephones, computers and many other types of office equipment in such diverse environments as office complexes, mines, harbours, airports, warehouses and factories. Traditionally, cables and wires, or fibre optical waveguides have been used as information transmission media when the required data rates are very high, and only recently has radio been considered for such use. The flexibility inherent in a radio system opens new prospects for the economic implementation of LANs. It is to this end that work has been undertaken to determine the feasibility of such systems. Present research is concerned with characterizing the propagation medium, and with assessing the interference and electromagnetic compatibility problems which implementation of such systems will entail. The research is primarily directed toward developing environmental models which may be used to design such systems in order to provide the technical base for establishing standards for managing the spectrum in which such networks and systems will operate. Since new and proposed systems are emerging at an increasing rate, it is essential that the research be done in a time frame which will be useful for development of the technology.

In addition it is recognized that a significant problem associated with workplace automation is the very high wiring costs, for both installation and maintenance. The obvious alternative, which appears to

be technologically and economically feasible, therefore consists in wireless interconnection techniques.

It is also an objective of the proposed program to assist Canadian industry to a better insight into the problems of wireless communication inside office buildings and to develop products with worldwide market potential.

Because this work would be a direct outgrowth of the Department's traditional concern with radio propagation, it would likely be located at the Communications Research Centre in Ottawa.

88/89	89/90	90/91	91/92	92/93	Leverage Factor
	(Million $)				
.5	.5	.25	-	-	2

6. COMMUNICATIONS DEVICES - Total $2.5 Million

Key to the progress of information technology is the miniaturization of electronic devices to improve efficiency and reliability and reduce cost. As miniaturization increases, industrial products with more machine intelligence will become available for communication and information technology applications.

CRC labs have been in the forefront of this work. In its formative years, CRC avoided R&D work on electronic components, to concentrate its efforts on developing circuits and systems that used such components. The advent of micro-electronics totally altered this situation. Today, the basic communications subsystem is the 'micro-chip' and it is impossible to chart and lead any significant communications R&D without extensive in-house expertise in integrated circuit technology.

7. New Semiconductor Devices - $1.25 Million

The development of new semiconductor devices for communications and information technology applications is based almost entirely on compound semiconductor materials such as gallium arsenide and its alloys, and is dependent upon the fabrication of complex structures which can only be created in sophisticated equipments providing very accurate control features. The cost of the raw materials is high because of the requirements for stringent standards of quality, as is also the maintenance of the equipments. Fabrication of prototype devices requires expensive mask making processes as with the high-speed digital device development. Participation in joint government/ industry/university projects such as the Focussed Ion Beam project managed by the Ottawa Carleton Research Institute requires the commitment of operational funds over several years in order to guarantee success.

Expertise in semiconductor devices is present in all regions of the country. With respect to advanced materials such as gallium arsenide, partnerships are possible with industry in British Columbia and with the Technical University of Nova Scotia.

88/89	89/90	90/91	91/92	92/93	Leverage Factor
		(Million $)			
.25	.25	.25	.25	.25	2

8. High-Speed Digital Devices - $1.25 Million

High-speed digital devices and integrated circuits based on silicon and compound semiconductor materials are vital building blocks for future communications and information technology systems. Their development requires considerable funding support in the areas of design, fabrication, and application. Without the availability of computer aided design software the developments cannot even be contemplated, and therefore

provision must be made to support the costs of the generation and procurement of advanced software programs. The fabrication of some devices and circuits cannot be carried out in Canada due to a lack of appropriate facilities and reliance must be placed on access to foundries in the U.S. The costs can run into tens of thousands of dollars and involve several iterations. The end objective is the application to operational products and systems and this requires the involvement of industry through technology transfer and contract sharing arrangements.

88/89	89/90	90/91	91/92	92/93	Leverage Factor
	(Million $)				
.25	.25	.25	.25	.25	2

9. BROADCAST TECHNOLOGY AND INFORMATION SYSTEMS - Total $12.75 Million

Information technology systems are composed of a range of devices, each with their own subsystems. For the overall systems to function properly, their constituent parts must be designed and built to work together. Interconnectivity concerns the compatibility, interworking and standardization of equipment and systems. Through R&D in information technology involving the public, private and university sectors, a basis can be provided for new alliances offering compatible products and services that are competitive internationally. National and international standards negotiations (central in a strategy to capture a percentage of these markets) are strengthened by research in this dimension.

10. Advanced TV Systems - $ 5 Million

After several decades of technological stability, broadcast systems in general and television systems in particular are at the threshold of a revolutionary change which will ultimately bring vastly improved quality in terms of both sound and picture providing not only new opportunities for both the viewers and the program producers in entertainment. When

coupled with new network and computer technologies, these developments will transform broadcast services into an integrated information and entertainment service. Major research and development efforts have been launched both in Japan and Europe for planning, defining, developing and implementing advanced television systems in their countries. Canada cannot rely solely on developments taking place outside its borders and must develop its own expertise in these areas, if we want to maintain control on our future, not only with respect to technical choices in broadcast systems but also regarding our cultural policy objectives, since there are strong influences of broadcast technology on culture.

The advanced television systems research will develop expertise required to analyze possible new television systems with respect to their suitability to meet Canadian cultural needs, their impact on compatibility with existing and future delivery networks foreseen for Canada and hence provide the technical framework for future television system policy and regulatory decisions. It will also develop technologies and technical know-how which will enable broadcast equipment manufacturers to develop systems that will meet the demands of domestic and international broadcasters. Such a research and development effort will furthermore permit Canada to participate in international technical fora actively and on an informed basis and influence television system standards choices favourable to Canadian needs, which is vital if Canada is to achieve its cultural goals.

This project covers research in a variety of fields relating to the production, distribution and reception of television. Although much of the industry is located in central Canada, partnership arrangements could be developed in other regions in particular research areas.

88/89	89/90	90/91	91/92	92/93	Leverage Factor
	(Million $)				
1	1	1	1	1	1.5

11. Integration of Voice/Data/Video - $1.25 Million

The purpose of this research is to develop new network concepts, architectures and switching methods for the transmission and switching of wideband integrated voice/data/ video signals. Various transmission media such as fibre optics, coaxial cables and SHARP will be characterized, evaluated and compared. Optimum network solutions will be proposed based on cost and technical trade-offs. Emphasis will be placed on spectrum availability and on the compatibility with existing voice/data network especially in the areas of interfaces which will be defined according to the OSI concept. Network signalling methods and protocols will be defined. The types of integrated voice/data/video services supported by these networks will also be defined.

Research capabilities in many of these areas already exist at various Canadian universities. A prime objective of this project would be to focus these activities on a set of common research objectives.

88/89	89/90	90/91	91/92	92/93	Leverage Factor
		(Million $)			
.25	.25	.25	.25	.25	2

12. Stationary High Altitude Relay Platform - $4 Million

The SHARP (Stationary High Altitude Relay Platform) system envisages the use of high altitude microwave-powered airplanes as platforms to relay telecommunications signals. Microwave energy would be transmitted from a large ground antenna system to an unmanned airplane circling at a height of 20 km. This energy, converted to DC power by rectennas on the lower surfaces of the airplane, would power the electric motor and the communications payload. Recent developments in microwave powering and lightweight aircraft technologies now make it possible to maintain an aircraft on station for months at a time. With a coverage area on the ground of 600 km in diameter, all of southern Saskatchewan or the whole

island of Newfoundland could be served by a single platform. The SHARP system offers a capability to extend various telecommunications services, such as multi-channel cable TV, cellular radio, and FM broadcasting to rural and less populated regions of the country.

In addition, SHARP can provide new capabilities for surveillance applications, for example continuous ice reconnaissance for ship navigation, long-term monitoring of atmospheric constituents, and uninterrupted monitoring of fishing activities in our coastal economic zone waters. To further develop the technology for this concept and to demonstrate its capabilities, it is proposed that a medium altitude (e.g. 3 km) prototype system be developed.

Two options for regional partnerships for this activity have been identified. The first is in Alberta, where the Suffield range would provide an ideal test site. The second is in the Atlantic region, where SHARP technology could be applied to monitoring and surveillance activities, as well as telecommunications. This latter option is being discussed with the Department of Fisheries and Oceans.

88/89	89/90	90/91	91/92	92/93	Leverage Factor
	(Million $)				
2	4	2	-	-	1.5

APPENDIX D

APPENDIX D

REGIONAL APPLICATION CENTRES

Introduction

A major activity of the department is to encourage increased use of communications and informatics technologies through the development of new applications in order to improve the quality of Canadian life. Applications development increases industrial productivity and promotes the diffusion of new technologies in the user community - it provides the bridge between the users and the creators of technologies. Increased emphasis will be placed by the department on the application development function. One planned element within that function is the establishment of specialized regional applications centres across Canada. The centres would focus on unique regional strengths (e.g. R&D carried out by local industry) and on special regional needs, and be implemented through operational partnerships with other federal entities, provincial and territorial governments, universities and the private sector. In addition to the regional focus, there would also be a national dimension: each would become a recognized centre of Canadian expertise in a particular applications area (telehealth, tele-education, electronic publishing, wireless communications, fisheries and offshore communications, etc.).

Organizational Components

The following organizational components are considered essential:

1. Applications Coordinators: to bridge the gap between users and technologists and provide the necessary multi-faceted expertise and a forum for the engineer and the content specialist to communicate. Coordinators select the applications system to be tried, evaluate the results of any trials, and ensure the transition of successful trial products, systems and services to the commercial phase.

2. User Representation: to establish real needs and identify problems. These participants are also critical in trials operations and evaluation. Interchange arrangements with user groups in the private and public sectors would ensure up-to-date needs assessment and foster the diffusion of new technologies in different organizations and locations.

3. Applications Engineering: to provide the key interface between research laboratories, the users and industry. These user-oriented engineers take new technologies and adapt them for specific uses.

The Process

The chief mechanism that facilitates applications development is the conduct of field trials to test new technologies and the innovative use of existing technologies in new configurations. Only through trial use can needs and technologies (including alternative solutions) be fully assessed. The ultimate aim of these trials is to demonstrate that the communications needs can be met by domestic suppliers of commercially viable products, systems or services. The successful creation and maintenance of any applications function, including an applications centre, requires that it be founded on a strong base of communications and informatics technologies, a clear understanding of user needs and an expert multi-disciplinary team of coordinators to catalyze the development process.

The Action Plan

The following action plan is suggested for the establishment of specialized applications centres:

1. Increase departmental support for the applications development activities now underway in DGCA.

2. Identify potential applications centres where there is evidence of existing and/or planned specific applications activities to meet priority regional user needs, and existing or proposed partnerships for R&D or applications development.

3. Determine whether an existing partnership, institute or other infrastructure in a region would be an appropriate centre or whether a new entity/new bricks and mortar is required.

4. Develop application centre proposals in close consultation with the industry, users, service providers, provincial governments and other relevant organizations.

5. Identify sources of funding and management options.

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