Communications
Canada

THE WIRED SCIENTIFIC CITY STUDY

First Interim Report

- WHAT WHO WHY -

by D.A. Bowen, D.C. Coll, and
D.A. George

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31 July 1971

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PREFACE

This interim report describes, in a preliminary fashion, Phase I of a study contract being conducted by:

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of the Systems Engineering Division of the Faculty of Engineering of Carleton University, Ottawa, contracted by the Department of Communications, Ottawa in Contract OGR1-66, with Dr. J.A. deMercado, Director of Terrestial Systems and Technology Planning.

This contract states:

"Service to be Performed

To conduct a study, on behalf of the Department of Communications, Material Management Division, to determine the feasibility of and develop a plan for creating an economical and efficient teaching/research broad-band communications network between Ottawa and Carleton Universities and certain Government and Industrial Research establishments in Canada, for the period of April 1, 1971 to October 31, 1971.

WORK SCOPE:

PHASE I consists of:

1. a) Survey of potential users and their information requirements, facilities, and potential applications.
   b) Survey of available facilities and systems including common-carrier, and other experimental facilities under development.
   c) Survey of terminal equipment, including television, audio, hard-copy devices, writing tablets, computer graphics, and studio facilities.

2. Definition of the objectives and purposes of a research/teaching network. Phase II of the study will consist of the specification of a practicable pilot network, including cost estimates, and development and installation time estimates and possible management structures."

For purposes of ready reference, this study is called the "Wired Scientific City Study".

As noted above, Phase I is concerned with "definitions of objectives" and "definition purposes of a teaching/research network". During this phase, surveys are being made of potential users, their information requirements, facilities, and potential applications; of available facilities; and of terminal equipment. As well, the nature of the communications services that a network should provide to the teaching/research community in Ottawa will be defined and the rationale of the network discussed.

The design of a pilot network is the primary objective of Phase II of this study. It is, of course, hoped that it will be possible to proceed with this pilot network which will enable:

1) development of the techniques and methodologies involved in the utilization of broadband communication networks, and
2) evaluation of the practicability of such networks.

This report describes communications within the research/teaching community in the Ottawa area, certain of its activities and resultant requirements, the fundamental role of communications within the community, and defines the characteristics of a network appropriate to the support of those activities of the community that contribute most to its achievements. Thus, the report is concerned with the philosophy of such a network as well as the preliminary technical design.

INTRODUCTION

The "Wired City" is commonly understood as implying universal access to interactive telecommunications "capable of transmitting and receiving information in virtually any conceivable form" and having "the means at hand to manipulate and process that information in almost any way and for almost any purpose".[1] There is a further implication of a vast capability for instantaneous interconnection with the sources and stores of information, and of some important technological problems which do not all have solutions at this time. These problems have further ramifications of an economical, sociological, psychological, and political nature which are beyond the terms of reference of this study.

What then is meant by the "Wired Scientific City"? The insertion of the adjective connotes a restricted community of people and organizations, which has many specialized uses for a broadband communications system. There is within this community a growing awareness of the role of communications in innovative processes particularly in view of the exponential growth of technical information.

> "The assimilation and dissemination of information by scientists and engineers is an integral part of their research and development activities. With the realization on the part of scientists that they are confronted with an information crisis, much money and effort has gone into research on scientific communication and the development of information retrieval systems.

> The process by which scientists and engineers disseminate and assimilate information has been studied for a number of years by researchers from a wide variety of disciplines (e.g., psychology, sociology, engineering, history of science)."[2]

As this quotation implies, communication in the scientific community is both the subject of intensive study and of concern. The scientific community is often chosen as a subject for study not only because most communications researchers are part of it, but also because the communications within it is amenable to study. This is due primarily to immense numbers of publications, which may be counted and traced. Early research concentrated on the diffusing of information throughout the scientific world via publications, however, more recently:

> "Now we know, thanks to Menzel and to Garvey and Griffiths, that if we are speaking of the communication that is used by each research worker as an inspiration and as a data flow that makes his own work possible, then some 80 per cent of that input comes to him from other research workers at a stage before formal communication and through the informal channels of the grapevine, the conference, the seminar, the preprint, and the other tentacles of the invisible college."[3]

It is clear that there are two distinct forms of communication in science and engineering, the formal and the informal. The formal is typified by courses and publications, the informal by seminars and interpersonal contact.

The formal modes of communication are fairly familiar: journal articles, books, courses, and so on; and the attending contributions of information technology to the enhancement of this mode are well defined.

Most of them lie in the general area of information retrieval.[2,3] The properties of "successful" information retrieval systems, i.e., ones that are user-oriented, are very similar to those that have motivated the preliminary network designs in this study.[4] Information retrieval and communications technology are closely related in the overall field of information systems. Of course, any functional communications system designed for the research/teaching community must provide for access to automated information retrieval systems as they are implemented.

The informal modes, it is noted, are those most relied upon for the transfer of information. Menzel[5] has noted six advantages for person-to-person communications in a discussion of "the special functions of informal communications in science". They are: "promptness"; "selective switching"; "screening, evaluation and synthesis"; "extraction of action implications"; "transmitting the ineffable", and "instantaneous feedback". He goes on to discuss "the special role of unlooked-for information" in science.

Another important facet of informal communications is the role played by individuals who Allen[6] has called "technological gatekeepers". The present study of the Ottawa research/teaching community has produced a similar conclusion, viz., "There existed in the organizations ... a small number of key people upon whom others relied very heavily for information. These key people, or 'technological gatekeepers', ... read far more ... maintain broader ... and longer ... relationships with technologists outside of their organizations ... mediates between his organizational colleagues and the world outside, ... effectively couples the organization to scientific and technological activity in the world at large."

While we are aware that experiments with broadband communications are being conducted, the most significant being perhaps the Bell System Videophone, cable TV shopping systems, and systems of similar character being tried in various parts of the United States, and we are aware that educational systems are being used and studied at SMU, Florida, Stanford and so on, there is a need to gain and acquire this experience in Canada in a Canadian context. There are a few Canadian experiments in this field being conducted which provide particular and specialized services, however we know of no system that is attempting to service many needs, some of them quite sophisticated and others relatively elementary, using the same common system. Such a system has distinctly Canadian ramifications, since Canadian systems are probably going to have to be multipurpose so that unit costs can be sufficiently low in our environment of low population density and large distances.[1]

Within the scientific community in Ottawa are found the requirements for such a multipurpose communications system. A few examples of components of the community that could be served are:

1) two universities engaged in some cooperative teaching, and a widespread demand in the area for part-time graduate studies;
2) two research organizations, one private and one public, engaged in the same general area of technology;
3) research groups engaged in research on educational methods;
4) broad and common interest in seminars related to the field of electrical engineering.

Some examples of the communications activities which could be supported and enhanced through the "Wired Scientific City" are:

1) joint, inter-institutional, seminars;
2) the linking of teaching institutions with each other and off-campus students, as recommended for study by "The Ring of Iron" [7];
3) joint meetings of small groups of people, working as a committee;
4) close, collaborative work between physically separated individuals - provision of a common working space; *
5) the expanded opportunity of members of this community to meet together on an informal basis to exchange information, ideas, problems, and so on.

While the members of the Ottawa community are separated by geography, they can be interconnected by relatively short-haul communication links. Whereas the experiment would be a valid one for interconnecting any parts of Canada, conducting it in Ottawa in a more limited area will keep the costs of a pilot project much better in hand.

Naturally the cost, both capital and operating, of such a system is of great concern. It should be emphasized that any cost-benefit analyses of these systems should be based on the costs and on the benefits appropriate a

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* A significant portion of this report has been assembled by two persons working together through a two-way video system.

decade from now. Assuming such broadband systems to be successful, and to be in reasonably wide usage, the increased volumes and improved technology of the future should produce significantly reduced costs, as has certainly been the case with digital computers. Even today, however, the costs of such systems are not as high as might be expected. The talk-back television at Stanford University, which provides for 20 to 30 remote classrooms throughout the San Francisco Bay region was capitalized at less than $600,000 and has annual operating costs of $100,000. Some preliminary calculations, based on hardware studies currently being conducted, suggests that operating and capital amortization costs would not exceed $25 per hour for a system of the type being contemplated assuming a 75% usage.

CHAPTER 1

DEFINITION OF THE COMMUNITY

This chapter of the first interim report will attempt to give a preliminary description of the Ottawa research/teaching community, and some of its supporting facilities.

1.1 The Ottawa Research and Teaching Community

Ottawa is the seat of the federal government, the site of two universities, a technological institute, a large industrial research and development establishment, and several engineering firms engaged in developmental work.

The majority of the components of the scientific community are within the federal government, which has some eighty research laboratories and institutes in eleven different departments and agencies. The activities are concentrated in the Departments of Agriculture; Communications; Energy, Mines, and Resources; Health and Welfare; and in the National Research Council. A list of the establishments is given in Table 1.1, which gives an idea of the scope of the activities carried out in the public service. These activities are scattered throughout the Ottawa area. The Department of Agriculture, for example, has the bulk of its laboratories at the Central Experimental Farm on Carling Avenue, but has research stations in the 'green belt' areas southwest of the city. The National Research Council has most of its laboratories at a site on the Montreal Road, where they are spread over a large compound, but also has facilities on Sussex Drive and at Uplands Airport. Similarly, Energy,

Table 1.1

Research Establishments of the Government of Canada in Ottawa

Agriculture

- Animal Diseases Research Institute
- Analytical Chemistry Research Service
- Engineering Research Service
- Statistical Research Service
- Animal Research Service
- Cell Biology Research Institute
- Entomology Research Institute
- Food Research Institute
- Ottawa Research Station
- Plant Research Institute
- Soil Research Institute

Energy, Mines and Resources

- Mines Branch
- Beological Survey
- Earth Physics
- Marine Sciences
- Inland Waters

Fisheries and Forests

- Biometrics
- Fisheries Research Board
- Canadian Forestry Institutes
  - Economics
  - Fire
  - Management
  - Chemical Control
  - Forest Products

Health and Welfare

- Research and Statistics
- Food and Drug
- Drug Advisory Bureau
- Food Advisory Bureau
- Research Laboratories
  - Animal Care
  - Food
  - Microbiology
  - Nutrition
  - Pharmaceutical Chemistry
  - Pharmacology
- Health Facilities Design
- Health Services
- Environmental Health
- Canadian Communicable Disease Center

Atomic Energy of Canada, Limited

- Commercial Products Division (Ottawa and South March)

Communications

- Communications Research Centre
- National Radio Propagation Lab
- National Space Telecommunications Lab
- National Communications Lab

Dominion Bureau of Statistics

Indian Affairs and Northern Development

- Canadian Wildlife Service
- National and Historic Parks
- Northern Scientific Research Group

National Defence

- Defence Research Board
  - Defence Research Establishment Ottawa
  - Defence Research
  - Operations Research Directorate

National Research Council

- Applied Physics
- Biology
- Building Research
- Chemistry
- Mechanical Engineering
- National Aeronautical Establishment
- Physics
- Radio and Electrical Engineering

Post Office

- Engineering Division

Mines and Resources is concentrated in a complex of buildings on Booth Street, but has activities on the Corkstown Road, on Carling Avenue, and on the Experimental Farm. The point to be made is that the facilities of most Departments are dispersed.

The largest industrial research establishment in the Ottawa area is Bell Canada - Northern Electric Research Limited, with laboratories at Crystal Bay and Kanata. Together with its sister company, Microsystems International Limited, Bell-Northern is engaged in a broad range of studies in communication technology. Other industrial organizations in Ottawa are Leigh Instruments, Computing Devices of Canada, Acres Intertel, Spartan Aero Services, TMC (Canada), Instronics, and a host of specialized laboratories and consulting firms.

The two universities in Ottawa, Carleton University and the University of Ottawa, have active research/teaching programs in pure and applied science, engineering, and the social sciences.

Special aspects of this research/teaching community are the library and computer facilities available to it. Each of the major institutions has a very extensive scientific and technological library, with large holdings of periodicals, documents, and texts. Primary among Ottawa's library facilities is the National Science Library, which is part of the National Research Council. This is a national library and all others may call on it for assistance. The National Science Library operates a Selective Dessemination of Information (SDI) system to which individuals may subscribe. Another large library system is the Defence Scientific Information Service of the Defence Research Board which is primarily a document library. Individual research laboratories

in the federal system normally have their own libraries as well. The Universities have central and departmental libraries, and are connected to the Ontario Universities' system. All libraries cooperate through established inter-library loan procedures. As yet none of the libraries have automated document retrieval systems, nor automated card indices, but, of course research in information retrieval systems is underway.

The computer facilities in Ottawa may be divided into two categories consisting of those computers that are used in a service bureau or computing centre role, and those that are used as laboratory equipment. The results of a 1970 census of computers in the Ottawa area is shown in Table 1.2. Much activity in the research/teaching community is related to computers, instruction, design, and programming as well as use, so that the computer community forms an integral part of the research/teaching community. In fact, research and teaching in the field of information systems is the basis used in this study for the selection of the stations in a pilot network.

1.2 The Pilot Project Community

At this preliminary stage, planning for a pilot network has been based on the assumption that it would comprise stations (nodes) associated with those organizations most heavily engaged in communications/computer research and teaching. These organizations are (Reference Figure 1.1)

1) The Communications Research Centre, of the Department of Communications, located at Shirley's Bay;

Table 1.2

Computers in Ottawa (1970)

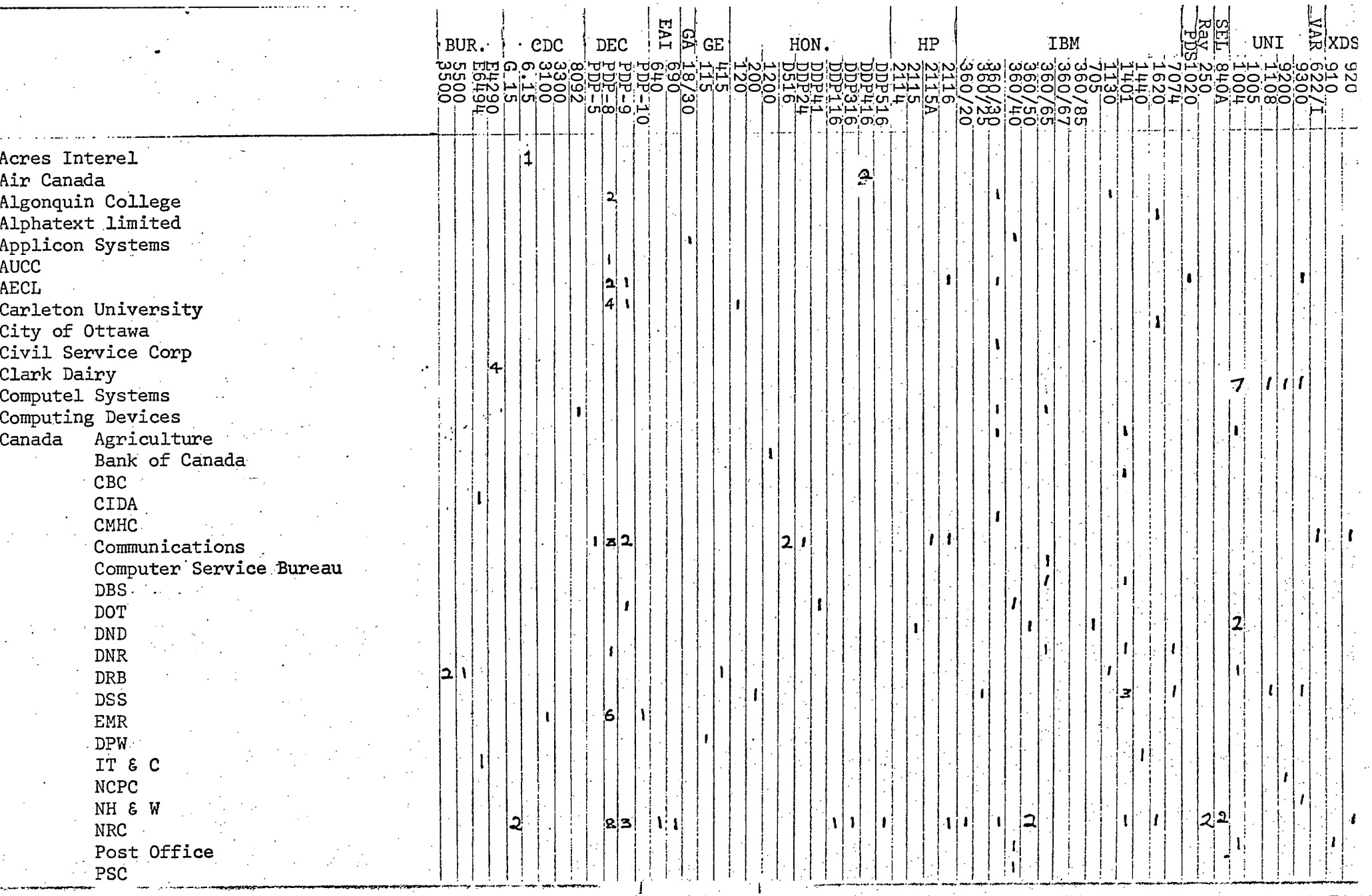
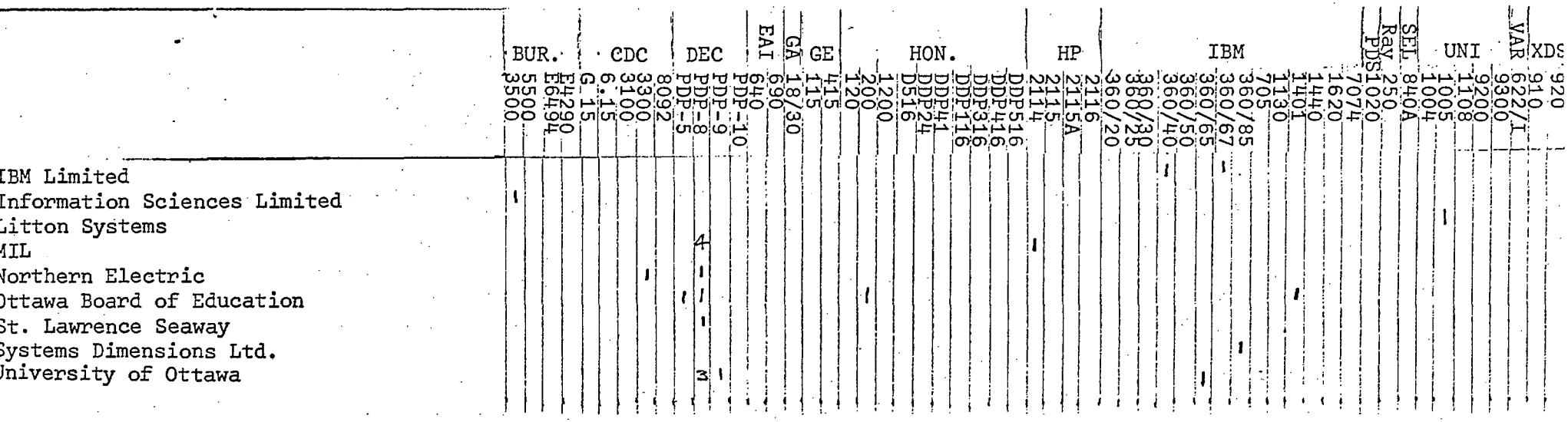


Table 1.2 (Continued)



2) Bell-Northern Research, located at Crystal Bay, with a laboratory at Kanata, and offices at Microsystems International Limited, on Moodie Drive;
3) Carleton University, on Colonel By Drive;
4) The University of Ottawa, in Sandy Hill; and
5) The National Research Council, on the Montreal Road.

The particular sections within these organizations that have been identified, as of this time, as having an interest in the "Wired Scientific City" are:

1) at the Communications Research Centre, the Informatique Directorate;
2) at Bell-Northern Research, the Distribution Systems Engineering Section;
3) at Carleton University, the Systems Engineering Division;
4) at the University of Ottawa, the Electrical Engineering Department; and
5) at the National Research Council, the Information Sciences Section of the Radio and Electrical Engineering Division.

The suitability of this set of specific nodes for the "Wired Scientific City" pilot project is under review at this time. It is not intended that they would necessarily be the primary users of network; they are designated at this time since they appear to have interests in such a pilot project. The relevance of the research/teaching activities of these particular groups to the successful operation of a pilot network, as well as representative communications within such a network, will be discussed in the following chapter.

CHAPTER 2

THE WIRED SCIENTIFIC CITY AND ITS USES

This chapter outlines, in a preliminary way, the functions of the communications facilities to be provided by the "Wired Scientific City". While surveys related to specific communications are still in progress, examples of the involvement of the Ottawa communications/computer community that relate to these functions, and specific communications that could use such facilities will be given. These examples are drawn from the functions, organizations and individuals of this particular "Scientific City".

2.1 Instruction

The first function that the network will allow will be the linking of the universities and the "surrounding community of scholars" via live interactive television for teaching purposes:[8] a one-to-many mode. Such systems exist in Florida (GENESYS), Texas (TAGER), California (STANFORD), and Minnesota, Wisconsin, Ohio, Rhode Island and Michigan.

The methods of linking teaching institutions with off-campus students in these systems are all based on the concept of bringing the off-campus students 'into' a live lecture, with regular on-campus students, by distributing television coverage of the lecture and providing a facility for audio talk-back. In these systems,[8]

> "a fundamental assumption is made that the on-campus environment will be studio classrooms ... to get a broad base of support from the faculty, a classroom rather than a studio environment has proven to be essential."

Many methods of transmission are used,

> "they fall into two general categories, area coverage systems and point-to-point systems. Area coverage systems include VHF/UHF broadcast TV, CATV, Instructional Television Fixed Service (ITFS), video tape, and satellites. Point-to-point systems include common carrier, private microwave, ITFS, and cable. ... talkback systems are all point-to-point systems. There are three common ways in which talkback can be handled; telephone, standard microwave equipment (FM multiplex radio), and ITFS response stations (FM 2.6 GHz radio). ... In all applications one should assume the need for a dedicated service because of the large number of hours of programming, and because dialup telephone service has proven, in practice, to be unsatisfactory.
>
> "University ITV networks will be feasible only with area coverage systems. Because of performance, cost, versatility, channel availability, and privacy, ITFS has to be the most important systems approach to a University ITV network. A survey of University plans throughout the country makes this fact self-evident."

The experience with the TAGER network at SMU in Dallas, Texas has led to the conclusions that, [9]

> "The following factors are considered essential to the success thus far enjoyed with instruction vai talkback TV at SMU:
>
> 1) All classes are 'live', with on-campus students in the room with the professor. No class is offered exclusively via video tape or to only off-campus students.
>
> 2) Students at remote receiving classrooms can participate fully in all class discussions.
>
> 3) TV cameras are inconspicuous, and there are no operate in the room to distract the professor or the students.
>
> 4) Innovations in presentation are possible because of the versatility of the medium.
>
> 5) Standards for admission, continuation, and graduation are identical for all students, regardless of geographical location.

6) All homework and examinations are graded on campus, regardless of the students' geographical class locations.

7) Individual consultations with the professor are possible, regardless of student location.

"The system has proved to be a highly satisfactory medium for achieving inter-institutional cooperation in higher education, as well as for bringing opportunities for higher education to industrial employees within a substantial geographical region. In addition, when used imaginatively, talkback TV has proved to be superior to the conventional classroom as an educational medium."

While the quoted articles are heavily in favour of the use of the ITFS microwave band (2.6-3.0 GHz)*, this method is not necessarily most suitable for a multipurpose network.

The successful experiences in the United States with talkback television systems is in marked contrast to many Canadian experiences, in which the talkback feature was not present. During recent years, Carleton University has presented many courses on its closed circuit television system. These courses have been broadcast to a number of standard classrooms equipped with TV monitors and nominal talkback via a single telephone in each classroom. Most of the televised courses have been mass attendance freshman courses, some with over 2,000 students. Large scale use has been made of video tape recording, with many repetitions of each lecture throughout each day, placing the onus for discussion on a teaching assistant present in the classroom. These courses have not been considered successful in the same way as the US ITV courses.

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* In Canada, 23 6MHz channels in the 2548-2686 MHz band. (DOT Standard Radio System Plan 300).

The situation in the Ottawa area is very similar to that which exists in the area served by the Stanford Instructional Television Network. [10] Large numbers of part-time students are enrolled as degree candidates at both universities. Table 2.1 shows the numbers of graduate students working for selected employers and studying electrical engineering part-time at Carleton University from 1966 to 1970. Difficulties that universities have had in meeting the demands for continuing education in Science and Engineering have been summarized by Vail and Bush: [9]

> "Logistical problems have loomed large: classes frequently have had to be held at night, when students and faculty are tired; long-distance commuting to class has been necessary for either faculty or students - or both; part-time or adjunct faculty have had to be utilized to teach off-campus or out-of-hours courses."

Part-time students often experience difficulty in attending regularly scheduled on-campus lectures because they cannot afford to be absent from work, or because of occasional travel out-of-town. Thus, the potential participation in regular programs on a part-time basis may be assumed to be much larger than that indicated by the present registration.*

Thus, if the "wired scientific city" were to provide the facility for talkback instructional television, with video tape recording as a limited use supplement, it would serve a vitally useful function in the Ottawa research/teaching community.

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* In the 1970/71 academic year, there were 5730 part-time students enrolled in degree credit courses at Carleton University alone.

TABLE 2.1

A PARTIAL LIST OF PART-TIME GRADUATE STUDENTS IN ELECTRICAL ENGINEERING AT CARLETON UNIVERSITY 1965 - 1971.

EMPLOYER	ACADEMIC YEAR					
	70-71	69-70	68-69	67-68	66-67	65-66
COMMUNICATIONS RESEARCH CENTRE AND/OR DEFENCE RESEARCH BOARD	8	8	5	5	1	2
DEPARTMENT OF TRANSPORT	6	8	5	3	2	-
NATIONAL RESEARCH COUNCIL	7	10	5	5	3	1
BELL-NORTHERN/ MICROSYSTEMS	27	30	15	14	8	3
NATIONAL DEFENCE	3	4	5	4	4	1
ENERGY, MINES AND RESOURCES	-	1	1	2	1	-
TOTAL	51	61	36	33	19	7

2.1.1 One example of relevant activities in the communications sub-community vis-a-vis the use of broadband communications in the educational field has been the implementation of the Information Retrieval Television (IRTV) system in Ottawa.[11] This system, originated by C.A. Billowes of Bell-Northern Research and implemented and operated by Bell Canada for the Ottawa School Board, has been in operation since December, 1967 . It provides, in individual classrooms, access on demand to a library of some 3,000 video tapes, films, and film strips. IRTV is presently installed in four schools, and is entering the second phase of its development, in which the task of scheduling material and channels is being computerized.

Mr. C.A. Billowes is part of a group at Bell-Northern Research which is concerned with the development of user-oriented communications. He and Mr. Gordon Johnson, under the leadership of Mr. Alex Curran[12], Manager of Distribution Systems Engineering, are involved in Project 91, IRTV, and with many branches of the Bell Canada System. Project 91 is a part of the Wideband Distribution Systems Study and is a two-way switched video system involving some twelve stations within the Bell-Northern Research/Microsystems International complex at Crystal Bay. Dial telephone circuits are used to control the (manual) video switching and to provide 'Speakerphone' voice communications. The equipment at each station consists of a fixed-view TV camera, an 11-inch monitor, and a 'speakerphone' - equipped telephone. This system is being used for experimental evaluation of the uses of video in conjunction with telephone conversations. Mr. Billowes is being aided in these studies by G.B. Thompson, of Bell-Northern Research, and Professors C.M. Woodside and J.K. Cavers, of

the Systems Engineering Division, Carleton University, and Professor Conrath of Waterloo University. Discussions are currently underway regarding the connection of Project 91 to the Communications Research Centre.

Mr. Johnson's group is concerned with studies of terminal equipment, is developing an experimental television laboratory, and a computer operated voice response unit for the IRTV system.

2.1.2 An example of cooperation in the university teaching area that would be well served by a talkback TV network is given by activities in the civil engineering area. During the 1970/71 academic year, some 35 students from Carleton University took 89.431 Hydrology, as a required course. The course was given at Ottawa University (with their students) and a bus was hired for $300 to transport the Carleton students back and forth. The lectures were consolidated to reduce transportation costs, and were two hours in length. Talkback television would have allowed the presentation of the course in two one-hour lectures per week and effectively reduced the size of the class, thus providing a better learning environment. Also, because travel time would be eliminated, the scheduling of the course would become much simpler.

It is the policy of Carleton and Ottawa Universities to allow students to take one course each year at the other institution as part of their regular program. This program is in its initial stages and the use of it in 1970/71 was limited; talkback TV could greatly increase the effectiveness of the program.

2.1.3 Another example of the involvement of the communications/computer sub-community in the use of communications in teaching is given by the research and development program of the Information Sciences Section, National Research Council, under the leadership of Mr. W.A. Brown. This group is engaged in the development of computer facilities, software, and terminal devices for Computer Aided Learning (CAL).

The CAL program involves the use of a single central processor (a DEC PDP10) for development of a standardized language for educators, standardized hardware, and the testing of the system by use. It is a national program with participants at the Universities of Calgary, Quebec, New Brunswick, and at the Ontario Institute for Studies in Education. Links with the Universities of Western Ontario and Alberta also exist, and participation from British Columbia is expected. Communications with the computer takes place over the Government Telephone Service. Communications related to the project is handled at present by an executive committee which meets every two months.

The CAL program includes central computer development, work on peripherals (audio, video, graphical), graphics, and CAL for the handicapped (in cooperation with Dr. Resnick of the Ottawa Civic Hospital).

The Information Sciences Section is also engaged in radar research: circuitry, microwaves, logic, instrumentation, radio altimetry profiling for the Forestry Service, remote earth sensing with Energy, Mines and Resources, and the Weather Physics program.

Mr. Brown is actively engaged in several ways with educational technology. He is a member of Project CARTIER, a group from government and industry with interests in education. He is also a member of the NRC Associate Committee on Instructional Technology which has eighteen nationally selected members. This latter body advises on the CAL project, among other functions. Mr. Brown also has frequent contact, on a personal level, with C.A. Billowes regarding IRTV.

The Information Sciences Section is well equipped with communications peripherals. They have developed a touch sensitive tablet for computer input, access of audio and video tape recordings under computer control, and various graphical display devices. They also make extensive use of VTR of their activities, particularly for demonstration of the system.

The activities of Mr. W.A. Brown are shown schematically in Figure 2.1.

2.2 Seminars

The second function that the network will serve is that of linking the universities and the research community via live interactive television for seminar purposes. The term 'seminar' is used here to denote a meeting of a type commonly held in the research/teaching community at which a paper is presented by a single speaker followed by a general discussion. Attendance at such seminars is usually between 10 and 40. This function is similar to that required by instructional television, with the difference that video signals must originate from whichever node the seminar is being held.

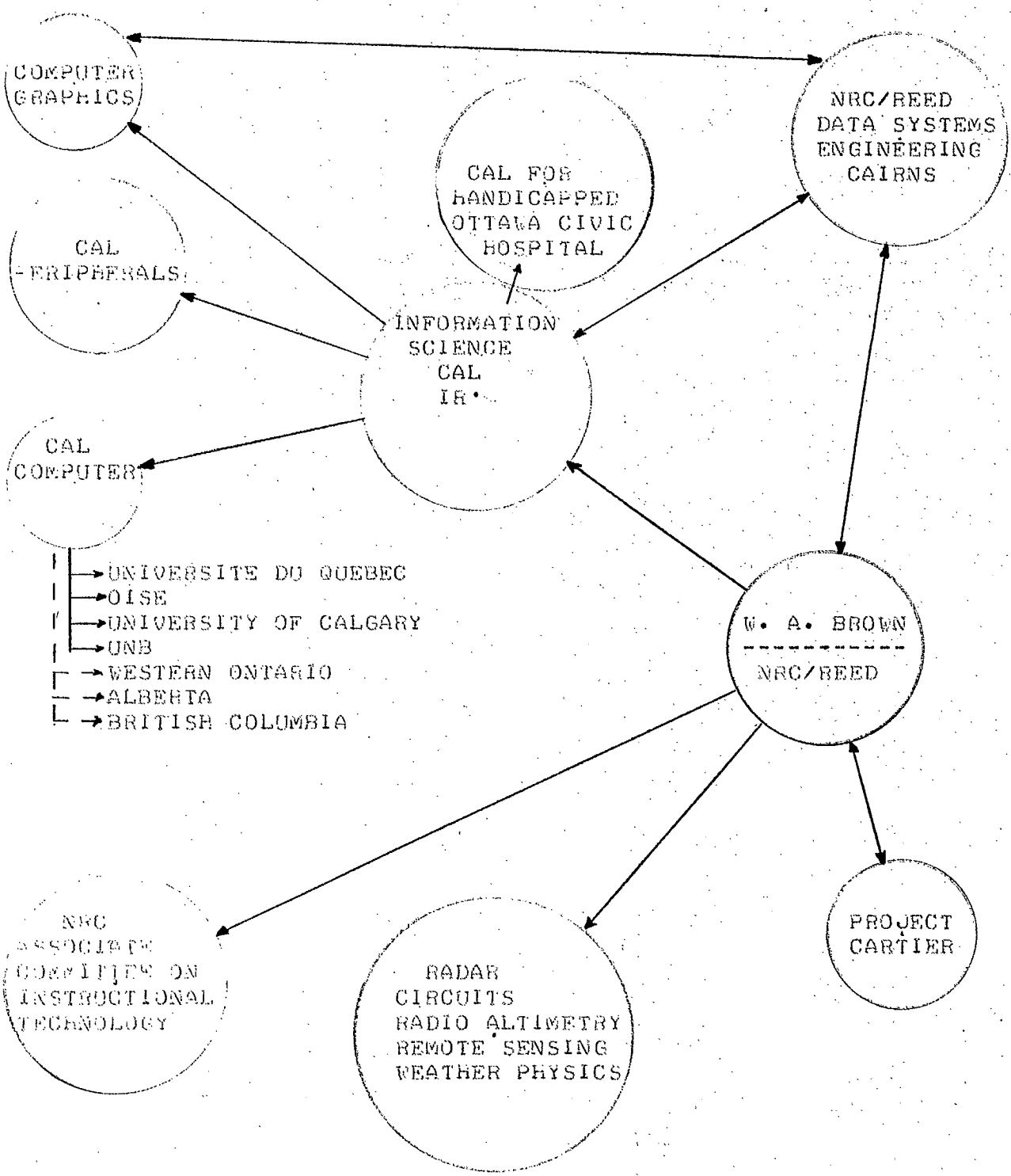

FIGURE 2.1 MR. W. A. BROWN

Seminars are one of the main means of information exchange in the research community. Some are held at regularly scheduled times, others are presented as and when occasions arise. Speakers may be in-house personnel, or visiting specialists. Topics include brief research reports, visit reports, thesis presentations, paper rehearsals, descriptions of new devices, products, computer programming systems, and so on. Many seminars are regularly advertised (through mailed notices) in the appropriate organizations throughout the community, while others are 'company confidential'. However, our inquiries show that few 'outsiders' attend seminars to which they have been invited, mainly for the reason that travelling to a seminar, the contents of which may turn out to be of little interest, takes too much time from busy schedules. It is also found that many seminars are missed due to insufficient or tardy notices.

As an example of the number of seminars that take place in the Ottawa research/teaching community, some of the seminars in electrical engineering that took place at Carleton University, the University of Ottawa, the Communications Research Centre and Bell-Northern Research from October, 1970 to June, 1971 are shown in Table 2.2. This chart does not include seminars at the National Research Council, Microsystems, computing centres, other scientific establishments in the area, or those papers presented at conferences in the Ottawa area during this period*. It also does not include papers presented to professional and scientific associations. While these are normally held

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* e.g., the EEMTIC Conference, June 1971 and the NRC Man-Machine Communications Conference, 7 May 1971.

TABLE 2.2

A PARTIAL CALENDAR OF ELECTRICAL ENGINEERING SEMINARS IN THE OTTAWA AREA 1970 - 1971

		MO	TU	WE	TH	FR
					UO	CU
	4			CU	UO	CU/BNR
OCT	11				UO	CU/BNR
1970	18				UO	CU/BNR
	25	CU			UO	CU/BNR
	1	CU			UO	CU/BNR
NOV	8	CU				BNR
1970	15	CU			UO	CU/BNR
	22	CU			UO	BNR
	29	CU				BNR
	6					BNR
DEC	13					BNR
1970	20					
	27					
	3					BNR
JAN	10	CU			UO	BNR
1971	17	CU			UO	CU/BNR
	24			CRC		BNR
	31	CU			UO	BNR
	7	CU				CU/BNR
FEB	14					BNR
1971	21			CRC	UO	BNR
	28	CU				CU/BNR
	7			CU		BNR
MAR	14	CU		CRC	CRC	BNR
1971	21				CU	CU/BNR
	28	CU			UO	BNR
	4	CRC		CRC		BNR
APR	11					BNR
1971	18					CRC/BNR
	25				CRC	BNR
	2					BNR
MAY	9		CU		CU	BNR
1971	16	CU		CU	CRC	BNR
	23					BNR
	30		CRC			BNR
	6					CU/BNR
JUNE	13				CU/CRC /BNR	CU/CRC /BNR
1971	20			CU/BNR	CU/BNR	CU/BNR
	27					

CU :CARLETON UNIVERSITY
UO :UNIVERSITY OF OTTAWA
BNR:BELL-NORTHERN RESEARCH
CRC:COMMUNICATIONS RESEARCH CENTRE

in the evening, visiting speakers are usually available during the day for possible seminar presentations.

There appears to be sufficient activity in the research/teaching community in the electrical engineering field alone to occupy a multistation interactive television channel at least thirty hours per week during most months.

The seminar facility of the wired scientific city is one that is a general requirement of the research/teaching community, as is the educational facility. They have the following attributes:

1) 'attendance' without the expenditure of travelling time;
2) participation in discussion;
3) sharing of speaker/lecturer costs;
4) recording of presentations for later viewing in case of unavoidable conflicts in scheduling; and
5) maintenance of a universal calendar of events.

2.3 Collaboration

A third function of the 'wired scientific city' network is the linking of collaborators via two-way visual communications: a one-to-one mode. Such linkages are primarily point-to-point, but could involve three stations. This function serves the needs of separated groups or individuals who work together in their professional activities.

While the network requirements to satisfy the lecture and seminar functions are fairly well defined, the communications that take place between cooperating groups is more varied, and results in different network requirements. The function to be served will be illustrated by a number of specific examples of existing cooperative programs.

2.3.1 The first example is that of Professor V. Makios of Carleton, who has full-time graduate students carrying out their research at the Communications Research Centre, in cooperation with Dr. W. Chidobiak and Dr. G.W. Jull of that establishment. Professor Makios' students are engaged in laboratory research on microwave oscillators, microstrip circuits, and optical materials. He devotes approximately one day a week to visits to CRC to consult with the students and to see the results of their work, the sources of their current problems, and to suggest the next steps to be taken in their research. He also spends a large amount of time on the telephone (one to two hours/week) in consultation with his collaborators. The nature of this cooperative research is such that the supervisor has the need to see experimental work in the laboratory, to establish a close presence with his student, to work on the writing of jointly-authored reports, and to draw sketches and mathematical derivations for his students.

Professor Makios has similar arrangements with Dr. E. Jull, of the National Research Council. There, a graduate student is working on antenna diffraction under Dr. Jull, with Dr. Makios' cooperation. As well, another form of collaboration exists in the form of the joint development of graduate courses in electromagnetic theory, which they have been teaching at Carleton for some years, into a new format.

The extent of Professor Makios' cooperative ventures within the research/teaching community are shown schematically in Figure 2.2. It is evident that his involvement is greater than most, but it is an example of a function that could readily be enhanced by the 'wired scientific city'.

2.3.2 Another example of cooperative research in the electrical engineering community exists between Professor A.R. Boothroyd, Chairman of the Electronics and Materials Division of the Faculty of Engineering at Carleton University, and his colleagues (particularly Professor M.A. Copeland) and Bell-Northern Research. (Professor V. Makios is also a member of this division). The cooperation is with Nichols and Sadler and is in the area of solid state devices: basic device theory, device modelling, and computer aided circuit analysis. To a large extent, Professor Boothroyd and his students use facilities at Bell-Northern Research for device fabrication and measurement. They also use computer facilities there. While access to the Bell-Northern Research computer can be gained from a local terminal at Carleton, the users prefer to use a terminal at Bell-Northern Research, because of the ease of communications with computer personnel there. Professor Copeland also has students working at Bell-Northern Research and Bell-Northern Research uses device fabrication facilities at Carleton.

Professor Boothroyd visits Bell-Northern Research on a regular basis, for about one day per week. His rationale for doing so is to obtain a change of environment, stimulation through contact with his colleagues at Bell-Northern Research, and to escape the (anticipated) interruptions that are

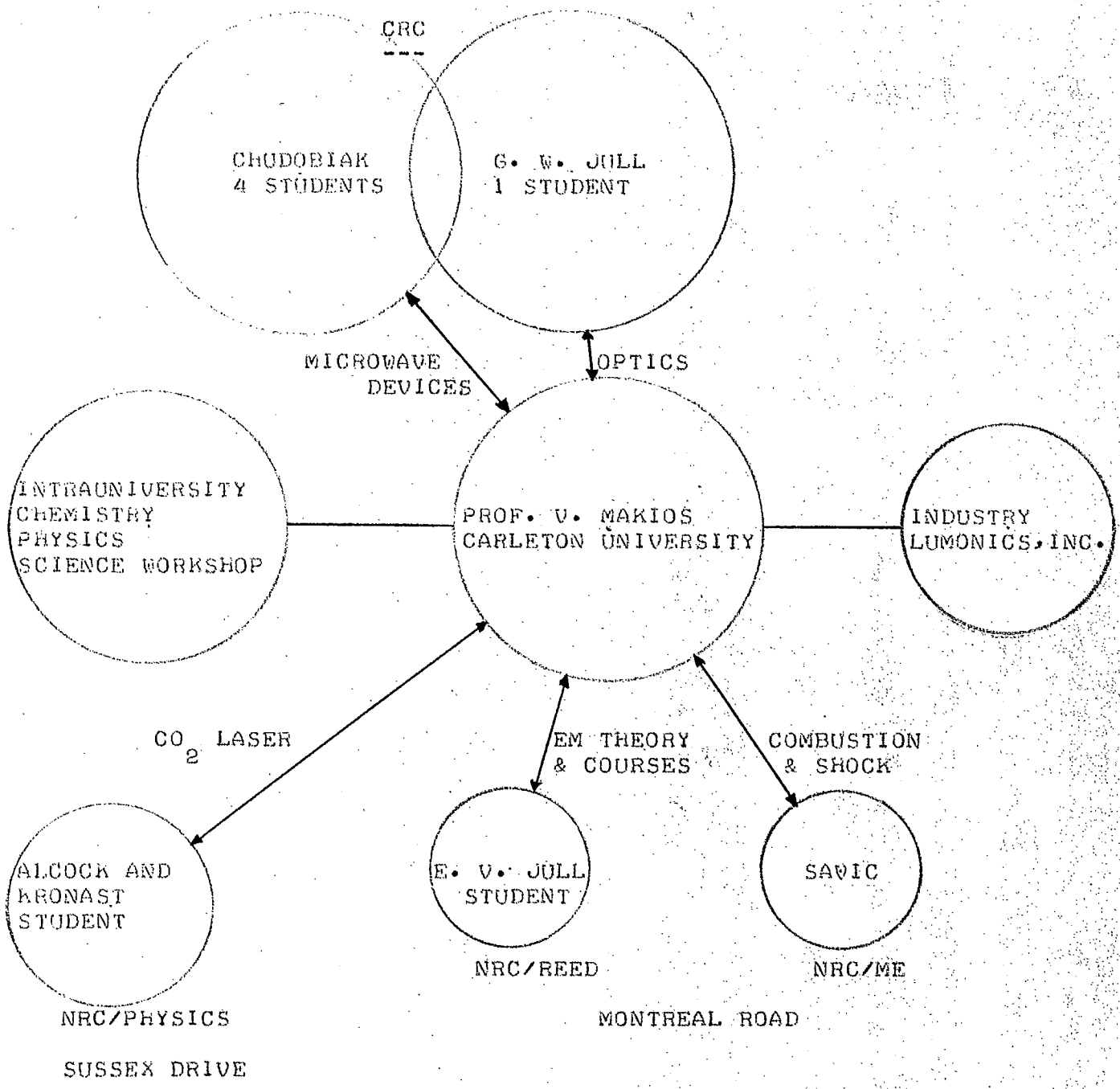

FIGURE 2.2 PROFESSOR V. MAKIOS

prevalent in his situation of the University. Professor Boothroyd has many extra-territorial communications: he has been a member of an IEEE committee on devices and solid state circuits for six years, and visits regularly at IBM, BTL, and Berkeley.

The communication requirements associated with this cooperative activity are for support of personnel using physical facilities remote from their normal place of work.

2.3.3 A further example of scientists cooperating and sharing common resources is given by the activity in low energy nuclear physics at Carleton and Ottawa Universities, and the Applied Physics Section of the National Research Council. This research is based on the joint use of the Dynamatron accelerator at Ottawa University, and a Van der Graaf and linear accelerator at NRC, and a DEC PDP9 computer at the Dynamatron. The communication paths in this network are shown in Figure 2.2. The members of this community write jointly-authored research papers and, hence, have a great deal of personal contact at times. One major communications requirement is for data transmission between measurement apparatus (nuclear scalers) and central computers, e.g. the SIGMA 7 at Carleton.

It is interesting to note here that the Physics Department at Carleton has installed a 'message alert' system, in which the fact that messages exist for any staff member is shown on annunciators mounted in the hallways of their building.

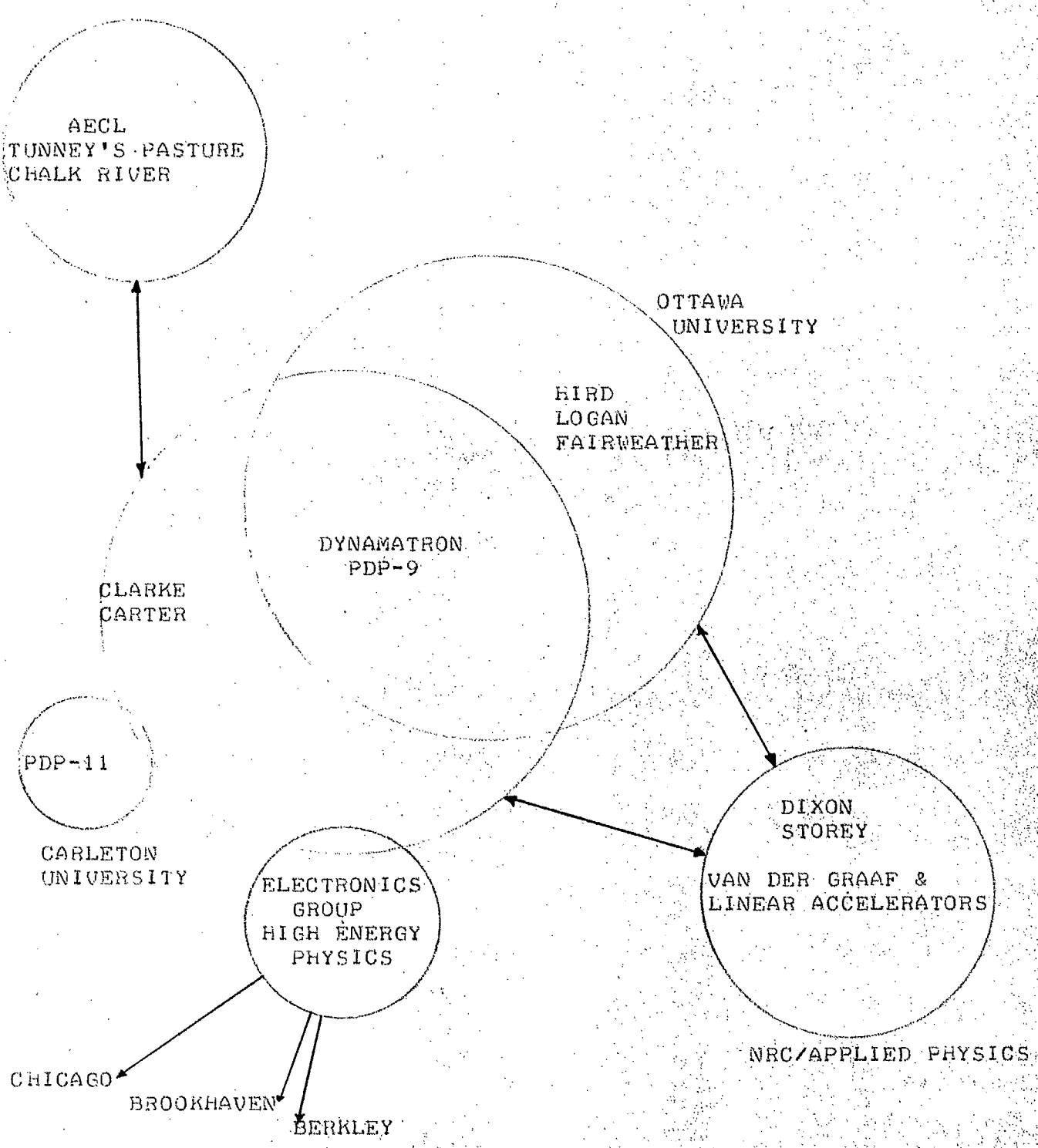

FIGURE 2.3 LOW ENERGY PHYSICS

2.3.4 An example, which requires the use of a common writing space, is given by the activities of an informal group formed by computer scientists in the Ottawa area to consider the development of 'compiler generators'. This group includes Scott of Bell-Northern Research, D.A. Thomas of Carleton University, and others from the Dominion Bureau of Statistics, Ottawa University, and the National Research Council. A major activity of this group is the joint development of computer programs, which involves a great deal of working on program listings on a line-by-line basis, that is similar to editing.

2.4 Discussions

The fourth function that the "Wired Scientific City" must provide for is that of a common communications space in which all nodes on the network are simultaneously connected: a many-to-many mode. This function serves the communications requirement for informal group discussions and the "lucky accident", or what Buckminster Fuller has termed "synergy", so common to scientific discovery.

This function implies simultaneous transmission and reception of all communication modes at each node.

This function of the network is the most difficult to describe in terms of specific examples. The role that it plays in scientific communications is apparently so well known and documented that Menzel is led to write: [5]

> "The fact that informal communication plays a very important role in the information exchange of scientists is by now quite well documented and need not be reiterated here."

Certainly, our preliminary studies have confirmed his opinions. As well, the common space, or discussion, function provides for an increase in the ease with which "gatekeeper networks" can operate.[6] The preliminary phases of this study had led to the conclusion that information was passed through a network of individuals who travel widely, attend many conferences, and are widely known both socially and professionally through the Ottawa research/teaching network. In fact, these key contact people are well recognized as a vital part of scientific/engineering communications.[6] Our own observations show that they are perhaps even more prominent in universities with their diversities of disciplines.

In relation to discussions, then, the function of the "Wired Scientific City" is twofold:

1) to enhance the natural communication processes by providing technological means for the operation of these processes, and
2) to provide the means whereby the natural process can be expanded through a common discussion space.

As was mentioned above, this function is the most difficult to define because it is a function that is not now available. As McCarthy has said of information technology:[13]

> "The computer will not make its revolutionary impact, however, by doing the old bookkeeping tasks more efficiently. It is finding its way into new applications that will increase human freedom of action. ... it is impossible to recite more than a small fraction of the uses to which enterprising customers will put it."

In an analogous way, communication technology must provide new and different modes of communication, on a formal and informal level. The cost/benefits of such modes are not predictable because of the unknown effects they will have on the communities they serve. The only sure result will be that they will affect those communities, sometimes drastically, as McLuhan has so forcefully demonstrated.

While the provision for the dissemination of lectures and seminars (the one-to-many mode) and facilitation of person-to-person communications (the one-to-one mode) are essentially the automation of existing functions, the common discussion space (the many-to-many mode) is a new function that requires experimental investigation and hence, is a vital function of the "Wired Scientific City".

CHAPTER 3

FACILITIES AND EQUIPMENT

This chapter is intended to provide information on the available voice and data facilities and terminal equipment as provided by the two major common carriers, Bell Canada and CN/CP Telecommunications. The actual services and costs are included in Appendix 1. The chapter is divided into three major parts. The first part deals with telephone terminal equipment and services, the second part deals with Data Services and leased land lines and the last part is about customer owned terminal equipment and associated policy.

3.1 Telephone Terminal Equipment and Services

3.1.1 Automatic Answering and Recording Services

Both Bell-Canada and CN/CP will provide facilities, and in some cases terminal equipment, for automatic recording and receiving. Some of the available units from both companies are listed below.

(i) - Code-a-Phone 200/700 - The above units will automatically answer unattended calls. Code-a-Phone 700 will automatically record any messages for a pre-set time limit.
- Bell Canada provides and services this unit.
- The rental price is $55 per month plus a $30 installation charge.
- The above units have applications in offices and firms whose personnel are continually on the move.

(ii) - CN/CP will provide automatic answering units at a rental price of $8.50 per month plus a $10 installation charge.

(iii) - Recorder connectors and couplers

Both common carriers provide the above units. These units allow the connection of customer owned recorders and answering units. The policy for connecting customer-owned equipment is that the customer may connect any terminal equipment onto companies lines provided certain conditions are met.

- Bell Canada rents these units at $5 per month.
- CN/CP will rent same at $10 per month.

3.1.2 Automatic Dialing Services

The "common carriers" provide switching facilities to allow subscriber-to-subscriber direct dialling. Some of automatic dialling equipment is described below.

(i) Magicall-Automatic dialling set-Bell

- This is a Bell-Canada set that automatically dials a number of pre-recorded names and telephone numbers. This set can store and remember 400 numbers. The user merely selects the appropriate name and the number is automatically dialled.
- The set rents at $21.75 per month plus a service call charge of $7.50.

(ii) Abbreviated dialling

- This service enables the establishment of a connection by use of a two digit number push button instead of the usual seven digit code.

(iii) Call Director - (Bell)

- This is a pushbutton set that allows distribution and routing of incoming and local calls.
- Monthly rental on the set is $19.50 plus an installation charge of $22.50.

3.1.3 Conferencing Services

(i) Pushbutton Dial PBX - Bell

- This set will allow a conference of up to 3 members.
- The rental price on the set is $59.59 per month plus an installation charge of $7.50.

(ii) - Both companies will provide conferencing capability either by making an oral request to the operator or by dialling a predesignated number that will cause a connection to the desired parties.
- The cost of the conference depends on how many users were on and how often. There is a practical limit to how many members may be on. For example, Bell Canada sets the limit at 14 users for long distance conferences and 10 for local conferences.

3.1.4 Facsimile Services

(i) INFOFAX - CN/CP

- This is a facsimile transceiver designed for operations over switched or dedicated circuits. The unit transmits and receives hand-written documents, graphics, and so on. 8 ½" x 11" documents take about 3 ½ minutes to transmit.
- Unit rents at $175 per month with an installation charge of $50. Toll charges are applicable for the "time on line".

3.1.5 Telewriting Services

(i) Telescript (Bell); VERB (CN/CP)

- These sets will transmit instantaneously hand-written messages and diagrams.
- The service is particularly useful to people sending engineering drawings and circuit diagrams.
- The Bell set rents at $55 per month plus $2 per ¼ mile of the conditioned lines.
- Information on the CN/CP system is not available at this time.

3.2 Data Services and Leased Land-Lines

Data communications services are available from both carriers. Both companies provide data communication up to speeds of 4800 bauds. Terminal equipment may be rented or bought and installed on the companies' lines in accordance with special conditions set by the companies. Terminal equipment

includes teletypes, modems, and so on. The cost of renting different modems and teletypes are included in Appendix 1. The following is a brief summary of the land-line services available.

3.2.1 Broad-Band-Exchange Service - CN/CP

This is a high speed service up to 48,000 bauds. The service is available in two packages; switched and dedicated.

(i) Switched Network Service

- In this service the company provides channel facilities connecting a subscriber's terminal to a company exchange. Full duplex or simplex operations are available.
- Dial access units (voice/data) are provided.
- The cost of leasing the lines and services are as follows.

  For each station there is a monthly charge of $100 plus $20 installation charge. Toll rates are applicable between any two points at 10¢ per minute. For the various data sets and services see Appendix 1.

(ii) Dedicated Network Service

- The company will provide 4 wire direct leased lines between subscribers. The cost* of renting terminal equipment and leased lines is as follows:

  2400 baud circuits

  (i) Monthly rental - $660.
  (ii) Installation charge - $400.

  4800 baud circuits

  (i) Monthly rental - $1240.
  (ii) Installation charge - $400.

---

* The quotation above refers to the cost of renting four 4-wire circuits between Carleton University and NRC, BNR, CRC, and Ottawa University.

3.2.2 Telex, Data Telex Service CN/CP

The 'common carrier' will provide low speed data lines for subscriber to subscribe transmission of digital direct current signals such as data telemetering etc. The service can be provided as either a switched or dedicated system.

a) Switched Network

Under the switched network system there are two options available.

(i) Data Telex up to 200 baud

The customer is provided with lines and terminal equipment if requested for. The customer can only establish one connection at a time.

- The monthly rental for above option is as follows.

User terminals	Monthly rental	Installation
Teletypes	$	$
Model 33KSR*	50.	250.
33ASR	100.	35.
35KSR	65.	25.
35ASR	135.	35.

* KSR - Keyboard send and receive
ASR - Automatic send and receive

- Dial access unit rents for $65 per month with a $25 installation charge.

(ii) Telex Computer Inquiry Service (TCIS)

This service will provide lines between computers and the local exchange. The use is provided with the capability to dial up a computer through the switched network. Special trunk lines are required between the computer and local exchange. However if all users are in Ottawa a flat rate of $15 per user per month is required. The following is the monthly rate based on the premise that the computers will be in Ottawa and that they will be connected via Data Telex facilities.

Monthly Rental/Terminal

Line rental toll	$15.00
Teleprinter 35ASR	135.00
TCIS access line	300.00
Total Monthly Rental	$450.00

Optional terminal equipment

Computer Data Interface - (CDI 101A)

- rents at $30/month.

In all of the above cases a non-recurring installation charge is applicable.

- See Appendix 1 for full explanation.

b) Dedicated Networks (Intra-City)

The company will provide low speed dedicated circuits suitable for data and text material transmission. In this service full duplex operation may be obtained depending on customer requirements.

Monthly full duplex rental rates are as follows:

(i) Channel charges: $2 per ¼ air mile

Carleton Unit to BNR	8 miles	$64
CRC	9 miles	$72
NRC	6 miles	$48
Ottawa U	5 miles	$40
Total Channel charges		$224

(ii) Terminal equipment per station

Teleprinter ASR #33	$110
Data loop converter	$ 10
Electronic station selector*	$150
	$270

(iii) Installation charges $ 50

* An electronic station selector is a unit that will automatically select the desired station.

Bell Canada will provide leased-lines to suit different forms of communications. The communication packages offered are:

(i) Radio Broadcasting Channels

(ii) Telephotograph channels (facsimile)

(iii) WATS (Wide Area Services)

(iv) TWX (Teletype Exchange Services)

(v) Data-Com Services

(vi) Telepak - channels

(vii) Data communication channels of varying speed and capability.

The company will also provide terminal equipment.

NOTE: At the present it is not possible to actually say what these services are and how much they cost because of the difficulties encountered in trying to obtain the information.

3.3 Customer Owned Terminal Equipments and Policy

The "common carriers" maintain a policy that the customer may supply all or some of the terminal equipment. Certain conditions and requirements have to be met before installing the equipment onto the companies' lines.

Bell Canada require that the customer provide special equipment to protect the company's lines against over-voltage and currents.

CN/CP requires the customer to ensure that currents and voltages in excess of those specified by the company's are not impressed on their lines. Further, creation of extra channels over and above the leased ones by multiplexing etc. is prohibited. The following is a compilation of telephone and data equipment that may be owned by the customer.

1. Telewriting
   - (i) Telescript or Verb

2. Telephone
   - (i) Pushbutton PBX (6 buttons)
   - (ii) Ordinary telephone
   - (iii) Ampliphones
   - (iv) Speakerphones

3. Autodialling and Answering
   - (i) Code-a-Phone 200 or 700
   - (ii) Magicall
   - (iii) Recorder coupler/connector

4. Facsimile
   - (i) Info-Fax
   - (ii) Xerox Telecopier

5. Switching
   - (i) 30 button PBX
   - (ii) Call-directors
   - (iii) Centrex

6. Paging
   - (i) Bell-boys
   - (ii) Loudspeakers

7. Data
   - (i) Teletype (both keyboard and automatic send and receive)
   - (ii) Data modems of speeds up to 48 Kbps.

CHAPTER 4

A TENTATIVELY PROPOSED SYSTEM

It is our intention, in this chapter, to briefly outline the general characteristics of the system which our work to date suggests would be appropriate for a pilot "Wired Scientific City". The technology of effecting this system will not be discussed, but rather the general characteristics of the system as it would appear to the participating organizations.

As discussed previously, the system is to be used in three primary modes. The one-to-one mode, as provided by the conventional telephone, is to enable discussions and working sessions between two individuals, each at a different node in the system. The one-to-many mode (with some provision for many-to-one) is to provide for the conventional lecture session. Finally, the many-to-many situation arises during group discussions, and similar occasions. This last mode determines the primary characteristics of the hypothetical system as the other modes can be viewed as sub-sets of this mode. It follows directly from the many-to-many situation that the signals emanating at any particular node must be available at all other nodes. The system must have the capability to bring all users into a "common space".

A vital characteristic of an experimental system is that it be readily modified and varied. Below, we shall discuss a prototype system, but it does not follow that all nodes would have identical characteristics and facilities. Each node could, to a reasonable extent, adjust its particular facilities to its requirements and financial capabilities. However, at each node all

communication signals originating within the system would be available, although private circuits could probably be appended to the system.

The communications "backbone" of the "Wired Scientific City" is taken to be television. Although colour would have obvious attractions, economics would appear to rule this out, particularly as there appear to be no distinctly identifiable colour requirements (as might be found, for example, in a communications system for medical use). The basis, then, will be black-and-white television with certain auxiliary services.

Our studies to date have indicated clearly that each node should originate two television signals. One channel, the most important one, would be devoted to a writing surface of page size or less through which prepared textural material, handwritten notes, charts, diagrams, and so on could be communicated. The other channel would be devoted to a general view of the person or persons communicating from a node. Of course, the channels could also be used for other purposes such as the viewing of experimental facilities. Each node would have the potential to originate two video signals and to receive two video signals from each of the other nodes. Clearly, considerable work is required to determine the best methods for the production and viewing of these images. Our preliminary experiments have suggested that a communications system of this type could readily fail if insufficient attention were paid to the interaction between the users and the system.

The video signals, of course, would be accompanied by the appropriate high quality audio signals but provision should be made for some additional services. Foremost among the other possibilities are a facsimile capability

to exchange hard-copy documents and the capability for teletype-level computer connections. Some provision for video and audio recording warrants serious consideration and the capacity to interconnect with the telephone system would be valuable.

The basic system which is proposed consists of two video channels with a high quality audio channel, and some auxiliary "narrow band" capabilities, at each node with the output from each node available at all the other nodes. Switching in the system would be accomplished by selection which would be primarily under the control of the viewers, not the originators, of the video signals.

It is evident from the foregoing that our concern is primarily with a system based on human-to-human interaction. In reality of course this is but one component of the total picture which would in its entirety see human-machine and machine-machine interaction.

The sharing of resources particularly computing power is most desirable and indeed studies of this concept are being undertaken seperately by other researchers.

The success of this, or any other pilot system, will depend in very large measure on the proper design of terminal facilities and on the development of a good level of the system. Further detailed design of the system will determine its ease of usage, cost and flexibility. At this stage it is most important, however, to determine the basic communication facilities which will be available. This chapter is a first step in this direction. The next stage of this study will develop these concepts in detail.

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DIRECTORY OF COMMUNICATION RESEARCH CENTRES

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University of Denver, Division of Research, College of Business Administration.

University of Notre Dame, Research Program in Marketing Communication.

State University of New York, Center for Field Services and Research.

University of Colorado, Bureau of Speech Services.

Western Michigan University, Communication Research Center.

Aerospace Corporation, El Segundo, California.

University of Utah, Computer Center.

California Institute of Technology, Jet Propulsion Laboratory.

Massachusetts Institute of Technology, Research Laboratory of Electronics.

Southern Methodist University, Information and Control Sciences Center.

Boston University, Communication Research Center.

Brandeis University, Morse Communication Research Center.

Colorado State University, Center for Research in Communications.

Colorado State University, Institute in Technical and Industrial Communications.

Columbia University, Bureau of Applied Social Research.

Communications Research Institute, Coconut Grove, Miami.

Fairfield University, Center for the Advancement of Human Communication.

Indiana University, Bureau of Media and Opinion Research.

Indiana University, Mass Communications Program.

Marquette University, Center for the Study of the American Press.

Marquette University, Institute of the Catholic Press.

McGill University, Institute of Islamic Studies.

Michigan State University, Department of Communication.

Municipal University of Omaha, Organizational Psychology Laboratory.

National Center of Communication Arts and Sciences, Denver, Colorado.

Ohio University, Persuasion Laboratory.

Purdue University, Communication Research Center.

Rutgers, The State University, Bureau of Information Sciences Research.

Rutgers, The State University, Sociology Research Laboratory.

Stanford University, Institute for Communication Research.

Syracuse University, Communications Research Center.

Syracuse University, Laboratory of Sensory Communication.

Syracuse University, Newhouse Communications Research Center.

Texas Technological College, Speech and Hearing Clinic.

University of Cincinnati, Communication Institute.

University of Florida, Research Division.

University of Illinois, Institute of Communications Research.

University of Iowa, Mass Communication Research Bureau.

University of Minnesota, Communications Research Division.

University of Oregon, Division of Communications Research.

University of Washington, Communications Research Center.

University of Wisconsin, Mass Communications Research Center.

University of Wisconsin, Speech Experimental Laboratory.

George Washington University, Biological Sciences Communication Project.

Western Behavioral Sciences Institute, La Jolla, California.

Duke University, Research Triangle Institute.

Massachusetts Institute of Technology, Lincoln Laboratory.

Spindletop Research, Inc., Spindletop Research Center.

APPENDIX 1

AVAILABLE VOICE AND DATA FACILITIES:

BELL CANADA AND CN/CP SERVICES AND COSTS

A1 (a) Bell Canada Services

Data Set Charges

Dial-Up

Speed	Model	Monthly	Installation Charge
Up to 300 baud	103A	$ 31.90	$ 37.00
2000 baud	201A	116.90	150.00
		$148.80	$187.00

Private Line

Speed	Model	Monthly	Installation Charge
2400 baud	201B	$115.00	$150.00
4800 baud	4800 series	260.00	150.00
		$375.00	$300.00

Approximate Line Charges:

Schedule 4 Type 4 Duplex Circuits:

2400 BPS

Carleton University to:

	Monthly	Installation Charge
A. Ottawa University		
Mileage	$ 19.20	$ 30.00
Conditioning	35.00	22.00
B. National Research Council		
Mileage	38.40	30.00
Conditioning	35.00	22.00
C. Communications Research		
Mileage	41.60	30.00
Conditioning	35.00	22.00
D. Bell-Northern Laboratories		
Mileage	41.60	30.00
Conditioning	35.00	22.00
	$280.80	$208.00

Approximate Line Charges:

Schedule 4 Type 4 Duplex Circuits:

4800 BPS

Carleton University to:

	Monthly	Installation Charge
A. Ottawa University		
Mileage	$ 19.20	$ 30.00
Conditioning	50.00	30.00
B. National Research Council		
Mileage	38.40	30.00
Conditioning	50.00	30.00
C. Communications Research		
Mileage	41.60	30.00
Conditioning	50.00	30.00
D. Bell-Northern Laboratories		
Mileage	41.60	30.00
Conditioning	50.00	22.00

A1 (b) CN/CP Services Offered

Low Speed: 50 Baud up to 200 Baud

Switched: Telex and Data Telex Services furnished by CP/CN Telecommunications whereby facilities are provided for direct Subscriber-to-Subscriber transmission of digital direct current signals such as Data, Telemetering, etc., at speeds up to 200 Bauds (bits per second) in accordance with the regulations and rates specified in Tariff C.T.C. (TG) 13TA.

Description of Service:

The Service contemplates the furnishing by the Telecommunications Company of intercity channel facilities between exchanges, and as provided for in the following, local channel facilities connecting the Subscriber's premises with the Telecommunications Company's exchange to enable said Subscriber to the service to transmit signals to other Subscribers.

The facilities furnished by the Telecommunications Company permit two way non-simultaneous transmission.

The service is offered only on a "Paid Here" basis. That is, the charges applicable for all connections made by the calling Subscriber will be applied against that Subscriber's account.

The calling Subscriber can establish a connection to only one other Subscriber at a time.

The Telecommunications Company does not transmit messages but merely provides the use of its facilities, when and where available, to Subscribers to the service in accordance with the regulations, rates, and charges contained in mentioned Tariff.

Conditions of Operation:

(A) The calling Subscriber may establish a connection with another Telex or Data Telex Service Subscriber, at any time.

(B) Prior to connecting Subscriber-owned equipment to the Telecommunications Comapny's facilities, the Subscriber shall comply with the conditions stated by the Telecommunications Company and shall not impress upon the Telecommunications Company's loops, voltages and currents in excess of those specified by the Telecommunications Company.

OPTION #1

8 Level ASCII Code
5 Stations: Carleton - Bell Northern Research - Ottawa University - Communications Research Centre - National Research Council.

Tolls: The applicable Toll Rate within the Ottawa Area is ten cents per minute. No minimum charge.

In order to enable several user terminals to interrogate your computer in Ottawa on a multi-access switched basis in the ASCII CODE AND SPEED RANGE OF 110 BAUDS, the following equipment options are recommended.

User Terminals	Monthly	Non-Recurring Installation Charge
Model 33KSR	$ 50.00	$ 25.00
Model 33ASR	100.00	35.00
Model 35KSR	65.00	25.00
Model 35ASR	135.00	50.00

Connection Capabilities:

The following charges applicable for equipment operating up to 200 Bauds when such equipment is not provided by the Telecommunications Company (unless otherwise specified connection will be on the basis of a 20 MA. or 40 MA. make/break current basis).

Switched Connection:

		Monthly Rental	N.R.I.C.
(A)	When the Telecommunications Company does not provide a dial unit (non-originating only).	$ 20.00	$ 25.00
(B)	When the Telecommunications Company provides a dial unit.	25.00	25.00
(C)	When the Telecommunications Company provides an RS-232B interface.	30.00	25.00
(D)	When the Telecommunications Company provides a dial unit and an RS-232B interface.	35.00	25.00
(E)	When the Telecommunications Company provides a dial unit and an RS-232B interface and a Telex printer.	65.00	25.00

Automatic Calling Unit, Computer to Telex (ACU-1A)

Optional:

Basic Unit Without Answerback	60.00	25.00
Basic Unit With Answerback Feature 8 level code.	66.75	25.00

OPTION #2

User terminals which are located in the same city as the computer can be connected to the latter through Data Telex facilities at a flat rate in lieu of tolls of $15.00 per user per month plus whatever might be applicable for terminal and/or interface equipment.

Monthly Rates: Continuous Service

5 users within the Ottawa Core at $15.00 per month in lieu of tolls	$ 75.00
5 KSR Tele-printer @ $50.00 per month per unit	250.00
One TCIS ACCESS LINE	300.00
One user in mileage block #2 (Kingston) @ $50.00 per month flat toll	50.00
One KSR teleprinter monthly rental at Queen's @ $50.00	50.00
TOTAL MONTHLY RENTAL	$675.00

Optional Equipment

CDI (Computer Data Interface) 101A

The CDI-101A is the nucleus of the interface equipment and allows the interconnection of computer/data equipment with a voltage output per EIA specifications RS-232B into a current operated teletype loop.

One CDI-101A interface at computer port rents for $30.00 per month.

Non-Recurring Installation Charges:

6 Teleprinters including Kingston installation @ $25.00 per installation	$150.00

Optional CDI-101A installation charge is $25.00 per unit.

NOTE: Manual teleprinters have been quoted in this example but we will, of course, supply automatic send and receive teleprinters where required at regular Telex rentals.

ASR Model 33 Teleprinters lease for $100.00 monthly.

Intra-City Dedicated Circuits

Low Speed: Up to 200 Baud

Dedicated: Point to Point and Multi-point service

Description of Service:

(1) This service contemplates the furnishing by the Telecommunications Company of channels which are suitable for transmission of data and text material. The data processing equipment and the station wiring for data transmission purposes, other than the data terminal equipment referred to under "Rates" following, generally are provided by the Subscriber.

(2) Transmission may be one-way, two-way non-simultaneous or two-way simultaneous, as specified by the Subscriber.

Channel Schedules:

Schedule 3A - These channels are suitable for the transmission of binary signals at rates up to 200 Bauds.

Rates:

Channel Charges

Intra-City Channels

Intra-city data circuitry of 110 bauds $1.00 per quarter airline mile, minimum $3.00 per month. Double charge for two-way simultaneous.

Total Mileage Charges

Carleton to Bell-Northern Labs	8 miles
Carleton to Communications Research Centre	9 miles
Carleton to Ottawa University	5 miles
Carleton to National Research Council	6 miles
TOTAL MILEAGE	28 miles
28 miles equals 4 x 28 = 112 quarters	
112 quarters x $1.00 per quarter =	$112.00
Two-way simultaneous/full duplex =	112.00
Total circuits rental per month	$224.00

Station Equipment

Monthly Rental:

5 MDL #33 ASR @ $110.00 per unit	$550.00
1 Data Loop Converter DCI-101 to work into one computer port	$ 10.00

Electronic Station Selectors (Optional)

If necessary pricing would have to be developed.
Approx $150.00 monthly complete.

TOTAL MONTHLY RENTAL	$784.00

Non-Recurring Installation Charges

5 teleprinters @ $20.00 per unit	$100.00
1 CDI-101 @ $25.00	$ 25.00

High Speed Circuits

OPTION #1 Broadband Exchange Services

Description of Service: Switched

Broadband Exchange Service is furnished subject to general regulations as stated in our C.T.C. (TG) 137B TARIFF.

This tariff applies to Broadband Exchange Service furnished by the Canadian Pacific Railway Company and the Canadian National Railway Company whereby facilities are provided for direct subscriber-to-subscriber transmission of digital or analog signals, such as data, teleprinter, telemetering, voice-coordination, voice program material and facsimile, in accordance with the regulations and rates specified.

Broadband Exchange Service is offered to subscribers connected for such service to exchanges of the Telecommunications Company. Subject to the availability of facilities, service may be provided to locations remote from exchange at full-period Private Line Telephone Service rates or Class 4 Data Transmission Service rates, depending on type of facilities required by the subscriber.

Broadband Exchange Service contemplates the furnishing by the Telecommunications Company of intercity channel facilities between exchanges and local channel facilities connecting the subscriber's premises with the Telecommunications Company's exchange to enable a subscriber to the service to transmit signals to another subscriber.

The facilities furnished by the Telecommunications Company permit, optionally, non-simultaneous or simultaneous signals in both directions.

The Telecommunications Company will provide, install and maintain on subscriber's premises a telephone handset, and associated sub-set.

The Telecommunications Company will provide data sets (modem) required for the conversion of data signals for transmission over the channel facilities being provided. Other equipment as required by the subscriber amy be provided by the Telecommunications Company or by the subscriber, subject to the approval of the Telecommunications Company.

Prior to connecting subscriber-owned equipment to the Telecommunications Company's facilities, the subscriber shall comply with the conditions stated by the Telecommunications Company and shall not impress upon Telecommunications Company's loops, voltages and currents in excess of those specified by the Telecommunications Company.

The subscriber shall not create additional channels from the facilities furnished by the Telegraph Company.

The calling subscriber can establish a connection to only one other subscriber at a time, except as indicated in a conference package configuration.

The initial contract period for service and equipment furnished by the Telecommunications Company is one month. PROVIDED, however, that the Telecommunications Company may stipulate an initial period longer than one month where:

(A) special construction is necessary for the provision of the service, or

(B) special non-standard equipment or special assemblies of equipment are installed.

Special Services

At the request of the subscriber, the Telecommunications Company may provide the following special services:

(A) ABBREVIATED DIALLING which will enable the subscriber to establish connection with subscriber designated by him through use of a two-digit push button number rather than the standard seven-digit number.

(B) CONFERENCE CALLING which permits a subscriber to establish connection with more than one subscriber at a time. This may be accomplished by the subscriber either making an oral request to the conference operator or by dialling a predesignated special number which will automatically cause connection to the desired parties.

Power, Personnel and Supplies

The subscriber shall furnish at his expense any electric power outlets required on his premises. The subscriber must provide the personnel, power, stationary and other supplies required for operation of the station equipment on his premises.

Service Limitations

(A) Facilities provided by the Telecommunications Company shall be employed only for the private use of subscribers and such facilities shall not be used either directly or indirectly for the purposes of handling communications or for any other purpose for the public or any person, firm or corporation other than the subscriber or subsidiary or affiliated companies of the subscriber and their representatives, except as permitted by the Telecommunications Company.

(B) Bills are issued monthly and are payable upon receipt. In the event of non-payment of any sum owing to the Telecommunications Company for Broadband Exchange Service for more than sixty days beyond the date of issuance of the bill for such services or upon violation of any of the conditions governing the furnishing of service under the tariff, the Telecommunications Company may, without incurring any liability forthwith, discontinue the furnishing of facilities under the tariff and retake possession of its equipment and for this purpose may enter a subscriber's premises.

Recording of Broadband Exchange Service Usage

For billing purposes the usage of Broadband Exchange Service is recorded by automatic toll ticket devices located in the Telecommunications Company's exchange and connected to the subscriber's station.

Usage time is recorded in tenths of minutes and begins when connection to another subscriber station is established and ends when the connection is terminated. There is a 30 second minimum per call.

Rates: 2400 Baud

For each broadband exchange station connection there is a $100.00 monthly charge plus $20.00 installation charge.

Locations	Monthly Rental	N.R.I.C.
Kingston	$100.00	$ 20.00
Carleton	100.00	20.00
Bell-Northern Laboratories	100.00	20.00
Communications Research Centre	100.00	20.00
National Research Council	100.00	20.00
Ottawa University	100.00	20.00
TOTAL	$600.00	$120.00

The applicable toll rate between any two points within Ottawa or between Ottawa-Kingston is .10 cents per minute. A 30 seconds minimum applies per call which is .05 cents.

Optional:	Monthly Rental	N.R.I.C.
1st Extension Telephone Sets VOICE/DATA (4 wire)	$ 15.00	$ 10.00

NOTE: 3 Extension Telephone can be provided with each main telephone. Where the loop length exceeds 100 cable feet, it may be necessary that the loop be engineered. Signalling is not provided.

Additional extensions sets - each	$ 10.00	$ 10.00

Data Terminal Sets	Monthly Charge	Installation Charge
Suitable for conditioning signals up to 1800 bauds		
No. 202B (z), 202-C, 202D or equivalent	$ 40.00	$ 50.00
No. 202D-1, 202D-2 or equivalent. No reverse channel	42.50	50.00
No. 202D-1, with reverse channel simulator	45.00	50.00
No. 202D-2 with reverse channel	50.00	50.00
Suitable for conditioning signals at 2000 bauds		
No. 201 or equivalent	110.00	100.00
Suitable for conditioning signals at 2400 bauds		
No. 201B-1 (equipped for internal timing) (Z)	115.00	100.00
No. 201B-2 (equipped for external timing) (Z)	115.00	100.00
No. 26C (internal or external timing)	115.00	100.00
Suitable for conditioning signals at 4800 bauds	Special Assembly	

(Z) No longer purchased but provided if available.

10.3 (a) Miscellaneous Service Charges

Abbreviated Dialling, for each abbreviated number per exchange station connection	$ 2.00	$ 16.00 (Y)
Automatic Answering Unit	8.50	10.00
Automatic Call Connector (NOTE 1)	10.00	10.00
Automatic Calling Unit, computer to broadband (ACU-3A) (NOTE 2)	60.00	25.00
Data Set Coupler (198420) (required for interconnecting teleprinter to data set)	5.00	--
Extension Shelf (for housing equipment associated BES)	2.00	--

	Monthly Charge	Installation Charge
(a) Miscellaneous Service Charges (Cont'd)		
Teleprinters:		
Model 32KSR	$ 55.00	$ 25.00
32RO	50.00	25.00
32ASR	105.00	35.00
Model 33KSR	55.00	25.00
33RO	50.00	25.00
33ASR	105.00	35.00
Model 28KSR	70.00	25.00
28RO	60.00	25.00
28ASR	140.00	50.00
Model 35KSR	70.00	25.00
35RO	60.00	25.00
35ASR	140.00	50.00

The foregoing teleprinter rentals include data sets and coupler where required.

(Y) The $16.00 charge covers up to 8 numbers; additional numbers $2.00 each. Numbers installed subsequent to the initial installation $5.00 each.

NOTE 1: Permits automatic seizure of the broadband line by a business machine or computer which is connected to the "DATA" side of the subscriber's broadband termination.

NOTE 2: Rental includes Extension Control Box (ECB-1) unit.

Temporary Disconnection and Restoration of Service Within a Period of 90 Days.

Rental during the time of suspension will be 50% of regular monthly connection and equipment charges. In addition, a charge will apply during the period of suspension for facilities including local loops, where such facilities are leased by the Telecommunications Company from others.

Rate Mileage *

Over	Up to and Including	Rate Per Minute **
0	350	$ 0.10
350	700	.15
700	1050	.20
1050	1400	.30
1400	1750	.40
1750	2100	.50
2100	2500	.60
2500	--	.70

* The mileage between Rate Area Centres is measured without turning points, using the Vertical and Horizontal method of mileage calculation.

** The minimum charge for each call is based on one-half minute. Fractional minutes beyond the minimum on each call are proportionately charged for in tenths of minutes.

The per minute usage charge for 4800 baud operation is that which applies for Telex and Data Telex services. EXCEPT, for calls between Toronto and Ottawa where a rate of 30 cents per minute applies.

OPTION #2 — Dedicated Circuits 2400 or 4800 baud

Circuits - 4 circuits

One each between Carleton and Bell-Northern, Carleton and CRC, Carleton and Ottawa University, Carleton and N.R.C.

	2400 BAUD	4800 BAUD	Installation
4 @ $50.00 4c circuits including conditioning	$200.	$200.	
4 modems at 2400 baud @ $115. per unit. N.R.I.C.	460.		
@ $100. per unit			$400.
2400 Baud Monthly Total	$660.		$400.
4 @ $50. 4c circuits including conditioning		200.	
4 modems at 4800 baud @ $260. per unit. N.R.I.C.		1040.	400.
@ $100. per unit			
4800 Baud Monthly Total		$1240.	$400.