TELECOMMISSION

Study 5(a)(c)
(d)(e)

Policy Considerations with Respect to Computer Utilities

The Department of Communications

POLICY CONSIDERATIONS WITH RESPECT TO COMPUTER UTILITIES

TELECOMMISSION STUDIES 5(a), 5(c), 5(d), and 5(e)

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Introduction

The Importance of the Computer Utility

During the decade of the 1960's, the previously disparate technologies of computers and communications came together to create an important new class of combined computer/communications systems. Such systems, often called "computer utilities", are defined more precisely in Part I. These systems employ telecommunications links and a variety of equipment and time-sharing* techniques to make available directly to customers in their own premises a wide range of information and data-processing services. The system overhead is shared among all users, with each paying a service charge that varies with the use made of the system. Ideally, the utility should be able to provide each user, whenever he needs it, with the equivalent of a private computer capability responsive to his immediate needs, but at a fraction of the cost of an individually owned system.

The application of such systems, however, extends far beyond the field of computation. For in addition to making computer power available in a convenient economical form a computer utility can be concerned with almost any service or function that can in some way be related to the processing, storage, collection and distribution of information. As a result, at least within the technically advanced nations, computer utilities could eventually make the computer as much a part of everyday life as the telephone is today. Indeed many authorities predict that the computer services industry, by the end of this decade, will become one of the three largest in the nation. Out of this widespread availability of computer, or more correctly "information" power, there could flow social changes and opportunities for human development that promise to make the next few decades among the most critical that mankind has ever faced. Consequently, Canadians are faced now with many fundamental problems of law and public policy whose proper resolution is of vital importance to the future of our country and to the life-style of each citizen. These include the optimum means for ensuring equitable access to the benefits of computer power to the widest possible number of citizens and industries wherever located, the question of foreign ownership of a vital Canadian industry, the kinds of systems and services that should be built in Canada and the institutions and policies that are needed to encourage and guide their growth.

*Definitions of technical terms used in this paper are contained both in the text where appropriate and in the glossary of terms.

All of these questions can be summarized in the form of the following fundamental policy question: "How can Canada best exploit the computer utility concept to make the potentially revolutionary benefits of computer power available to the entire public and at the same time provide effective safeguards against the misuse of that power?"

It is the purpose of this report to assist the process of policy determination by illuminating the many dimensions of this fundamental question and examining the major policies and actions that have been proposed for dealing with it.

Related Telecommission Studies

The importance of the subject of computer utilities was recognized in the organization of the Telecommission and in particular in the studies of Section 5 - "Information and Data Systems".

Thus Section 5 is comprised of the following studies:

5 (a) The relationships between common carriers, computing companies, and information and data systems.

5 (b) Computers and privacy.

5 (c) Concept of a computer utility.

5 (d) Long-term market prospects for computer services.

5 (e) Telecommunications services; present and anticipated needs of the computer industry and its customers.

5 (f) Institutional arrangements for optimizing the development of data banks in the public interest.

5 (g) Problems in data transfer with particular regard to visual data.

Because of the close interdependence of their subject matter, it was decided early in the course of the Telecommission work to combine studies 5(a), 5(c), 5(d) and 5(e) into a single comprehensive report and this report represents the result of that combination. In addition this report also draws heavily upon the results of many other Telecommission studies whose work has a bearing on certain aspects of the computer utility, although it does not, of course, replace their specialized reports. Studies 5(b) and 5(f) fall in this category, as do many of the studies in Section I "Legal Considerations". Studies 8(b) and 8(d), which are concerned with the vital issues of "interconnection" and the future of "wide band" cable systems respectively, also provided a great deal of relevant material. Finally, Section VI "The Telecommunications Environment", dealing as it does with subjects like "The Wired City" and "Access to Information" touches directly upon the social implications of many of the systems embraced by the term "Computer Utility".

Other Related Activities

In addition to the previously mentioned Telecommission studies a number of other special studies were performed in order to provide basic data for this report. The most important of these concerned the possible role of the Telecommunications Carriers in Public Data Processing and a special report* containing the results of this study was tabled in Parliament in June 1970. The report, entitled "Communications Canada - Participation by Telecommunications Carriers in Public Data Processing", was an attempt to provide objective background material for a full public discussion of the issues surrounding this complex subject. In this objective, the report was quite successful for, since publication, there have been extensive discussions in the press and the Department of Communications has received a number of thoughtful, well argued briefs from organizations representing both the telecommunications carriers and the independent data-processing industry. The contents of these briefs were of great assistance in the preparation of this report.

Additional public contributions were received in response to two questionnaires that were mailed to interested parties in the Canadian Communications and Computer Industries and to major users of computers and communications. The first contained a general set of questions designed to test public opinion concerning basic policy towards computers and communications and was mailed to a broad spectrum of different organizations. It, together with the results, is described in Appendix A. The second questionnaire was developed jointly with the Candian Information Processing Society and was intended to provide a picture of the current status and plans of those companies involved in supplying remote data processing services in Canada; consequently it was sent only to commercial suppliers of such services. Its results are summarized in Appendix B.

Appendix C contains the results of another important study. Entitled "The Economics of Integration: Telecommunications Companies and Data Processors" it was prepared by Prof D. Cowan and Prof L. Waverman of Waterloo and Toronto Universities respectively: and represents a preliminary attempt to evaluate the many factors involved in the difficult question, "What are the economies of integration, if any, when computer and communications functions are combined within a single organization?"

* The special report employed a great deal of material drawn directly from an earlier unpublished version of this more comprehensive Telecommision report. Consequently the reader will find considerable overlap and duplication between the two reports.

Three other important contracted studies also played a role in determining the content of this report even though they are not directly appended. These are:

A Forecast of Developments Within the Information Processing Industry in Canada; Lyman E. Richardson, T-Scan Limited. March 1970.

Relationships Between Telecommunication Carriers, Computer Service Companies and their Information and Data Systems; Richard W. Judy, Systems Research Group, Toronto. November 21, 1969.

Report to the Department of Communications on the Relationship Between Computer Service Companies and Common Carrier Telecommunication Organizations; Lyman E. Richardson, T-Scan Limited. December 1969.

Mention should also be made of the work of the Committee on Computer Applications and Technology of the Science Council of Canada. The Department of Communications and the Science Council Committee have freely shared information from their respective studies and there is basic agreement between the two organizations concerning the importance of the computer utility area. It is expected that the Science Council report will build upon the material in this document and recommend specific proposals for action to the Federal Government.

This importance was also emphasized by the Canadian Cabinet when, in its decision of October 1970, it directed the Department of Communications to create a Computer/Communications Task Force to expand upon the work of the Telecommission and prepare concrete plans for an "Integrated Network of Canadian Computer Utilities" designed to bring the benefits of computer power to all Canadians wherever they may live. A detailed description of this Task Force will be found in Appendix E .

Part I

Classification and Basic Concepts

The Sharing of Computer Power

Computer utilities are a new class of resource sharing systems by which a complex commodity called "computer power" is shared in a convenient and economical manner among many geographically distributed customers. These new systems differ fundamentally from the normal computer service bureau in that the services are supplied directly to the user without requiring the physical transportation of data between the customer and the central processors. The data transportation, instead, is performed over communications links, and it is for this reason that the term "tele-data processing system", i.e. combined communications and data processing system, is often used to describe the sorts of systems with which we are concerned.

Computer utilities also differ significantly from other resource sharing systems in the fact that computer power, or more correctly "information power", is a much more complex commodity than, for example, electric power or telephone service. In it are contained elements of mathematics, of information retrieval, of communications in all of its myriad forms, of publishing, and of human and machine actions and interactions. Its definition involves complex combinations of such factors as : time, computation rates, instruction repertoires, data and procedure bases, peripheral equipment characteristic and usages, and communications speeds, capacities and access times. Figure 1 is an attempt to portray something of this complexity. Computer utilities also differ from traditional utilities in that they currently operate in a competitive environment in which a number of firms may offer similar services in the same territory.

Basic Computer Utility Categories

As might be expected with such a complex commodity, the systems employed in the distribution of computer power can take many different forms. These can be categorized on a functional, operating mode, or institutional basis as follows:

Functional

Special Purpose - This is the oldest form and is exemplified by the familiar reservation and stock quotation systems. In it, the central processor is restricted to the performance of a single function or a group of related tasks specified in advance by the system designer.

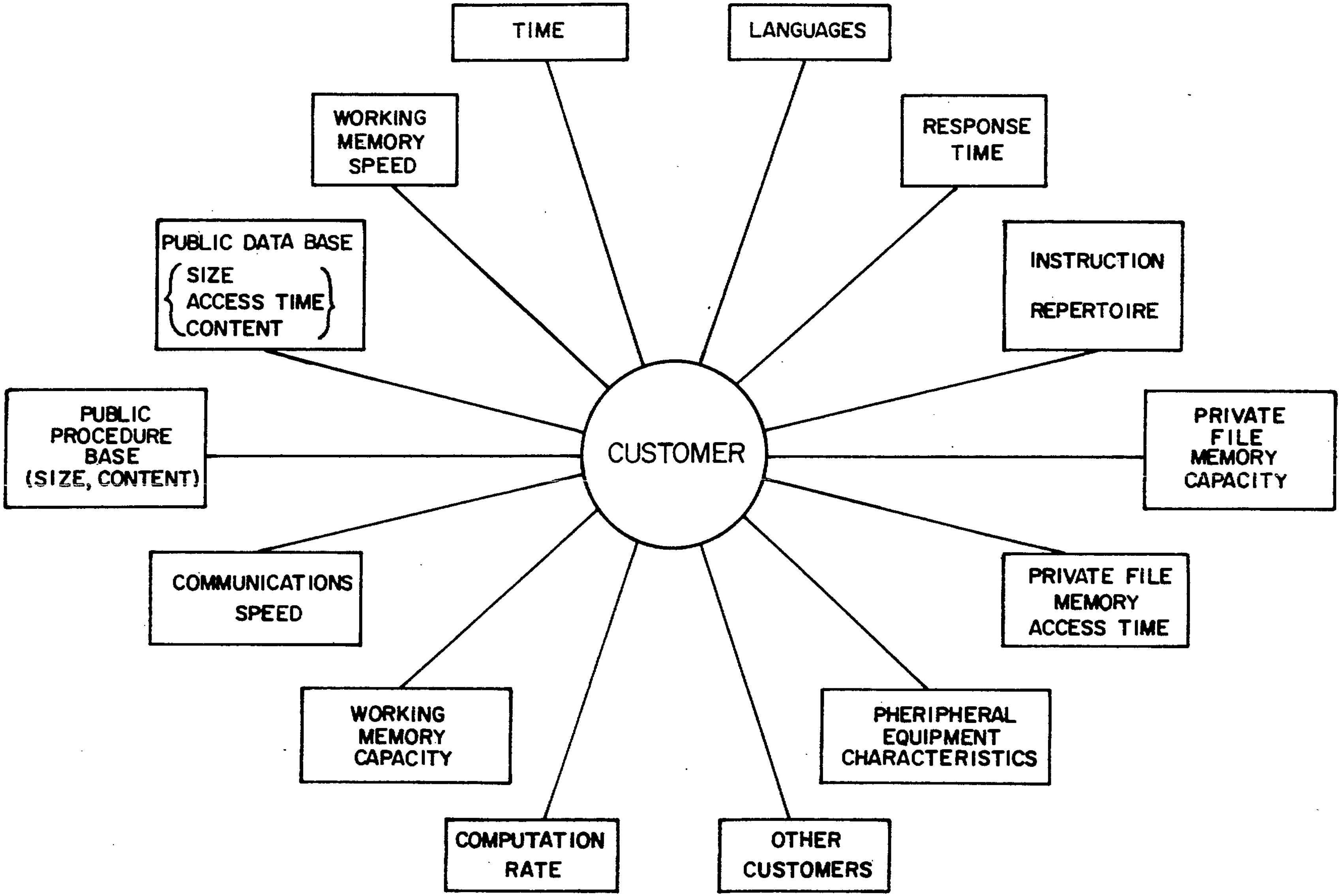
General Purpose - These are systems which can handle many different kinds of tasks; i.e. in the limit, any task for which a digital computer program can be written. In general, these tasks will not have been specified by or be known to the system designer.

Operating Mode

Batch Oriented - In such systems, each customer's programs are handled on a queuing or scheduled basis; i.e. completing customer A's work before going to customer B, etc. The operation here is similar to that in a normal service

FIGURE I

THE MANY DIMENSIONS OF COMPUTER POWER



bureau batch processor operating under the control of an "Operating System", except of course for the fact that the data and programs are transmitted directly between the users and the computer over communications lines. The term "Remote Batch Processing" is often used to describe this type of operation.

Responsive or Time-Shared - The phrase "responsive" here carries the connotation of immediate access or "real time" operation and it is made economically feasible through a technique known as time sharing. In a time shared system, many customers are served at the same time with the computer switching from customer to customer at a rate that is short in comparison to a typical human response time. Each user's program is thus run in the form of short bursts or quanta of computation so that all programs are multiplexed together in a continuously repeating cycle. Ideally the length of this cycle is short enough so that any single customer at a remote console is unaware of the intermittent nature of his service and feels that he is the sole user of the system.

Mixed Systems - Many systems operate in a mixed on-line and batch mode, where on-line service for problems up to a certain size or of a critical priority is provided, but other problems are run on a batch basis in the "background".

Institutional

Private - These are systems whose use is restricted to members of the owning organization.

Public - It is these systems which have generated the greatest popular interest and led to the use of the term "Computer Public Utility". As the term implies, they supply computer power to many different customers outside of the owning organization.

Combinations of Forms

These different forms can be combined in many different ways. For example, we can have private general purpose systems like those in use in hundreds of organizations today, private special purpose systems such as those used by individual airlines for reservation purposes, public special purpose systems, public and private multiple purpose systems, and a whole hierarchy of increasingly complex general purpose public systems which, in the limit, could encompass the entire computing power of the nation.

Basic Functional Elements

In all of these different categories of Computer Utility, three functionally distinct elements can be identified. They are:

(a) The basic computer facilities including the "Central Hardware", the "Executive System" and various Compilers and Access Control Programs. These facilities are sometimes called "raw computer power".

(b) The telecommunications system which links the computer facilities to the remote users and which may also include the terminals on the customers' premises.

(c) The services provided by the utility, e.g. payroll, inventory control, information storage and retrieval, invoice generation, etc. These are based upon data and programs, termed "application software" that is stored in the computer facilities and serves to organize those facilities as necessary so that they can perform useful work.

Within the facilities or "raw computer power" area, the term "Central Hardware" could include such elements as mass storage systems - core, drum, disk, video tape etc; working memory; data processing units; input/output buffers and control equipment; and in certain cases also switching facilities, modems and data multiplexors. The "Executive System" comprises both hardware and software and is responsible for coordinating and controlling the overall operation of the computer utility. It is therefore responsible for the control of functions like scheduling, swapping, memory protection and look ahead, and may also perform certain bookkeeping and data conversion tasks. Large "Compilers" like FORTRAN, COBOL, APL, etc. are special programs which make it possible for a computer to accept a set of instructions written in non-machine language and produce as an output a machine language program in which many of the original instructions are replaced by complex sequences of machine instructions called subroutines Such programs as well as the special Access Control Programs employed in the control of the "information retrieval" process in a "data bank" application seem to fall naturally into the category of raw computer power since the same programs may be used for an almost unlimited number of applications.

Business Categories

These functional elements provide a basis for categorizing the many different types of businesses that exist or might exist within the Computer Utility Industry.

(a) Supplier of Remote Computer Services

This type of business operates centralized information processing centers and makes raw computer power available via remote terminals directly to the customers on their own premises. In addition most organizations that supply this type of service (i.e. IBM, GE, SDL, Computel) also provide a host of special application programs. Some also perform certain secondary communications functions like line concentration and message preprocessing. Further, the computer utility may handle the leasing arrangements for communications circuits for its customers.

(b) Integrated Supplier of Special Services

The KEYDATA Corporation, represented in Canada by AGT Limited, the Credit Data Corporation and Bunker Ramo Corporation are good examples of this type of business. As in the Remote Computer Service case, the companies in this category own and operate information processing centers. They differ, however, in that instead of supplying raw computer power, they provide special services to their customers who, in general, are not provided with a capability for performing their own programming. The services are made possible by special packaged programs tailored to the performance of specific business functions. Thus, in the case of AGT's KEYDATA services, these functions include invoicing, credit checking, inventory control, customer analysis and special report generation while for Bunker Ramo, the functions are those concerned with the operations of brokerage houses.

(c) Purveyor of Raw Computer Power

Since the term "raw computer power" refers to the facilities portion of a computer utility, a Purveyor of Raw Computer Power is one who offers the use of such facilities. Such an organization represents a sub-class of the "Supplier of Remote Computer Services" category in that it does supply raw computer power but does not supply application programs other than the previously mentioned compilers and information retrieval control programs.

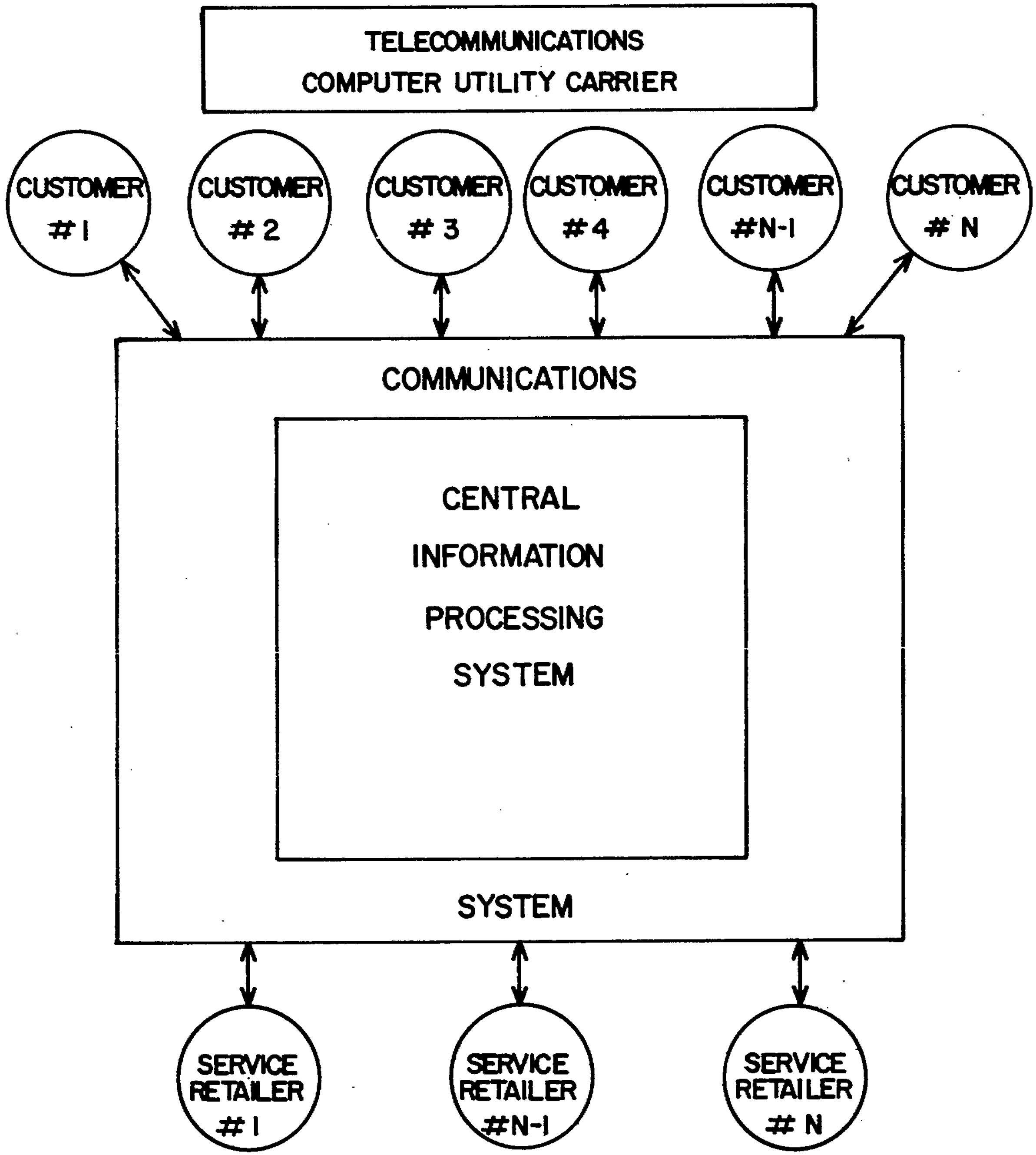
(d) Telecommunications/Computer Utility Carrier

In a computer utility, there may be valid technical reasons, especially when the switching and data conversion aspects are considered, for combining many of the communications and data-processing functions. This leads to the concept of a hybrid organization that could supply both "raw computer power" and telecommunications but not Application Services. In this report, such an organization is called a "Telecommunications/Computer Utility Carrier, and it is illustrated in Figure 2.

(e) Independent Service Retailer

The concept of a Purveyor of Raw Computer Power implies the complementary concept of a purveyor of processed power or, as it is called in this report, an "Independent Service Retailer". Instead of owning or renting computers, these organizations would rent memory capacity and processing capability; i.e. "raw computer power" from a Raw Computer Power Purveyor, fill the rented memory space with their own and their customers' proprietary data and programs, and then retail their services to their remote customers through the facilities provided by the telecommunications carriers and the Purveyors of Raw Computer Power. In other words,

FIGURE 2


TELECOMMUNICATIONS
COMPUTER UTILITY CARRIER
CUSTOMER #1
CUSTOMER #2
CUSTOMER #3
CUSTOMER #4
CUSTOMER #N-1
CUSTOMER #N
COMMUNICATIONS
CENTRAL
INFORMATION
PROCESSING
SYSTEM
SYSTEM
SERVICE RETAILER #1
SERVICE RETAILER #N-1
SERVICE RETAILER #N

the Service Retailer provides the same services as the Supplier of Remote Computer Services but utilizes other organizations' facilities for their distribution.

This concept of the "Service Retailer" is as old as the concept of the computer utility and was originally suggested by Prof. John McCarthy of Stanford University at the MIT Centennial in 1961 where he introduced the term "cottage computing" to denote the activities that this report associates with the Independent Service Retailer. Despite this, to date, such organizations have not evolved to any significant degree but it can be argued that, with proper encouragement, they could be the instrument for a dramatic growth of the application services industry. If this were to happen, one would eventually expect to find a multitude of different organizations represented in this category. They could include private companies, foundations, governments, educational and charitable institutions and even individuals.

(f) Total Computer Utility

As an alternative to the sort of functional segmentation of the industry implied by the preceding categories, it is also possible to envisage an integration of application services, communications and computer power in integrated monolithic companies that operate as "Total Computer Utilities". In fact, even today in the United States (Western Union) one finds a single organization proposing to engage in every facet of the Computer Utility business so that it will be able to provide its customers with any desired mix of raw computer power, data transmission and switching, and application services. Likewise, in the United Kingdom, the British Post Office has similar plans.

PART II

Applications

The general technical advances that have made possible the Information Utility can be briefly summarized as follows:

1. It is now technically feasible to bring the full power of a large-scale computer complex to anyone in the world who is served by suitable telecommunications facilities.

2. The interaction between the central computers and the remote user is essentially instantaneous so that the user receives service that is indistinguishable from that which he could receive if he were physically present in the same room as the computer.

3. The cost to each user is but a small fraction of what it would be if the same services were provided by individually owned computers.

4. Each subscriber can be provided with expandable, rapidly accessible private files that are reasonably well protected against unauthorized access.

5. The intellectual achievements and data collections of many individuals and groups can be pooled in large public files so that their contents become simultaneously available on demand to all customers of the system.

6. The technique of time sharing has made direct dialogue between man and computer economically practical.

7. Techniques of man-computer interaction have been developed that permit true partnerships between men and machines so that the special capabilities of each are blended together in a harmonious whole. These techniques have been successfully applied to many fields including engineering design, information retrieval, medical diagnosis, problem solving and computer programming.

This combination of advances makes possible a broad range of applications that were previously impossible for technical or economic reasons. In fact even today the range covers all of those tasks for which conventional computers are normally employed in addition to a host of others which only become feasible through the multi-user features. Consequently any complete list would be prohibitively large. On the other hand the general boundaries of the major application areas, insofar as these can be gauged at this early stage in the evolution of computer utilities, can be visualized by lumping the different applications together under suitable headings in a logical classification scheme. One such scheme that has been found useful employs six basic categories.

1. Reference Services

The first commercial applications of the on-line - real time and time-shared modes of operation were those which involved access to a common data base by many remotely located users. Early applications included airline and railway reservation services, order tallying, and stock market quotation services. Today, the range of application is being further extended and specialized information networks are evolving for handling such diverse forms of information as police records, credit reports, medical and legal files, and scientific data of all kinds.

The evolution of such specialized networks is likely to continue as more and more of the myriad social and occupational groups of the modern community come to appreciate the advantages of remote access. Some of the broad categories of services that might be provided include:-

- Professional - legal, medical, law enforcement, scientific, engineering, pharmacy, agriculture, etc.
- Business - credit, real estate, marketing reports, regulations, prices, trade data, etc.
- Consumer - consumer testing and satisfaction reports, product specifications and prices, product availability, advertising, etc.
- General Information - political and economic data, historical, travel, weather, entertainment, etc.

These are further summarized in Figure 3.

It is obvious that these categories could be expanded indefinitely until, in the words of Robert Fano, the Director of Project MAC, information utilities become "the depository of the data base and information processing procedures of the community". This depository could, in the long run, draw upon and integrate the resources of all of the specialized utilities so that it becomes a gigantic electronic encyclopedia, continuously distilling the essence from our society and making it available at any desired level of concentration to everyone.

2. Financial Services

No aspect of direct access computer utilities has received more attention than their application to the world of finance. Some applications, those concerned with ready access to financial data are, of course, partially covered by the reference services category, but there are many others, and just as in the reference services case they are likely to lead to specialized networks. These might include:

FIGURE 3

REFERENCE SERVICES

- PROFESSIONAL
  - Legal
  - Medical
  - Law Enforcement
  - Scientific
  - Engineering/Architecture
  - Pharmacy
  - Agriculture
- BUSINESS
  - Credit
  - Real Estate
  - Sales Statistics
  - Marketing Reports
  - Key Personnel
  - Regulations
  - Prices
  - Product Sales Figures
  - Technical Trade Data
  - Production Figures
- CONSUMER
  - Consumer Testing
  - Consumer Satisfaction
  - Product Specs
  - Product Prices
  - Product Sales Figures
  - Warranty Information
  - Product Availability
  - Advertising
- GENERAL INFORMATION
  - Employment Data
  - Political Facts
  - Sports Statistics
  - Historical Data
  - Weather
  - Travel
  - Repair Information
  - Gardening

Investment Nets concerned with security transactions, market analysis services and stock service.

Insurance Nets capable not only of providing routine services to insurance companies but even of generating tailor-made policies on-line for individual customers.

Banking and Credit services. Both the banks and credit agencies have been particularly active in opening up the "Direct Access Age" and are currently heavily involved in such activities as the development of professional billing services; the provision of on-line teller terminals, sometimes integrated with management information services; and the establishment of banking and credit networks.

As a result of these and similar developments, it has been argued that in the near future, we will see the credit card idea merged with the concepts of computerized banking and credit bureaus to create a new type of universal financial utility whose customers will identify themselves by means of a universal credit card or "money key". As time goes on, this "money key" could replace both the cheque and most normal currency as a medium of exchange. In fact, in both America and Europe, key experiments aimed at exploring the possibilities of such automatic transactions are currently underway. These experiments could eventually lead to an integrated world-wide financial network that will permit a customer to make money key transactions anywhere in the world. The range of services offered could also grow to eventually encompass every type of financial transaction no matter how complex or trivial it might be.

If this happens, the Financial utility, illustrated in Figure 4, could have available within its files, a complete, immediately accessible electronic record of the current and past financial status of every customer from billion dollar corporation to school child. Bank balances, obligations, credit ratings, earnings (current, projected and past), data on all of these and more could be contained in the records. As a result, the flow of money between individuals, organizations, or even nations, could involve nothing more than an automatic transfer of information within the memory banks of the utility. In effect, all of the world's myriad financial institutions would have been integrated and transformed into a single vast electronic information system.

3. General Business Services

Both the financial and reference services applications are, of course, deeply involved with business in all of its aspects. Nevertheless, there are many other areas of business life that could profitably use the services of a direct access computer utility. Some of these have been lumped together under the broad heading of General Business Services and are shown in Figure 5.

FIGURE 4

FINANCIAL SERVICES

INVESTMENT
- Purchase and sale of Securities
- Market Analysis
- Stock Quotations

INSURANCE
- Shopping
- Tailor Made Policies
- Cost/Benefit Analysis
- Premium Payment
- Actuarial Calculations
- Customer Statistics

BANKING
- Transfer of Funds
- Automatic Bill Payment
- Automatic Payroll Distribution
- Loans
- Overdraft
- Instant Cash
- Purchasing

CREDIT
- Credit Check
- Tailored Loans
- Loan Repayment
- Credit Planning

TAXATION
- Calculation
- Collection
- Checking
- Customs
- Excise
- Sales
- Property
- Assessment

FIGURE 5

GENERAL BUSINESS SERVICES

RETAIL & WHOLESALE PROCESSING

- Invoice Preparation
- Merchandise Management
- Credit Checking
- Point of Sale Recording
- Marketing

PRODUCTION CONTROL

- Scheduling
- Process Control
- Production Reporting
- Inventory Control
- Materials Management
- Resource Allocation
- Project Status Reports

PURCHASING

- Shopping
- Selling
- Ordering
- Payment
- Consumer Satisfaction Survey

PLANNING

- Sales Forecast
- Policy Selection
- System Evaluation
- Market Analysis
- Production Planning
- Investment Analysis
- Plant Layout
- Resource Allocation

MANAGEMENT INFORMATION

- Personnel
- Financial Reports
- Sales Reports
- Production Reports
- Inventory Status
- Market Situation

4. General Computation Services

Calculation in one form or another is, of course, interwoven with just about all of the applications that are discussed in the report. Likewise, many of the functions included under the heading of General Computation Services in Figure 6, have already appeared elsewhere, either as functions within a larger application category, or; as in the cases of reference data and planning, as major categories. Despite this, it was felt that the three major application categories shown: vis Design, Business Computation and Automated Laboratory Services, were sufficiently different from the applications that have been discussed hitherto to justify separate treatment.

5. Educational Services (See Figure 7)

Few areas of computer application hold greater long term promise than the field of education. In this connection, the three main areas of application shown in Figure 7 provide a convenient format for categorizing the thousands of possible uses. Of the three categories shown, the "Administrative Services" area is currently the most highly developed and both "stand alone" and remote access computers are in extensive use by school systems throughout the world. The "teaching" field has also received a great deal of attention and a number of experimental and pilot systems have been established, especially in the United States, to evaluate the many possible techniques and systems configurations. In fact one of the most important is currently being undertaken by NRC in cooperation with various provincial educational authorities. Widespread operational use of computer assisted instruction (CAI) even in the school environment, not to mention private homes, is however still some years away. Major obstacles at the moment include the high cost and crudity of program material; the high cost of terminals; central processor and communications costs and the need for extensive research and pilot experiments to determine the proper role of CAI in the teaching process.

The General Encyclopedia category, on the one hand is covered by the previously mentioned "reference services" group with the schools becoming both suppliers and customers in reference service networks. On the other hand, it tends to merge with computer assisted instruction so that the contents of the encyclopedia data banks can be drawn upon as necessary by the Instructional Systems and integrated with the programmed instruction material. Needless to say the latter type of operation has not to date moved out of the research laboratory. Computerized data banks ranging from specialized systems: medical, legal, technical etc., to general library services are however in use in many universities, although they do not appear so far to have invaded the secondary and elementary school systems.

6. Personal Services

A computer utility can provide many services to many users; it can also provide specific services to a single user. Indeed existing public systems already provide private storage facilities to which only the authorized user can have access. Such facilities can be provided to a user at his place of business for his private files, appointments calendar, and message storage, or at his home for a multitude of personal records from tax files to recipes and shopping lists.

FIGURE 6

GENERAL COMPUTATION SERVICES

DESIGN

- Calculation
- Reference Data
- Computer Graphics
- Simulation
- Engineering Vote Book
- Cost Analysis

BUSINESS COMPUTATION

- General Financial
- Planning
- Calculation
- Cost/Effectiveness Analysis

AUTOMATED LABORATORY SERVICES

- Calculation
- Record Keeping
- Data Reduction
- Reference Data
- Control of Experiments

FIGURE 7

EDUCATIONAL SERVICES

ADMINISTRATIVE SERVICES

- Record Storage
- Curriculum generation
- Marketing
- Financial
- Supply
- Progress monitoring
- Testing
- Report Generation

GENERAL ENVYCLOPEDIA

- History
- Mathematics
- Language
-
-
-
-
- Current Affairs
- Art
- Social
- Sports
- Trade Data
-

TEACHING

- Drill & Practice
- Tutorial
- Dialogue
- Generation of Teaching Programs
- Game Playing
- Simulation
-
-

Relation of Applications to System Characteristics

Earlier in this report, Figure 1 portrayed some of the many factors involved in a definition of "computer power". For any computer utility the relative importance of these factors and the ways in which they interact are, to a large extent, dependent upon the application that the system is designed to support. For example, if the application of the system is to be restricted to the single job of storing and retrieving information, then there will be no requirement for either a customer programming capability or for extensive computational capabilities at the central processor. Thus, both the organization of the central machines and their program structure can be optimized around the data manipulation and file searching problems. On the other hand, there may well be a need for storage of voluminous amounts of narrative and pictorial information in a rapidly searchable form and for its transmission to and reproduction at the user's console.

Again, if the application is basically a routine business processing one: invoice production, credit checking or inventory control, for example, then the full facilities of a General Purpose Business oriented computer will be required at the central station, but once more, there may be no need for user programming. Instead, an extensive library of packaged prewritten programming systems will be needed, each designed to handle a particular application for a whole industry, and hopefully, capable of satisfying with only minor modification the needs of many different customers. Many of the Financial, Educational Support and General Business Services applications fall into this category.

At the other extreme are the systems where customer programming is a major element in meeting the users' needs. In fact, as was mentioned earlier, the interactive operating mode which becomes economically feasible with time-sharing, is in itself, a major asset for the programmer. In such systems, most of the application programs are written by the users, and the only software provided by the system, apart from the executive, and possibly certain compilers, is that which is concerned with providing assistance in the programming process.

PART III

Promise VS Danger

The Promise

It should be apparent from the broad scope of the applications described in Part II that the information utility is destined to have a major impact upon our society. In fact, the social importance is implicit in the term "information power" for information is, in a very fundamental sense, the basic stuff of human society - the true élan vital, if you will, whose communication and application in a billion different forms makes us human. Consequently, quantum jumps in our ability to handle information are likely to be marked by fundamental changes in the nature and quality of society. Just such a transformation of information handling capability into social change happened 500 years ago with the development of moveable type. It will almost certainly happen again through the application of computer technology.

In this connection, the term "post industrial society" is now increasingly used to denote the new society towards which the most technologically advanced nations seem to be evolving. This society has been described as follows by J. Servan Schreiber in his book "The American Challenge.":

"Not only will it be a richer society, but a different kind of society since, beyond a certain level, wealth is measured not so much by a higher standard of living as a completely different way of life."

It has been suggested that the developments discussed in this report will play a central role in this new society. For, in the post industrial community just about every activity whether in the arts, sciences, industry, education or government could center around and, in fact, function through the ubiquitous computer networks. As a result, "the completely different way of life" promised by Schreiber could include services and capabilities that even today sound utopian and which only a few years ago would have been pure fantasy. Thus, some authorities see the emergence over the long term of:

(1) An Economy of Abundance, largely automated and integrated so that all of the myriad industrial, distribution and business functions would become in effect a single distributed machine, capable of turning out goods and services of a quality and in numbers that seem fantastic today.

(2) Individualized Computer Assisted Instruction providing each student with the equivalent of a private tutor embodying the best judgment and total experience of the world's greatest educators. Education thus might become a continuing process largely independent of age and geographical location; i.e. no one would even be further from the classroom than his local "fireside computer terminal". In the long run this could have a major impact upon the entire educational system. Both the form of the school and the role of the human teacher could undergo drastic changes as "fireside computer consoles", universal electronic encyclopedias, teaching utilities and academic administrative utilities come into widespread use. For one thing, the concepts of grades and of classes based on calendar age might have to be abandoned. In their place would be a system of independent tracks for each student. Progress along these tracks would be

continuous at a pace that would be separately controlled for each student, according to his individual performance. In fact, with the advent of domestic computer utility service, there is no reason why much of a student's instruction and study could not take place at home. The time at school could then be devoted to laboratory work, group discussions and seminars and individual consultations with the teachers.

(3) Automatic Publishing: Another area where computer utilities could bring about some interesting changes is the publishing business. An author, for example, might do his writing at the keyboard of his personal utility console. His product would take shape in his private files in the central computer and, to publish, he would simply notify the utility of the existence of his work and authorize its inclusion in the public files. Once in these files it would be freely accessible to all the other utility customers via the viewing screens of their own terminals. Utility fees, royalty payments and the like would be handled automatically, with a direct transfer of credits to the author's royalty account every time someone accessed his document. Similar arrangements could apply to every other type of creative work - newspapers, magazines, motion pictures, computer programs, data banks and so on.

(4) Decentralization: With the development of a "communications affluent" society in which the techniques of television, computer graphics, computerized data bases, data-processing and normal telecommunications were combined and their services made universally available via "fireside" terminals, many of the pressures for urbanization could be reversed. Some experts claim that if people could access and manipulate any piece of information without leaving their homes and simultaneously interact with other people and machines as easily as if they were sitting in the same room with them, then there would be little reason for concentrating workers in large office buildings. Just as we mentioned for education, they might better conduct their routine business activities from the comfort of their homes and gather together only for formal affairs, laboratory work and social occasions.

Eventually, with the production and distribution processes largely automated and with shopping, entertainment and business transpiring largely via telecommunications, predictions have been made that the need for people to live within easy commuting distance of their businesses, school or shopping facilities could also vanish. It might be possible for people to live in any part of the country and eventually the world and still partake fully of all of the social and economic amenities that we associate with urban life. A family, for example, might live on a mountain top in British Columbia even though the husband "worked" in Toronto, the son went to school in Halifax, the daughter in Montreal and the wife did her shopping in London, New Delhi and Paris.

(5) Universal Access to Knowledge: The reference services mentioned earlier eventually should provide universal access to the complete store of human knowledge. The contents of the Lenin Library, of the British Museum or the Library of Congress could be instantly accessible at every man's terminal whether he lives in Yellowknife or Toronto. Combined with the teaching utilities mentioned earlier, this universal access to information would be bound to profoundly modify our traditional educational values. What, for example, would be the value of those forms of education that are based upon the memorization of factual material, when every man could know any fact merely by approaching his fireside terminal?

(6) True Participatory Democracy: The national computer networks could provide a natural medium for increasing the direct participation of citizens in the political process. Beginning with electronic opinion sampling, extending next to electronic vote-taking in local elections and referenda, later to national elections, they could eventually permit everyone to vote directly on all major issues.

This list, of course, could be continued indefinitely but it does seem obvious that even if only a few of the possibilities mentioned come to pass, they will still vindicate Schreiber's prediction of a "completely different way of life". Within this way of life, there is a common thread that ties together all of the possibilities and constitutes the true promise of the computer utility. This is the promise not alone of change, for change can just as easily be bad as good, but rather of large scale improvements in the quality of life for everyone. Taken together, these improvements add up to an infinitely freer life than any to which human beings have ever before dared aspire - literally a life of limitless horizons in which human intelligence will be free to develop to its ultimate limits.

For Canada, many enthusiasts feel that these possibilities present us with what may be our supreme challenge. They suggest that, by aggressively and imaginatively exploiting the promise of the information utility, Canada could leap-frog decades of normal development and become among the world's first post-industrial societies. Within this new Canada, the universal availability of information power could magnify by orders of magnitude the economic and intellectual capabilities of our people and lift the nation in a gigantic quantum jump to an unprecedented level of achievement.

The Dangers

Unfortunately, there is also a darker side to the information utility and it requires little imagination to see some of the dangers that might face us if certain of its capabilities were to be misdirected. The same technical advances that promise so much in the way of a freer and more open society have dangerously magnified the power of both governments and private organizations to keep all of us under close surveillance and could easily be perverted into the instruments of total political control.

Together the various data files of the different networks - medical, educational, financial, legal, law enforcement, etc., could make available in a conveniently accessible form a complete record from birth until death of even the most private affairs of everyone. In the absence of adequate controls, this could create a dangerous menace to the right of privacy and, if carried far enough, to a society in which conformity would become the price of survival.

Even more serious are the problems of freedom of access and of censorship that will arise as information utilities replace the more orthodox media - newspapers, radio, television, etc., as methods of mass communication. We are all familiar with the enormous impact that television has had on our way of life and the ease with which unscrupulous interests and politicians can employ it to manipulate public opinion. But the impact of television is limited in comparison to that of a "total information system" in which the data manipulation and information storage capabilities of the computer could be combined with television in a sort of universal electronic oracle backed by the resources of a monopolistic enterprise or totalitarian state.

Potentially, the information utility could provide the rulers of a conformist state with the ultimate instrument for control of the minds and ideas of the people. Instead of faithfully preserving the infinite varieties of human thought, the files of the system would hold only that which the censors decided was good for the populace. History could be continuously rewritten, facts inserted or distorted, any material that questioned the status quo carefully excluded - all in the best Orwellian tradition - and horrible as this may seem - if the deception were carefully handled, no one would be aware that anything was wrong. Likewise even in a nominally democratic society, 1984 would not be far away if we were to permit any group, government or private, to manipulate the public files or to tap into an individual's private files without that individual's permission.

Fortunately, these dangers are for the moment only distant shadows from the future, but when set against the glittering promise described earlier in this chapter they do help to delineate the nature of the challenge that Canada faces in devising a viable policy with respect to computer utilities.

PART IV

Basic Considerations

In devising policies that will permit Canada to realize the promise of computer utilities and at the same time minimize the dangers that could arise from their misuse, there are a number of basic considerations that should be kept in mind. These include:

The Interdependence of Computers and Communications
The Importance of the Public Files
Technological Uncertainties
Impact on Canadian Sovereignty

Interdependence of Computers and Communications

In the computer utility, the normal boundaries between data-processing and communications become blurred. The primary reason for this blurring is the total dependence of remote access systems upon data transmission lines, but in addition many other important reasons have been advanced by both communications and data-processing interests:

(a) The computers required for the data-processing segment of a computer utility are perfectly capable of performing many "communications" functions that are normally regarded as being the prerogative of the communications carriers. Included here are functions like signalling, store and forward message switching, multiplexing and message concentration.

(b) The communications carriers employ and in many cases manufacture an enormous variety of digital equipment including special purpose computers. Thus, they possess an extensive body of knowledge and experience in digital technology that is potentially transferable to both the data-processing and communications segments of the computer utility.

(c) The optimum design of a computer utility demands a "systems approach" in which the emphasis is on the integration of functions like information transfer, storage, message switching, data compaction, computation, etc., rather than an arbitrary division into data-processing and communications segments.

(d) Some of the equipment employed by the carriers in the operation of their networks, it has been suggested, could be adapted to perform or assist certain data-processing tasks for their customers. The use of augmented automatic message accounting equipment to perform computer usage and billing for independent data-processing utilities as suggested in Part VI is a good example.

As a result of this interdependence of computers and communications, there has been a tendency for many data-processing firms to attempt to diversify into the communications area (Bunker Ramo, Control Data, University Computing, etc.) and for communications carriers, notably CN/CP Telecommunications in Canada and Western Union in the United States, to enter the field of data-processing. The fact that the communications carriers are regulated monopolies, while the data-processing industries are highly competitive and unregulated, complicates the resultant situation.

A further complication arises from the fact that the existing telephone networks and their associated rate structures were, with few exceptions, designed for voice rather than data services. Many remote access applications, however, are distinguished by very long holding times, (hours instead of minutes), but rather low line utilization factors. Traffic tends to flow in rapid bursts, with long intervals between the bursts, and may also be highly asymetric -- the computer to customer data flow normally being considerably higher than that from customer to computer. As a result, computer users would like to see the current time and distance tariffs replaced by a charge based upon the amount of data transferred, or alternatively to see the current connection times, (of the order of several seconds), and minimum holding times -- (minutes), reduced to milliseconds and seconds respectively.

Basic Policy Questions Concerning Carriers

The foregoing considerations lead to a number of basic policy questions concerning the future role of the telecommunications carriers in the computer utility field:

(a) Should telecommunications carriers be permitted to provide public data-processing services or should they be barred from the field?

(b) In the event that the carriers are permitted entry to the data-processing business, then:

  (1) What services will they be permitted to offer:

    (a) Only the use of their computer hardware; i.e., "raw computer power"?*

    (b) A full range of software services as well?

    (c) Certain other carefully defined and limited services?

* For definition see P. 8.

(2) Should such services be tariffed?

(3) Should such services be provided by the carrier itself - "horizontal"* diversification, or should they be offered through a separate corporate affiliate - "vertical"* diversification?

(c) Should data-processing and other organizations be permitted to establish specialized data communications networks or provide special communications services like third party switching or multiplexing in competition with the carriers? If the answer is yes, should the carriers be required to interconnect with these new networks, thereby allowing data-processing companies to use their switched facilities?

(d) How should "wide band" services as exemplified by video phone, high speed data transmission and the rapidly developing cable TV systems be handled. Should the cable systems, for example, be left as they are, or combined into a new regulated two way wide band network with an obligation to "supply all demands for services"?

If the latter, should new regulated carriers be created? Or should the CATV systems be absorbed by the existing telecommunications carriers?

The importance of these questions has evoked widespread interest on the part of both governments and industry and this interest has been reflected in a number of important recent events that are relevant to the subject matter of this report. These are:

1. In January, 1969, CN/CPT acquired a controlling interest in Computer Sciences Canada Limited and thus became the first Canadian telecommunications carrier to offer public data-processing. Quebec Telephone, a provincially regulated company affiliated with General Telephone and Electronics also offers public computational services. Other carriers, including Bell Canada, have expressed interest in entering the field.

2. Independent data-processing companies, in a brief to the government dated June 20, 1969, expressed concern about the entry of telecommunications carriers into the public data-processing business and requested that the government undertake a public enquiry.

3. Recent computer industry statements allege that, pending a clarification of the relationships between telecommunications carriers and public data-processing, the growth of the entire industry will be inhibited.

* For definition see P. 47

4. The F.C.C., in a notice of intended rule-making dated April 1, 1970, has proposed that U.S. telecommunications carriers, with the exception of AT&T,* be permitted, subject to a variety of constraints to offer public data-processing services. This opens up the prospect of subsidiaries of U.S. carriers; i.e., General Telephone, IT&T, Western Union, offering data-processing services in Canada while Canadian carriers are forbidden to do so.

5. In June 1970, the Minister of Communications tabled in Parliament, a special report entitled "Communications Canada - Participation by Telecommunications Carriers in Public Data-Processing". The report, which was in essence a summary of material from an earlier draft version of this Telecommission Report, was intended to provide objective background material for a full public discussion of the issues surrounding this complex subject.

6. In July, 1970** the F.C.C. served notice that it would entertain proposals for specialized data transmission networks intended to provide a variety of new services. As a result, the current AT&T and Western Union monopolies in interstate data transmission may be broken. If this does happen then a number of technologically advanced data transmission systems could come into existence between major centres in the United States. The low cost and versatility of the resultant services could further increase the disparity between Canadian and American telecommunications offerings and accelerate the tendency of Canadian users to utilize United States remote data-processing companies.

The Importance of the Public Files

The system of files in most multiple user systems, whether general purpose, special purpose, private or public, in general, constitutes one of the most basic and important features. These are of two types:

(1) Private

Where access is restricted to the authorized user or his designees.

* AT&T is barred because the services will not be regulated and, under the terms of a 1956 consent agreement, AT&T is not permitted to engage in unregulated businesses.

** F.C.C. Notice of Inquiry to Formulate Policy; Notice of Proposed Rule-Making and Order; Docket No. 18920; Adopted July 15, 1970; released July 17, 1970.

(2) Public

In many systems these files could represent the greatest single asset, for they would contain an ever increasing library of programs and data generated by many different users, but accessible to every customer. Since the resources and information possessed by these files would grow continuously as the system was used, they would represent at any instant in time, the integrated knowledge and intellectual resources of the users up to that time. Thus, they would provide an unprecedented capacity for the rapid dissemination of knowledge. The effective utilization of this capacity which could easily exceed the value of the physical plant, is one of the major challenges facing the designers and users of computer utilities as we enter the direct access age. If some, or all, of the data or routines in the public files were copyrighted, however, serious royalty problems would arise. Who should pay the royalties - the customer or the utility? If the former, should the utility be made responsible for their collection? If so, what collection fees should be charged?

Technological Uncertainties

The computer industry has been distinguished from its beginning by the presence of rapid technological change. Thus, in the twenty years that have passed since the first stored program computer became operational at Cambridge University, three distinct generations of computers have appeared and a fourth is now in the process of being born. For the policy planner, this dynamic characteristic introduces many complexities, for there is always the danger that, by the time a policy is implemented, technological change will have destroyed the assumptions upon which it was based. In particular, recent developments in the area of mini-computers, video recorders and communications technology could have a major impact upon the future of computer utilities.

Mini-Computers

The term 'mini-computers' is applied to a large class of low cost physically small, free standing general purpose computers which first achieved prominence in the mid 1960's. Since 1965, when the Digital Equipment Corporation introduced its PDP-8 machine at the then phenomenally low price of $18,000, there has been a rapid growth of the mini computer industry as both the older, well established computer corporations and dozens of aggresive new companies have rushed to exploit the miniaturization and cost reduction possibilities of solid state electronics.

"Large Scale Integration" (LSI), in particular has led to desk top machines costing less than $10,000 which provide a level of performance and an internal memory speed which would not have been available five years ago in computers costing twenty times as much. In fact, for under $12,000 it is possible to obtain a computer* with a 300 nano second instruction execution time, 4096 words of 16 bit monolithic memory, teletype interface, and direct memory access data channel. Other machines are priced as low as $3,000 and many authorities predict that progress in LSI will eventually bring the price below $1,000.

Of equal importance, is the fact that mini-computers are now available with a host of "big machine" features including extensive software libraries; large compilers like ALGOL, FORTRAN IV, COBOL and BASIC; real time clocks; magnetic tape units; disk memories; card readers and printers; and even time sharing. Of course the inclusion of major items of peripheral equipment like disk memories and tape drums can rapidly multiply system costs to the point where the mini-computer proper represents only an insignificant fraction of the total system price. Indeed, as is discussed later in this chapter, mini-computers may well replace flip-flops and other logical elements as the basic building blocks of very large size multi-million dollar "super computers" for computer utilities.

Applications of mini-computers have proliferated at a rapid rate and now include process control in industrial plants; experiment monitoring, control and data collection; educational applications; computer aided design; terminal and communications control in time sharing networks; and a host of business and scientific data-processing functions. In fact, even at their current prices, these computers represent an attractive alternative to public time sharing services for many applications. Consequently, if the cost/performance ratio continues to fall and is not balanced by similar reductions in the figures for remote access systems, then a significant fraction of the computer utility market could be lost to the private machine.

Video Recorders and Play-Back Systems

During 1969 and 1970 the subject of "Electronic Video Recording" or EVR, received a great deal of attention as several promising new techniques opened up the possibility of low cost compact video recording and play-back equipment for educational and home use. There are at the present time at least four basically different, and incompatible systems in the early marketing or prototype stage of development and within the next two years it is expected that home systems capable of displaying good quality pictures on a TV set and retailing somewhere between $400 and $1000 will be widely available. The four basic techniques currently being promoted are:

CBS/EVR which employs tiny photographic images on low cost thin film stored in a plug in cartridge.

* The Data General "Supernova SC", price $11,900

Magnetic Tape Cartridge Systems such as those developed by AVCO and Sony and capable of recording programs as well as playing pre-recorded material.

RCA Selecta-Vision which uses laser beams and holographic recording techniques and promises both very low cost and high quality but is still several years from commercial production.

The Decca/Telefunken disk system in which special wide band width phonograph disks are used to store video data in an analogous manner to conventional audio recordings. In addition to low cost, this technique offers a number of significant advantages over cartridge systems for information retrieval applications.

If, as is generally expected, these systems, before the end of the decade, develop a truly mass market comparable to that enjoyed today by conventional television, then they are bound to have a dramatic impact upon the entire information industry. Video cartridges could well replace books for many purposes and except for a few restricted applications where live coverage is vital, conventional television could disappear. Instead, video cartridges would be sold, or rented from libraries the way books are handled today and, depending upon the relative costs of cartridges and communications, "demand" cable television systems could provide on line access to central stores of information and entertainment material. The latter development, however, is strongly dependent upon wide band communications costs, for if these remain too high, many data bank services may be better supplied by individual libraries of video cartridges, video playback equipment and mini computers for search and selection. In other words, people might buy their data banks from the corner drug store instead of subscribing to a public service.

Communications Advances

Development in communications, such as satellite technology, the use of digital modulation techniques and the development of economical wide band two way distribution systems could help counteract the impact of the private mini-computers and low cost mass data stores. Satellite technology in particular could ultimately have as great an impact on the future of information utilities as the perfection of time-sharing has had in bringing them to their present state. With communication satellites distance is no longer a significant factor in the cost of providing communications services. Further, since they eliminate the need for expensive ground relay networks, satellites are likely to be the least expensive means for providing mass communications in the less developed countries of the world. In fact, for areas like Northern Canada, Africa, India and Brazil, it may soon be possible to provide communications services of the most advanced type at a fraction of the cost of conventional systems. These could include not only high quality television, radio and telephone communications, but also a wide range of data transmission services. The first Canadian communications satellite "Anik" which will also be the world's first geostationary domestic satellite is expected to begin to provide services in 1972. It will provide a total of twelve television band width channels, ten of which will normally be available with two held in reserve as spares.

In the international field the eight Intelsat 4 satellites now on order for the global network will each provide the equivalent of 5000 voice circuits in normal "area coverage operation" or 8500 circuits in the narrow beam operating mode. This capacity could be increased to 10,000 by providing for narrow beam operation on all 12 transponders instead of the 8 in the current version. In fact Hughes engineers estimate that relatively minor modifications such as the use of orthogonal polarization on high density routes could increase the capacity to 22,950 circuits. Finally, by the end of the decade, Intelsat engineers estimate that new larger satellites will provide up to 85,000 circuits.

The factor which is expected to have the greatest impact on communications satellites systems however is the provision of exclusive frequency bands for satellite use. In this connection, the forthcoming World Administrative Radio Conference, to be held in 1971, will review allocations for the various services and may allocate approximately 6 GHZ of bandwidth between 11.7 GHZ and 31 GHZ for exclusive satellite use. By removing ERP restrictions and eliminating interference from terrestrial microwave systems, such allocations could drastically reduce the size of earth terminals, and make it possible to eliminate the costly microwave tails between terminals and urban switching centers. This would result in major system cost reductions which could be reflected in a corresponding reduction in the cost of long distance data transmission.

With the elimination of distance as a significant communications cost factor, some tantalizing new prospects are opened up for the exploitation of the Information Utility concept. World-wide information networks have now become technically feasible and, with such networks, the vital commodity which we have termed "computer power" could be made available in any desired concentration everywhere on earth. A United Nations Information Utility, as the vehicle within which a multitude of international networks could develop and grow, could act as a gigantic electronic nervous system for the entire globe. In addition to enormously magnifying the operational effectiveness of the United Nations and its specialized agencies, such a system could leapfrog the knowledge barriers between the developed and underdeveloped areas of the world and ultimately bring the complete store of human knowledge within the reach of every human being.

Other new transmission techniques that could have a major impact on communications costs include: coaxial cable system in both individually switched and loop forms; waveguide systems currently capable of handling up to 280 M bits/sec but with a projected growth to 30,720 M bits/sec by the late 1980's and laser optic systems with capacities in the million M bit/sec range. It is worth remarking also, that conventional twisted pair cable as used today for normal telephone service has a potential one way transmission capacity of 1.5 M bits/sec with repeaters spaced at 1.15 mile intervals. In fact if low capacitance paired cable (which still costs far less than coaxial cable) is used, rates as high as 6.3 M bits/sec with repeater intervals of 2-5 miles are possible.

Digital communication techniques also promise to significantly reduce communications costs in both terrestrial and satellite system. Thus Telecommission Study 4(a) "The Future of Communications Technology" has estimated that:

"a 10 station FM/FDMA system having a capacity of 450 one way voice channels could provide 900 channels if PCM/PSK/TDMA were used."

Other improvements could result from the incorporation of the previously mentioned mini-computers directly into the communications systems so that the switching functions are geographically distributed instead of being concentrated in large costly central exchanges. Such a development would further blur the boundaries between computers and communications.

The rapidly developing Cable TV services represent another area of technical uncertainty with important implications for the future of computer utilities. Originally intended to be no more than a means of bringing improved television reception to viewers in areas where reception was poor or choice of programs limited, Cable TV now promises to impact heavily upon the entire field of telecommunications. Multi-service wide band systems using coaxial cable, could for example provide viewers with an almost unlimited choice of programs including conventional television. In addition however they could also make possible an enormous range of new services, many of which would involve two-way communication. Information retrieval services, for example, could include wide-band transmissions of pictorial material to the subscribers via cable and the use of narrow-band channels in the same cable for subscribers' queries and responses to a central computer. The implications of such a facility for computer assisted instruction and services like computerized shopping are obvious.

At this time, however, there is no agreement as to either the optimum approach to wide band services or the best means for incorporating them into the sorts of systems with which we are concerned here.

Some authorities argue that the full exploitation of wide-band distribution systems in industry and the home requires that such systems be fully integrated into the communications common carrier networks with a requirement that the carriers be "required to meet all demands for service". Under this concept, television channels, for example, would cease to be a scarce and, therefore, rationed commodity and would become instead readily available to anyone, without any requirement for government licensing, as a normal telecommunications offering. Under such conditions, one can, for example, imagine an explosive growth of pay TV with the customer having a choice of hundreds of programs. The growth of other wide-band services involving the previously mentioned two-way communication would, however, probably be of even greater significance. These could include thousands of new services, many of which would involve access to computerized data banks.

Others, on the other hand, argue that granting the carriers a monopoly of wide-band services would stifle innovation and slow down the development of the very services that it is so vital that we encourage. They propose instead that new carriers be formed through amalgamation and interconnection of the existing cable TV organizations and that these carriers be licensed to compete with the established carriers in providing a limited class of video services. Finally, some would perpetuate the present situation and regard cable companies merely as broadcasters, subject to the same restrictions and limitations as normal television stations.

Closely allied to the cable TV issue is the issue of separate dedicated digital networks. Many countries: Sweden, Great Britain and Germany are good examples; are constructing or planning systems for data transmission that are separate from the carrier voice networks. Likewise in the United States, the FCC has indicated its willingness to entertain requests from non-carrier organizations for licenses to construct and operate such specialized networks in competition with the regular carriers.

The technical and short term economic arguments advanced by proponents of such separation include such factors as:

- ability to provide faster signalling times, milliseconds instead of seconds.
- elimination of any need for costly modems.
- economical digital transmission techniques since only pulses rather than analog wave forms need be handled.
- elimination of adverse loading effects on the conventional switched voice networks.
- inherent compatibility with transaction oriented tariffs and short minimum holding times.
- lower error rates.
- greater reliability.
- etc.

On the other hand, there are also strong arguments against the concept. These, together with the pros and cons of a number of different policy alternatives are discussed in some detail in Part VII.

Systems Architecture

The whole question of optimum system architecture is one of the major technical uncertainties in the multiple access computer network field. For one thing, there is no general agreement as to the form that the central processing complexes should take. One of the difficulties involves the rather limited number of simultaneous users that the current state of the art of time-sharing permits a single general purpose computer to serve -- somewhere between one and two hundred in even the largest systems. In order to serve the thousands of customers required by many of the proposed plans for mass utilization of computer utilities, new systems architecture approaches may therefore be required. In this connection some feel that the only way to realize the economies of scale promised by a truly large system is to adopt the super computer approach in which each central complex would contain a gigantic processor connected to an indefinitely expandable pool of memories. Others argue in favour of a multi-computer complex with pools of smaller processors (both general and special purpose) as well as memories and a few even visualize ultra parallel processors whose basic building blocks would be complete mini-computers instead of flip-flops and logical elements.

Speaking more generally, we can have systems with distributed processing and/or data bases, centralized systems, master-slave systems, specialized, multi and general purpose networks, and so on. Each of these different possible structural forms exhibits unique operational, economic and technical characteristics and has important implications for the communications sub-systems, memories, processors, etc., from which the networks are constructed. Interesting possibilities are also presented by central processors in which many functions which are today performed by software, would be built into the machine. With progress in read-only memories and L.S.I., it may soon be possible to build machines which can handle FORTRAN or APL statements, for example, directly without any need for compilers. In fact central processing complexes of the future may well be made up of a large number of specialized machines dedicated to particular applications but capable of working together as required on large problems.

Sovereignty Aspects

Of more immediate urgency than the potential long and medium-term environmental consequences of communications computer applications are their possible impact upon Canadian sovereignty. During the next decade, market forces if unconstrained, may have the following effects:

1. Through foreign ownership of the computer utility industry, Canada may lose control of what most observers predict will eventually become the nation's largest and most vital industry, and the second or third largest by 1980.

2. Increasingly, Canadian computational needs may be served by north-south communications linked to U.S. computer utilities. Such a development would seriously constrain the development of an indigenous Canadian industry, if it were not balanced by a corresponding export of Canadian services to the United States.

3. Many application services of Canadian computer utilities and in particular those concerned with reference and instructional offerings, may be dominated by foreign content to the point where Canadian cultural identity could be submerged.

4. The location, beyond the borders of this country, of data banks containing information about Canadian institutions and individuals might render ineffective any Canadian laws concerning information contained in those systems.

Historically Canada has been unwilling to submit to unconstrained market forces where essential services are concerned. In the development of railroads, telecommunications, broadcasting networks, banking systems, highways and air services, the importance of sustaining an east-west axis has been recognized, and appropriate policy measures have been taken.

PART V

Economic Considerations

Despite the obvious importance of economic factors in the development of a computer utility policy, generally accepted professional analyses of future trends are not yet available. One of the difficulties arises from the primitive state of the current industry. Thus attempting to predict the state of the industry in 1985, for example, is in many respects comparable to predicting the current automobile and highway industries in the days of the Stanley Steamer. Consequently no claim is made that the analyses in this chapter comprise anything more than a starting point for the comprehensive analyses of the Computer/Communications Task Force described in Part IX.

The Current Data-Processing Industry

At the end of 1969, the cumulative investment in computer systems in Canada was approximately $600 million. This is a depreciated value which represents an average investment of $430,000 per computer system and 1,928 *(1) systems where the term "system" includes both hardware and systems software. The revenue from these systems during 1969 was $250 million, up $40 million from 1968, and is expected to reach $300 million in 1971 *(2). Of this revenue, $47 million was accounted for by multi-subscriber time sharing services *(3) and the remainder by normal service bureau operations. Of the time-sharing market, commercial or business operations represented $27 million and scientific applications $20 million.

The distribution and rate of growth of computer installations in Canada is shown in Table No. 1, while Table No. 2 shows the distribution by computer size and industry. At the present time, the largest portion of the data-processing market is accounted for by the Toronto/Ottawa/Montreal areas, with over 50% of this activity in the province of Ontario. Quebec and the Maritime provinces account for 35% and the remaining 15% is distributed throughout Western Canada.

Growth Projections

Historically, both economic and technological forecasts of the data-processing industry have been notoriously unreliable. In the following examples two different but equally reputable approaches yield widely different results:

(a) Historical Extrapolation Approach

In this approach, the historical pattern of investment is computed from available data and then extrapolated into the future. Thus, Table No. 1 shows that the rate of growth of computer installations during 1968 and 1969 apparently levelled off at about 20% per annum although preliminary figures from the 1970 Information Processing Society of Canada census indicate that the rate rose again to 30% during 1970.

If the 20% rate if compounded annually and extrapolated to 1980, it results in a cumulative total of 15 thousand systems or a total investment of $5 billion, assuming an average cost of $430 thousand, less depreciation, per system.*(4)

*(1) Information Processing Society of Canada - 1969 Census of Computers
*(2) E.J. Cody - Univac Canada
*(3) CN/CP Telecommunications Time-Sharing Study
*(4) Trans-Canada Telephone System Telecommission Computer Study

Table No. 1.

COMPUTERS INSTALLED BY PROVINCE AND MANUFACTURER

	ALTA	BC	MAN	NB	NFLD	NS	ONT	PEI	QUE	SASK	TOTAL	% Growth
IBM	65	81	55	15	10	14	555	1	251	22	1069	
DEC	23	8	9	1	1	5	107		21	8	183	
HON	12	12	6	1		1	78		38		148	
BUR	3	5	2	1	1	8	71		67	4	162	
UNI	12	16	3			2	59		33	5	130	
CDC	8	3	4	1	1	2	33		16	1	69	
CE	2	5		1			28		18		54	
NCR	5	1			1	4	19		16	1	47	
SDS	5	1				1	4		3	1	15	
COL							14				14	
OTHERS	3	4				2	20		7	1	37	
TOTAL 1969	138	136	79	20	14	39	988	1	470	43	1928	20
May 1968	119	107	69	16	9	31	811		410	41	1613	20
May 1967	86	93	57	13	6	25	644		332	23	1279	35
June 1966	69	70	34	12	6	17	443		280	17	948	33
June 1965	52	52	30	8	5	14	330		204	15	710	41
March 1964											502	

Information Processing Society of Canada
Census of Computers
1969

COMPUTERS INSTALLED
BY INDUSTRY AND MONTHLY RENTAL

	UP TO $1,999	$2,000 to $4,999	$5,000 to $9,999	$10,000 to $19,999	$20,000 to $49,999	$50,000 AND OVER	TOTAL
PRIMARY/RESOURCE	26	34	19	9	5		93
CONSTRUCTION	16	14	9	2			41
MANUFACTURING	87	140	71	71	31	6	406
TRANSPORTATION	9	25	16	21	9	7	87
UTILITY	13	17	24	15	17	3	89
COMMUNICATION	19	14	4	5	1		43
DISTRIBUTION	30	66	32	29	3	1	161
FINANCIAL	25	43	41	57	22	4	192
OTHER SERVICES	143	70	39	22	19	12	305
SERVICE BUREAUX	25	49	26	28	13	7	148
GOVERNMENT	84	57	45	33	30	10	259
PETROLEUM	13	10	14	16	9	5	67
OTHERS	13	7	8	5	3	1	37
TOTAL	503	546	348	313	162	56	1928
MAY 1968	369	504	318	249	136	37	1613
MAY 1967	161	467	338	214	92	7	1279
JUNE 1966	83	370	285	134	76		948
JUNE 1965	78	300	116	168	45	3	710
MARCH 1964							502

Information Processing Society of Canada
Census of Computers
1969

(b) Percentage of Gross National Product

Another method of assessing the growth of the computer market is to relate investment to the gross national product. At the present time, the gross cumulative investment of $600 million in computer systems is approximately .8 of 1% of the GNP, and is rising towards the U.S. figure of a little over 1% *(4). The Canadian GNP for 1980 has been estimated to be in the order of $181 billion *(5) and, on this basis, gross investment in computer systems could be in the order of $1.8 billion by that time.

The problem with this approach is the assumption that the computer industry will represent a constant percentage of the GNP over the decade. This is probably unrealistic for an industry which most authorities agree is still in its infancy, and which may well be one of the three largest in the country by 1980. The Historical Extrapolation Approach seems to reflect this possibility, since its $5 billion figure represents an increase to about 3% of the expected 1980 GNP, and may therefore provide a more reliable prediction.

(c) The Transaction-Population Approach

A novel approach to the problem of predicting computer-industry growth has been developed by a consultant *(6) in a market study prepared for the Department of Communications. The study first defines a quantity called a "transaction", and then considers the number of transactions which might be involved in a variety of different Computer Utility application areas. Typical transactions could include making a reservation, asking for a stock quotation, registering a sale, transferring credits from one account to another, etc. Knowing the number of transactions and the rate at which they must be handled for a particular application, it becomes possible to calculate the computer and communication requirements and therefore the required capital investment for that application.

With the aid of this technique, the study concludes that the expected capital investment for all systems likely to be implemented in Canada by 1980 will be between $2.3 billion, if growth depends on normal market forces, and $6.3 billion if the government takes appropriate steps to stimulate the industry.

(d) A Comparative Canada - U.S. Approach

The above projections tend to assume that the Canadian computer needs will evolve in an international vacuum. In fact, we share a continent with the most computerized

*(5) TCTS - CNT/CPT Telecommission Market Analysis - Study 2(e)
*(6) Mr. Lyman Richardson, President, T-Scan, Toronto.

country on earth, the United States. Currently, our neighbours have a two and one-half to one lead over us in the number of installed computers per capita. The U.S. have a total of 63,000 computers for a per capita ratio of 2.5 per 10,000 population while Canada has a total of 2,000 computers for a per capita ratio of 1 per 10,000 population.

If we assume that it is desirable for Canada to stay abreast of the Americans and that public policies will be adopted to ensure this, then the figures we arrive at, based on American projections, are different again. Expert opinion *(7) has predicted that the U.S. could spend $260 billion before 1980 to build and expand data processing and telecommunications systems. Of this total, capital expenditures for telecommunications alone would be at least $100 billion. The remaining $160 billion would be required for computer systems and services.

Obviously, Canada cannot hope to match an investment of this magnitude, but even to equal the same per capita rate of growth, we would still be involved with a bill of 20/200 x 260: $26 billion of $2.6 billion per year, as compared with the current figure of less than $1 billion for both telecommunications and computers.

Of greater significance is the fact that even a $26 billion investment would merely maintain Canada's present position vis-à-vis the United States. To close the gap, an annual expenditure in the order of $5.2 billion or double the U.S. per capita investment would be needed. If we assume that this is split evenly between systems and services, then the 10-year capital investment required would be $26 billion for computer systems and communications combined or $16 billion for the computer systems portion.

This figure of $1.6 billion per year compares favourably with the annual capital addition of the Canadian Electric Power and Gas Industries which, for 1969, was $1.535 billion.

Computer Services Revenue Projections

If we assume that the gross rate of return from computer systems investment must be between 30 and 40%, say 35%, then the revenue that would result for each of the previously described investment cases in 1980 would be:

Historical Extrapolation Approach	$1.75 billion
Gross National Product Approach	$0.63 billion
Transaction Approach	$0.79 billion to $2.2 billion
Stimulated Growth Approach	$5.6 billion

*(7) Business Week, December 6, 1969.

Economies of Integration

One of the major justifications for telecommunications carrier participation in public data-processing that is put forward in Part VI is based upon the supposition that economies of integration result when telecommunications and data-processing are combined within a single organization. If such economies exist and are passed on to the users in the form of lower data-processing and/or communications charges, then it could be in the public interest to permit the carriers to provide public data-processing services.

The question of the sorts of economies that might be realized was discussed in the following extract from a Trans Canada Telephone System document entitled "Response to Communications Canada", dated September 3, 1970:

> "Throughout our original submission and in this one we have indicated that there are types of communication/processing services that could benefit from carrier participation in processing because:
>
> a) it would optimize use of know-how, manpower, space, and other resources.
>
> For example:
>
> - the carriers have an undisputed experience in systems design and 'software' development that would be directly applicable to the design of a total communication/processing system.
>
> - communication and processing technology is rapidly merging. As integrated solid state devices are further introduced in designs, the circuit components of computers and telecommunication switching equipment will become identical. This has two impacts re..carrier economies. Firstly, it means that system design know-how in the two fields is going to become increasingly interchangeable and related. Secondly, in some cases even now, the same units needed for communications can, with some additional programming and at incremental cost, provide needed processing services. By about 1980, it is possible that this situation could lead to the development of communications switchers with considerable processing logic and storage capacity. However, this is pure conjecture at this time.
>
> b) it would permit the customer to buy his services from a single provider of total information systems. Hence opportunities for less "red tape" and potentially a system better optimized to the customer's total need.

c) it would reduce the need to isolate system troubles for the purpose of determining which supplier is responsible. This can be complex and expensive on integrated long haul networks where parts of the system are owned and maintained by different parties."

"However, having said this it is equally important to recognize that it is not a universal truth that such economies exist. We feel that in the huge market to be served that there are innumerable opportunities for entrepreneurs and that carrier entry would complement this effort in those areas where our skills and capabilities are most appropriate.

The following additional economies should be realized if the carriers were to provide processing services. However, they might also in large part be realized through cooperation between carriers and entrepreneurs:

d) remote plant maintenance features will become practical and economical. Tests can be conducted from well equipped test centers and looped back via the equipment at the remote computer location. This would reduce the number of visits to customers and speed up maintenance. Such economies would be possible if the equipment at the customers' location had the necessary test features.

e) there will be economic opportunities within the decade to integrate test and other circuit features of telecommunication channels with computers, especially with communications controllers. Candidates for integration are data set functions, automatic dialing, supervisory and control of communication channels, fall back and recovery switching, line hunting for better utilization of communications controller 'ports', and telecommunication terminal equipment."

It is important to note that TCTS in their response were far from dogmatic in their claims for economies of integration. For example they qualify their case with statements like "it is not a universal truth that such economies exist" and "they might also in large part be realized through cooperation between carriers and entrepreneurs."

A very preliminary analysis of the subject is contained in Appendix C of this report. This Appendix contains the results of a special study performed on behalf of the Department of Communications by ProfessorsLen Waverman of the University of Toronto and Donald Cowan of Waterloo University.

In their study, Waverman and Cowan identified several additional possible sources of integration economies. These included:

- Ability of a large carrier to finance investments at a lower cost of capital than an independent data processing firm.

- Economies in research and development because of the increase in scale or in information flows.

- Decreased line and switching costs.

After analyzing these and other possible sources of economy the study concludes that the case for their existence on any meaningful scale in unproven. As illustrated by the comments of Dr. J. de Mercado in Appendix D, however, strong exception to some of the Cowan/Waverman conclusions has been taken by other authorities.

PART VI

Carrier Participation in Public Data-Processing

Introduction

Previous sections of this report have stated that there is a natural alliance between computers and communications and that this alliance expresses itself in the form of computer utilities. This leads to the question of whether telecommunications carriers should or should not be allowed to offer public data-processing services. The carriers being regulated monopolies, some consideration must be given to the advantages and disadvantages of allowing them to enter an unregulated field.

The question is given greater pertinence by the fact that two regulated telecommunications companies, one of them federally regulated, have already begun offering data-processing services to the public.

The recent proposal by the Federal Communications Commission in the United States allowing telecommunications companies to operate unregulated computer utilities gives rise to the possibility that various American carriers may enter the Canadian market.

A further consideration is the fact that the Canadian data-processing industry is already largely controlled by foreign owners. Consequently, measures may be necessary to assure a strong and viable Canadian participation which will be responsive to Canadian needs and which will assure the most equitable distribution of the benefits of the computer to all regional and social groups. In this connection it should be noted that the telecommunications industry in this country is now substantially owned by Canadians.

A corollary of the question of common carrier entry is the need to determine what constraints should be placed upon them if they are allowed to offer data-processing. It is the purpose of this chapter to first summarize the arguments for and against carrier entry and then to discuss a number of different policies under which such entry might be permitted.

Vertical and Horizontal Diversification

In the discussion in this chapter, the terms "vertical" and "horizontal" diversification are used to describe two basically different approaches to carrier diversification. These concepts have come into relatively common use in the United States during the course of the Federal Communications Commission enquiry into the Interdependence of Computers and Communications.*(1)

*(1) Author of the definitions cited above is Prof. Manley Irwin of the University of New Hampshire, an FCC consultant.

Horizontal Diversification

This approach enables the carrier to offer data-processing as a carrier with shared use of facilities, management, personnel and equipment between the data-processing and communications segments of the carriers' business.

Vertical Diversification

In this approach, the carrier establishes a corporate affiliate for the data-processing part of its business that is separate and apart from the parent.

Vertical Diversification Safeguards

In this chapter, whenever vertical diversification is discussed, it is assumed that the following safeguards designed to reduce the danger of unfair competition will apply:

(1) Absolute separation of financial, technical and management resources.

(2) Prohibition of:

a) Cross subsidization and preferential treatment

b) Disclosure to the affiliate of proprietary information obtained by the carrier from competitors of the affiliate

(3) The requirement that the carriers immediately publish and receive approval for a comprehensive, clearly delineated list of data transmission and raw computer offerings and charges.

(4) Detailed monitoring of the implementation of these conditions, and adequate sanctions against infringement.

I. Summary of Arguments and Alternatives

As a result of opinions gathered during the course of the Telecommission, a number of the arguments for and against carrier participation in public data-processing can be summarized as follows:

Arguments Advanced in Favour of Participation

(1) Resources Available to the Carriers

As mentioned in Part IX Section I the full exploitation of the power of the computer utilities in the interests of the

Canadian people will require large expenditures and the mobilizing of all the applicable Canadian resources. The federally regulated telecommunications carriers command technical knowledge, experience and financial resources.

(2) Common Use of Equipment and Optimum System Design

The offering by the carriers of public data-processing and in particular raw computer power, it has been claimed, would facilitate more effective use of total facilities, the development of an optimum system design for national computer utility networks and hopefully reduced costs for both computer and communications services.

(3) National Objectives

As regulated entities, the carriers could be required to bring data-processing services to many small users and to remote and underdeveloped parts of Canada where they might otherwise be unavailable. The offering of public data-processing by the carriers would ensure that, under the coordinating influence of Canadian public policy, the resources enumerated in (1) above would be brought to bear in areas of greatest social and economic value.

(4) Growth of the Application-Service Industry

The existence of computer utility networks based on the offering of raw computer power by the telecommunications carriers as well as others some believe, might lead to a rapid growth of the unregulated application-service industry including the rise of a new class of entrepreneurs who would not need to own and operate their own computer facilities (see Independent Service Retailer, P. 9). In many cases, this industry does not require large capital investment and competition here is clearly in the public interest.

(5) Need for Large Software Organizations

Despite the statements in (4) above, there are certain areas of the application-service industry which do require rather heavy capital investment. The creation of large data bases, the development of large industry wide application packages and the development of the software for major integrated systems: e.g., automated banks, national medical networks, etc., all demand the coordinated work of hundreds of people. At the present time, there are few Canadian organizations large enough to undertake such efforts and the field is dominated by American corporations. The carriers, however, might be able to create several large viable Canadian software and systems organizations that could compete effectively with their American counterparts.

(6) Restraint on Undesirable Practices

Some U.S. computer manufacturers have established a practice which could spread through the industry of reserving perpetual proprietary rights to any programs run on their machines or to any knowledge imparted to them by their customers. If the carriers, as potentially powerful purchasers of computers, were forbidden to accept these undersirable conditions which the manufacturers seek to impose, a national standard would be established and its general acceptance ensured by the operation of market forces.

(7) Canadian Ownership and Control

An obviously desirable objective in the national interest is that computer utility networks, operating in Canada, should be responsive in terms of ownership and control to Canadian public policy and law. The federally regulated telecommunications carriers (with the exception of British Columbia Telephone, which together with Quebec Telephone is affiliated with a United States corporation) are majority-owned by Canadians.

Arguments Advanced Against Participation

(1) Impact on Existing Data-Processing Companies

Many Canadian independent data-processing companies are undergoing a period of readjustment, and entry by the carriers into the field of public data-processing could intensify the competitive environment in which they operate.

(2) Cross-subsidization and Preferential Treatment

Many respondents to the Telecommission questionnaire (see Appendix A) criticized the propriety of allowing a carrier to offer data-processing services from a monopoly position unavailable to its competitors, alleging that small data-processing companies would be disadvantaged with respect to organizations on which they must depend for essential telecommunications services. If the data-processing services offered by a carrier were unregulated, they could be subsidized from telecommunications revenues. This would be harmful in two ways. First, charges to telecommunications users could be artificially inflated; and second, the carrier could be in a position to engage in unfair competition with its data-processing competitors by price-cutting.

Even if vertical diversification were prescribed, respondents claim there would still be many ways of giving preferential treatment to a quasi-autonomous subsidiary, as for example:

(a) early delivery of new equipment, advance notice of price and service changes and superior maintenance;

(b) special attention to the needs and competitive position of the subsidiary when considering whether to offer new services, the schedule for their introduction and the places or areas where they would be available; or

(c) the disclosure of proprietary information and development plans of competitors obtained through line-leasing arrangements.

(3) Obstacles to Effective Regulation

An amendment to the Railway Act which came into force on August 1, 1970 seeks to prevent cross-subsidization by subjecting all telecommunications services offered by the carriers to regulation, and requiring them to demonstrate the validity of the cost allocations on which tariffs are based. Historically, it has always been found difficult to identify true costs, even for particular elements of telecommunications services; for this reason, a tendency has developed to set total rates of return for the entire operation of the carrier, and to question the costs of specific services only when there is evidence of abuse. The enormous complexity of a horizontally integrated computer utility offering raw computer power, communications, and application services might make it extremely difficult for a regulatory body to arrive at a valid allocation of costs, but this difficulty might be partially overcome by insistence on vertical diversification.

(4) Slow Innovation by Carriers

Some respondents to the Telecommission questionnaire claimed that the carriers are slow to innovate and to introduce new techniques and devices. They further said that the needs of the computer utility industry demand modification of traditional tariffs, practices and customs that were originally established to satisfy the requirements of voice transmission.

(5) Dilution of Telecommunications Resources

The exploitation of recent developments which promise enormous improvement in the quality and diversity of telecommunications services will make heavy demands on the technical and management resources of the carriers. Since these resources are limited, there is a danger that diversification into public data-processing could detract from their ability to meet their primary telecommunications obligations.

II Basic Policies

The many possible policies that might be adopted seem to break down into seven basically different approaches.

A. The carriers would be barred from providing either raw computer power or application services to the public.

The basic arguments for and against this policy have been summarized in the preceding section.

B. The carriers would be permitted to provide both raw computer power and application services via horizontal diversification but without regulation.

Under this policy, the carriers would be providing data-processing services under conditions of unregulated competition and communications services as a regulated monopoly. Because of the horizontal structure, however, there would be nothing to prevent sharing of equipment, plant and personnel between the two services.

It is claimed that this policy would offer possibilities for providing the technical and economic advantages of an integrated total systems approach and, at the same time, maintain the existing highly competitive data-processing market. On the other hand, in an unregulated environment the carrier would be free to subsidize the unregulated data-processing segment of his business from the "guaranteed" revenues of the regulated segment and the arguments concerning cross-subsidization and preferential treatment would apply.

C. Carriers would be permitted to provide both raw computer power and application services via horizontal diversification but as a regulated activity.

Conceivably, this policy could avoid the risks of cross-subsidization of Policy B. For, with a regulatory commission approving the tariffs for both communications and data-processing, it would be easier than in Policy B for this commission to verify the correctness of the cost allocation procedures employed in the proposed tariffs. Further, since the service would be regulated, the socially desirable feature of equal access anywhere in Canada could also be more easily ensured. On the other hand, as mentioned in Section 1, there are serious regulatory problems in establishing true costs even for communications. As a result, there has been a tendency to set total rates of return for an entire carrier and to question specific service costs only when there is evidence of abuse. Consequently, in view of the enormous complexity of computer power, as demonstrated in Part I, a regulatory body would be faced with a task of very great proportions in attempting logically to analyze a carrier's figures for a combined computer/

communications service which also included applications services.

D. Carriers would be permitted to provide both raw computer power and application services via vertical diversification without regulation.

This policy which is the one proposed by the F.C.C. in the United States attempts to overcome the problems of cross-subsidization by forcing the carrier to establish a separate subsidiary for the data-processing portions of its business. Sharing of personnel, common equipment and plant would be forbidden by law and the subsidiary would enjoy an autonomous corporate existence. A further variation of this policy would also forbid the sale of services by the subsidiary to any telecommunications carrier.

The most compelling arguments in favour of this policy are that it brushes aside the problems of regulation and the cost allocation difficulty, and could lead to the establishment of several large important software organizations. The main arguments against the policy have already been enumerated in section 1 of this chapter and involve the dilution of carrier resources and the danger of unfair competition. In addition, if the separations were total, this might have a bearing on the social justification for the carriers entering the data-processing business. For, from the point of view of the public, important reasons for permitting such entry involve the claimed economic dividends of the total, i.e., combined communications/computer, systems approach and the possibility of promoting desirable social goals through regulation.

E. Carriers would be permitted to provide raw computer power via horizontal diversification on a regulated basis but would be completely barred from the application service field.

This policy would make the telecommunications carriers "Telecommunications/Computer Utility Carriers" as defined in Part I. It has been suggested that this might permit the public to reap the benefits of both optimized overall computer/communications systems design and regulation in an area where it is feasible. The appropriate use of regulatory authority might assist in ensuring the widespread availability of computer power everywhere in Canada. Eliminating the need for heavy capital investment on the part of application service organizations might help the growth of the application services industry, as described in section 1 of this chapter.

Regulation of raw computer power offerings would seem to present fewer difficulties than in the complex applications services field. On the other hand, the difficulties of equitable allocation of costs between the computer and communications functions and of defining "raw computer power" would remain.

Objections to this policy that have been offered are:

1) It would render a potentially large source of Canadian capital unavailable to the applications service industry and thus could hinder the growth of those portions of that industry where size and consequently large capital investments are important.

2) If real advantages of integration were realized,* the policy could in the long run eliminate competitive sources of raw computer power and create a carrier monopoly of the industry.

3) Both carriers and independent data-processing organizations have questioned the economic viability of an organization which offers only raw computer power.

F. Carriers would be permitted to provide raw computer power, via horizontal diversification and application services via vertical diversification with the affiliate banned from selling services to any carrier and from selling raw computer power.

This policy would permit the carriers to enter the application service business, subject to rigorous controls on a non-tariffed basis via an arms-length corporate affiliate and to also offer raw computer power on a tariffed basis through horizontal integration as in Policy E. In order to eliminate the possibility of indirect cross-subsidization through a captive market, the affiliate would be forbidden to sell to both its parent and any other carrier. In addition, it would also be prevented from offering raw computer power, either directly or as part of a service package which could wrap its own hardware and software costs into a single bundle.** If it were not for this latter prohibition, there might be a natural tendency for the carrier to offer raw computer power through its unregulated affiliate rather than directly on a regulated basis. This, it has been mentioned, could defeat one of the primary reasons for permitting carrier entry into the public data-processing field. In theory, this problem could be avoided by also tariffing the offerings of the vertical subsidiary, but this would create fundamental regulatory difficulties. Consequently, the policy requires the affiliate to obtain that power which it needs for its service packages from either the regulated carriers or a truly independent computer utility. For the

* But Appendix C indicates they may not exist.

** This, of course, would not prohibit the affiliate from offering an integrated hardware/software service package in which the raw computer power component was obtained from another organization.

purposes of the policy, a computer utility would not be regarded as independent if it were associated in any way with the carrier affiliate or any organization having an interest in that affiliate.

With respect to the raw computer power area, the advantages, disadvantages and impact of this policy would be identical to that of Policy E. An advantage over Policy E is based upon the claim that the carriers would be able to create several large viable Canadian software organizations that could compete effectively with their American counterparts.

G. The carriers would be prohibited from directly supplying either raw computer power or application services to the public but would be permitted to act as a merchandizer for such services on behalf of independent data-processing organizations.

This policy was suggested by Northern Electric and included in the TCTS Brief "Response to Communications Canada" presented to the Department of Communications on September 3, 1970. It could take many forms but typical features might include:

1) The carriers would sign blanket agreements with a number of independent data-processing companies in which they would agree to advertise the DP organizations' offerings, provide customer assistance, directories etc. and perform system accounting and billing.

2) All carrier customers would have access to all data-processing services for a nominal monthly rate over and above the regular telephone bill (about $10.00) plus a toll charge of so much per program.

3) Typical services mentioned in the TCTS brief which might be available include:

a) over touch tone telephone:

* ski reports
* highway condition reports
* stockmarket quotations
* weather reports
* news briefs
* details of retail store sales
* help wanted
* elementary computation
* programmed instruction

b) over more sophisticated alpha-numeric terminals:

* all the services available in a)
* normal time sharing computer services
* ability to be an author (or supplier) for both levels of service.

From the user's point of view, the most attractive feature of this policy is the freedom that it gives him to utilize a large number of different data-processing services and organizations. Instead of having to sign a separate contract with each organization whose services he wants to use and paying a separate monthly connect charge ($100 or more) to each, he is guaranteed access to all services via the blanket carrier contract.

For the data-processing organization the principal advantages include:

* access to a much wider market than might otherwise be the case
* a strong incentive for the carriers to introduce distance independent tariffs with a consequent expansion of each data-processing organization's operating territory to include the entire nation
* reduced marketing, billing and collection costs.

On the negative side, it has been claimed that this policy would reduce competition among processing suppliers, reduce the benefits of innovation from the supplier source and place excessive authority in the hands of the communications carriers.

PART VII

Other Policy Considerations

In addition to the question of telecommunications carrier participation in public data-processing there are a number of other policy considerations of equal or greater importance. These have been touched upon in earlier sections and include:

Wide Band Services
Separate Digital Communications Network
Foreign Attachments
Multiplexing

Wide Band Services

In Part IV the subject of wide band services such as those provided by Picturephone or potentially by cable TV was introduced. These services are important to the future of computer utilities as many of the more imaginative (and socially important) services discussed in Part II require the transmission of pictorial material. Consequently these new services and the institutional arrangements for providing them form a vital part of any overall computer utility policy. Such services today involve many different jurisdictional authorities and operating organizations. CATV, for example, is obviously a wide band service which is currently regulated in technical areas by the Department of Communications and in all other matters by the Canadian Radio-Television Commission. Communications carriers, including those that are federally regulated, are involved in the industry through the provision of hardware and the mechanism of pole attachment agreements. Services, however, are mainly provided by a host of independent entrepreneurs covering a wide range of financial commitments. Any change in the existing CATV policies involves many constitutional, economic and technological considerations. These are currently the subject of Government study and analysis and their proper treatment would be beyond the scope of this report.

Picturephone Service

A possible alternative to the cable systems is provided by the carrier's Picturephone service. This has the significant advantage of being able to use the existing twisted pair distribution systems used for normal voice communication. It also provides full two way video communications, a host of sophisticated user features and capabilities for high speed data transmission. It is currently limited by its high cost, about $160 per month, and the inferior picture definition that results from the restricted signal band width, about 1.5 MHZ compared with the 4.5 MHZ of conventional commercial television. Both of these limitations however, could be alleviated as the service develops.

Separate Digital Communications Network

Although the development of video band width services and the role of the carriers and CATV companies in their provision are important considerations for future information utilities, there are a number of basic communication questions that are of much greater immediate importance. One of these concerns the optimum means for providing data transmission services and in particular the question of whether such services should be integrated with conventional telephone services or supplied by a separate dedicated digital network.

Some of the differences between the characteristics of the present switched voice network and the needs of data processing organizations were mentioned in Part IV. Others are detailed in the responses to the Telecommission Computer/Communcations Inquiry summarized in Appendix A. Another excellent summary of the arguments is contained in a review of the DATRAN arguments before the Federal Communications Commission presented in a recent OECD publication.*

"Specifically, Datran argues that the costs of existing communications services have not declined in proportion to data processing costs; that existing analog transmission systems require costly modulator-demodulator equipment to convert digital signals to analog and back again; that current switched services often take significant time to establish connections, (which detracts from the productivity of the data terminal and operator); that transmission systems originally engineered for voice and record transmission do not meet the more demanding reliability standards of digital data transmission; that existing switched services generally cannot handle full-duplex transmission (which leads to reduced throughput and wasteful line reversal time); that the basic switched services, originally intended only for voice and record, provide only two major speed selections whereas many new data applications require faster and more varied choices; that attempts to establish a switched connection for data transmission can be impeded by the high incidence of busy signals currently being experienced in points and times of heavy user concentration; that communication between terminal devices utilizing different line speeds is not possible in most existing major networks;

* A Preliminary Survey of Data Communications in the United States edited by John M. Richardson and Robert Gary - Office of Telecommunications, United States Department of Commerce, OECD. Document no. DAS/SPR/70.66. (Organisation for Economic Co-operation and Development).

that many data transmissions can be completed in far less than the minimum charge periods now in force; and that while common carriers have recently begun to drop barriers against sharing and interconnection, much confusion and difficulty continues to exist in user attempts to apply this flexibility.

Datran attributes many of the asserted unmet needs of data transmission users to the circumstances that the existing switched facilities of common carriers were originally engineered only for voice and record analog transmission services, a constraint which does not exist in its proposed digital system. The three basic integrated components of Datran's proposed end-to-end system (trunking system, switching system, and local distribution system) are engineered specifically for, and dedicated to, digital data transmission. Thus, a subscriber need not convert his digital signals to a different (analog) transmission mode, since the system transmits the subscriber's signal in its original form. Moreover, as the signal is transmitted through the system, it is continuously regenerated into a new, clean and conditioned signal without the amplified system noise present in analog systems."

These Datran arguments are echoed in a special Telecommission Study performed by consultant Lyman T. Richardson. In this study Mr. Richardson argues strongly in favour of what he calls a "transaction oriented network" in which data would be transmitted by special store and forward equipment in the form of packets of characters called "transactions". Typically each packet might contain somewhere between one and two hundred characters. The tariffs for such a network would involve a fixed charge per packet and would be independent of distance.

Involved in the Richardson proposal is another basic question concerning digital services. This is the question of whether the network should be "circuit switched". Circuit switching is of course, the basis of the existing voice networks and involves the setting up of an exclusive wire path or circuit between the calling parties. This circuit is maintained until a call is terminated regardless of whether information is actually being sent over the wires.

It has the advantage of great simplicity since no storage or manipulation of data is involved and information is received with exactly the same order and timing in which it is transmitted.

For transmission of continuous streams of data, voice or video information, or lengthy messages where the duration of the message is an order of magnitude or so greater than the circuit set up time, circuit switching is quite satisfactory. Thus a circuit switched service like Bell Canada's MULTICOM may be reasonable for applications like the transfer of large files or the dumping into distant computers of the contents of a magnetic tape, but it is not nearly as satisfactory for short intermittent messages of the type encountered in interactive time sharing systems, stock quotation services, reservation systems, point of sale recording and so on.

Such applications are distinguished by relatively long holding times, hours in the case of some time sharing situations, but extremely low line utilization rates. Information tends to be transmitted in short bursts with long intervals between bursts so that most of the time the circuit remains idle. Despite this, it is not available to any other customer and the user is forced to pay for the total elapsed time from the original completion of the circuit to its termination. This has a number of undesirable consequences:

1. Carrier circuits and equipment are employed very inefficiently.

2. The high cost of long distance service, in terms of actual quantity of information transmitted that results from the circuit switching optimized time and distance based tariffs, inhibits the development of interactive national computer networks and unduly inflates user charges.

3. In local areas, carrier facilities may become overloaded by data traffic so that unsatisfactory service is received by all customers both voice and data. New York City, of course, provides the classic example of such a situation.

4. In order to obtain more efficient use of the circuits, users must often resort to the use of expensive multiplexing and data compaction equipment or utilize remote batch processing when time sharing might be more satisfactory.

It is claimed by many authorities that the creation of a special "message switched" network is the best way around these difficulties. In such a network no permanent circuit is established between the calling parties. Instead the message to be transmitted is assembled at the user's terminal or in a local concentrator, in the form of a "packet" or transaction which also contains destination information. The message is then propagated from node to node through the network with routing and timing that depends upon the instantaneous traffic and circuit conditions in the network. By delaying and rerouting messages at each node, the system is able to ensure that available circuits are efficiently shared among many different messages. This leads to very high circuit utilization factors and makes possible the desirable transaction oriented tariffs - tariffs that could be much less costly for many classes of users than the conventional time and distance rates.

On the other hand message switching does present a number of problems:

1. Processing and storage is required for every packet at every node in the network and this can be costly.

2. Timing between successive packets is destroyed.

3. Successive packets may take different routes to their destination and thus arrive out of sequence.

Outside of Canada, the decision to create independent digital networks, separate from the conventional voice networks, although in some cases sharing certain trunks and local loops, appears in many countries to have already been made. In the United Kingdom for example, the British Post Office is constructing a network which will probably consist of two sub nets, one circuit switched which will be built on top of the present voice network and the other packet switched, which will be completely separate. The packet switched system is expected to be based upon the pioneering work of a group at the National Physical Laboratory, Teddington who, under the direction of Mr. D.W. Davies, have had an experimental network in operation for over a year now. West Germany, via a consortium consisting of the Post Office, Siemens, AEG Telefunken and the Nixdorf Computer Company has a circuit switched system under construction that is completely separate from the voice network. It is expected to be completed in 1977. Sweden is also building a dedicated digital network, but in this case it will be physically integrated with the voice network. In the case of Japan, also, planning is now well under way for a dedicated data communications network.

In the United States developments are moving very rapidly and include:

1. Initiation in January, 1970 of a two year cooperative experimental program involving the Post Office and the Western Union Telegraph Company. This will permit Western Union's INFO-COM and Telex subscribers

in twelve cities to send mailgrams via computer to teleprinters in 110 participating post offices for delivery the following morning.

2. Introduction by AT&T of the "DATREX" data communications service which provides time sharing computer systems with a concentration facility to interconnect many remote computer imput-output terminals into a smaller number of computer ports.

3. Rapid growth of AT&T metropolition PCM facilities utilizing the T1 carrier system. The 1.544 megabit/sec data stream now serves virtually all metropolition areas and involves some 10 million channel miles. When development of the Bell System's 306 data set is completed, it will be possible to directly apply a data rate of 1.344 megabits/sec to the carrier stream.

4. Development and partial completion of sophisticated government digital networks like AUTODIN, the GSA Advanced Record System, the NASA Deep Space Tracking Network and the National Crime Information Network.

5. Introduction of commercial Picturephone service incorporating a digital inter city network and also providing high speed computer to computer communication at 460.8 Kilobits/sec.

6. Announcement by AT&T on April 14, 1970 that they were focussing on a digital network which would provide a wide mix of speeds from 150 bits/sec to 1 megabits/sec; fast set up times, of the order of 3 seconds; short charging intervals; abbreviated dialing and "data block", i.e. transaction or packet switched techniques and corresponding tariffs.

7. Proposals by a number of organizations to establish new independent data carriers. These proposals are currently under study by the FCC and the chances are good that one or more new regulated specialized carriers will be created to compete with AT&T.

8. Successful demonstration of the ARPA Network. This experimental store and forward network is designed for the transmission of messages from 1 to 1000 characters in length and involves some 20 nationally distributed nodes. It is intended to provide for the economical sharing of the computer and software resources at any node with all other nodes. Thus it incorporates many of the features that have been postulated for the Trans Canada Computer Network in Part VIII.

Returning to the Canadian problem, there are many different institutional arrangements that might be utilized to augment and improve our data communications services. They include:

1. Leasing the responsibility for the planning and creation of data communication services, as is the situation today, with the existing telecommunications carriers.

2. Licensing of new competing private specialized data communication networks as in the US Datran proposals.

3. Creation of a new Federal Crown Corporation which would construct and operate a dedicated national data communications network. This network might lease certain local loops and long distance transmission facilities where necessary from the TCTS system, but would otherwise be granted a full monopoly of all public data communications services.

4. Creation of a Federal Government sponsored body like the Canadian Computer/Communications Agency described in Part IX to develop in cooperation with all interested parties a broad national plan for data communication services whose implementation however, would be the responsibility of the existing telecommunications carriers assisted where necessary by Federal and perhaps Provincial subsidies.

5. Creation under Federal Government Charter of a new National Data Network Corporation owned jointly by the Federal Government, the carriers, (both Federal and Provincial), the Telesat Corporation and the general public. Operating under the overall planning authority of a Federal body such as the proposed Canadian Computer/Communications Agency, this new corporation would have the responsibility for constructing and operating a dedicated national data communications network on a monopoly basis. As in option 3 however, it would lease certain facilities from the TCTS, the Telesat Corporation and CN/CP systems.

A full discussion of the pros and cons of these different policy options is beyond the scope of this report, however, the Canadian Computer/Communications Task Force described in Park IX will be undertaking a comprehensive cost/benefit analysis of these and many other options with the objective of providing definite recommendations to the Federal Government.

Foreign Attachments

The development of remotely accessed data-processing systems has led to widespread discussion and even litigation concerning the issues and problems arising from the interconnection of privately owned terminal devices (foreign attachments) with the carrier facilities.

Until recently, it was the policy of most telecommunication carriers to forbid the attachment of any foreign, i.e. non carrier supplied, equipment to the public switched networks. This prohibition was justified on the grounds that the carriers were responsible for the overall quality of the service and that they would not be able to guarantee the integrity of the total system and protect other customers if equipment over which they had no control was connected to the network. On the other hand, both users and independent manufacturers of terminal equipment pointed out that such a policy seriously restricted the choice of equipment available to the user, artificially inflated his costs, impeded the development of a viable independent terminal manufacturing industry and exercised an inhibiting influence over technological progress.

The first major breach in this policy occurred in the United States with the issuance by the FCC in June 1968 of the "Carterphone Decision". This decision ordered the American Telephone and Telegraph Company to delete general prohibitions against interconnection and customer attachments from its interstate message toll tariffs. As a result, new tariffs were submitted which permitted foreign attachments provided that they were connected through a carrier provided and tariffed network protective and/or network control signalling arrangement.

In Canada the carriers in general have followed the American example and relaxed the interconnection restrictions. Thus at the present time customer owned computer terminal equipment, for example, may be connected to the networks provided connection is achieved either via a customer or carrier supplied acoustic coupler or via a carrier supplied protective coupling device. In either case however, all network signalling functions must be performed by carrier supplied equipment. Typical of the protective devices employed by the carriers is the Bell Data Connector Equipment. This is a wall mounted device measuring approx. 4¾" x 7¾" x 1¾" and weighing about 1¼ lbs. For each unit that he requires the customer is charged a monthly rate of $4.00 and a service charge of $15.00. It provides suitable terminals so that customer provided modems can be connected to the switched telephone network. Bell Canada, however, retains responsibility for network control including switch hook, dialing and other control functions.

According to Bell Canada, the Data Connector has the following functions:

"(a) To provide an access for customer provided modems to the switched message network."

"(b) To provide necessary features for network control."

"(c) To allow attendants to manually transfer control of the telephone line between the telephone set and customer provided data modem."

"(d) To limit signals above a specified value, if the customer's power level is too high in order to prevent overloading of telephone facilities."

"(e) To protect personnel from injury and equipment from damage due to hazardous voltages. The maximum metallic surge due to lightning the modem may encounter is 25 volts."

The overall subject of "foreign attachments" in the Canadian context has been treated in Telecommission Study 8(b)iii "Problems Relating to the Interconnection of Terminal Devices With Common Carrier Provided Telecommunications." This study indicated that both users and equipment manufacturers are still unsatisfied with the current carrier practices. In this connection, in a brief to the Telecommission entitled "The Users Viewpoint" the Canadian Industrial Communications Assembly, recommend:

"(a) The establishment of standard technical interface characteristics to permit terminal devices to interconnect directly with the lines of the common carriers."

"(b) The establishment of a central agency, similar to the Canadian Standards Association, to test and certify the various equipment offerings of independent manufacturers. These tests would ensure this equipment meets the technical standards set by the common carrier for the interconnection of the devices directly to their network."

Support for these recommendations was contained in a report*(1) to the FCC by a special panel of the National Academy of Sciences of the United States, which while concluding that uncontrolled interconnection would be harmful also stated:

"--- the following two approaches - used either alone or in parallel in such proportions as non-technical factors might determine - can supply the required degrees of protection for the network, including network control signalling:

1. Protective arrangements as required by the tariffs.
2. A properly authorized program of standardization and properly enforced certification of equipment, installation, and maintenance."

Even stronger support was contained in the recommendations of a subsequent FCC sponsored study*(2) performed by Dittberner Associates which stated:

"In essence, we recommend that customer-provided equipment be allowed to interconnect directly to common carrier networks without the necessity of common carrier provided interconnecting arrangements as long as such equipment meets common carrier developed and FCC approved standards for network protective capability and is installed and maintained by an FCC certified installation/maintenance organization or individual contractor."

*(1) "A Technical Analysis of the Common Carrier/User Interconnections Area" - June 1970
*(2) 'Federal Communications Commission, Interconnection Action Recommendations," September 1970; Dittberner Associates, Bethesda Maryland.

Similar suggestions are contained in the discussion of possible roles for the Canadian Computer/Communications Agency in Part IX of this report. In fact the suggested standards role proposed for the Agency is close to that prepared by Dittberner Associates for the "Joint Council of Telecommunications." This it is suggested should consist of manufacturers, telecommunications users and common carriers and should develop standards and recommend them to the FCC for possible inclusion in the tariff.

The certification role in the Canadian Agency scheme would however, go further than the Dittberner proposal in that it would also include the certification of carrier supplied equipment.

Multiplexing

Telecommission Study 8(b)iii as well as many respondents to the Computer Utility Inquiry point out the developing importance of "multiplexors". Study 8(b)iii for example states:

"One developing variety of terminal device that should not be overlooked is the multiplexor. Their main function is to derive channels from a selected bandwidth as required. For instance, a multiplexor may derive twelve 300 baud channels from one voice circuit after the network connection is established. Though these terminals are more appropriate to private-line use, some system designs have applied them to private lines between large centres but which are connected to the local switching in one or both locations. Interconnection practices at present, limit the manner in which multiplexors may be used, and appear to deprive the user of benefits he could obtain from more efficient use of his communication channels.

The use of multiplexors has both economic and technical advantages to the user. From the technical point of view, flexibility in the use of bandwidth at the users' discretion is particularly attractive. Among the economic advantages is one that results directly from the telephone carriers' rating structure for voice channels; for example, the user may obtain twelve low-speed channels more cheaply by derived them from a voice-private-line than he can by leasing twelve separate low-speed channels directly from the carrier.

The employment of user-owned or leased multiplexors would appear to the users to have significant long-range advantages which will not be fully realized without appropriate changes in interconnection practices and rating structures."

At the present time, carrier approved multiplexors may be owned and attached to the carrier lines when the circuits terminate in a foreign country or they may be used on intra Canada circuits by several users where the multiplexed signals terminate in a computer and the carrier bills one user, usually the Computer Utility organization, for the long haul service. Users however would like to go beyond this limited application and have the right to utilize multiplexors for unrestricted sharing of communications long haul facilities. Under this policy a group of users could band together, rent a long haul wide band line between say Toronto and Vancouver, install multiplexors in both cities and thus provide low cost communications service for themselves between the two cities merely by dialing the local multiplexor. Alternatively, a special multiplexing company could be established to provide the same service to the general public.

At the moment, both of these alternatives are prohibited by the carriers on the grounds that subleasing is tantamount to reselling circuits and thus establishing pseudo telecommunications carriers. Nevertheless, unless the carriers themselves are willing to readjust their rate structures to provide the same savings as "private multiplexing", there would seem to be little rational justification for the continuation of such a prohibition.

PART VIII

Overall Policy Options and Consequences

There are, of course, dozens, if not hundreds, of possible policies which Canada could adopt for dealing with the challenge of the computer utility. Fortunately, however, these policies tend to cluster naturally into eight basic policy groups and in this section the pros and cons of each of these groups are discussed. The groups are:

1. Unrestricted Competition
2. Constrained Competition
3. Privately Owned Total Computer Utility
4. Government Owned Total Computer Utility
5. Multiple Carrier Owned Total Computer Utilities
6. Single Telecommunications/Computer Utility Carrier
7. Integrated Network of Telecommunications/Computer Utility Carriers.
8. Integrated Network of Computer Utilities - The Trans Canada Computer Network.

(1.) Unrestricted Competition

Under this policy the Computer Utility industry in all its aspects would operate in a normal competitive environment subject only to the same general business laws that apply to other enterprises in a basically "free" enterprise oriented society. All of the previously discussed business forms would be permitted and both the telecommunications carriers and government organizations would be free to engage in any aspect of the business. Likewise, computer organizations and others, would be permitted to perform, if they so desired, certain communications functions that are normally restricted to regulated telecommunications carriers. These would specifically include message switching, operation of shared communications links, and use of own terminal and modem equipment.

Claimed Advantages of Policy Group 1

1. Direct government financial involvement would be minimal although governments would not be precluded from operating competitive services if this was judged to be in the national interest.

2. Ensures widest possible area of financial support - a very important consideration in view of the large capital requirements and current shortage of capital in this country.

3. Provides maximum encouragement of risk taking and innovation and, thus, ensures rapid application of new technology and widest range of new services.

4. Involves minimal interference with established business framework

5. Would require only minor legislative action and no constitutional changes

6. Insures that know how and experience available in all areas of the computer/communications and service bureau industries will be utilized.

Claimed Disadvantages of Policy Group 1

1. If significant economies of scale and integration exist, there is a serious danger of eventual monopoly.

2. Uneven financing and, in many cases, inadequate financing might make it difficult to ensure adequate protective mechanisms in such areas as file integrity and privacy.

3. Market place, rather than social or national needs, would determine type, quality and distribution of services.

4. United States interests would probably own and control the Canadian industry.

5. Many computer centres and data bases would be located in U.S.A. and merely connected to switching centres or distribution points in Canada.

6. It would be difficult to prevent regulated telecommunications carriers from recouping possible losses in competitive segment from regulated portion of their business and thus eliminating competition.

7. There would be wasteful duplication of communications facilities, uneconomic and inefficient use of scarce resources and poor system planning, with resultant higher costs or poorer service for consumers.

8. There is a danger of "cream skimming" of communications business by non-carrier organizations - again with resultant higher costs for many Canadian consumers.

9. There is danger of carrier discrimination against competitors.

10. It would be difficult to establish and enforce standards

11. Interconnection among the many competing systems would be difficult to implement.

12. Fragmented industry could result in wasteful duplication of facilities.

(2.) Constrained Competition

Obviously, there are innumerable ways in which the unrestricted competition of the preceding policy could be constrained, but only two will be considered here:

Option (a) - Unrestricted competition as per policy 1 would exist except that telecommunications carriers would be forbidden to enter the data-processing business and computer organizations would be forbidden to perform communications functions. This, in essence, with a few minor exceptions, is the policy that currently exists in Canada.

Option (b) - Unrestricted competition as per policy 1 would exist except that telecommunications carriers would be forbidden to enter the data-processing business. Computer organizations, however, would be permitted to provide certain communications services.

Claimed Advantages of Policy Group 2 - Option (a)

This policy incorporates all of the claimed advantages of policy group 1 although in a somewhat diluted form because of the continued separation of the computer and communications areas of business. In addition, however, the following extra advantages are claimed:

1. The possibilities of carrier discrimination and subsidization of unregulated business from the regulated portions are eliminated.

2. It would prevent wasteful duplication of communications plant and "cream skimming" of communications business by non-carrier organizations.

3. It would reduce dangers of monopoly by separating communications and data-processing aspects.

4. It would facilitate interconnection and standardization of terminals since telecommunications carriers would control communications.

Claimed Disadvantages of Policy Group 2 - Option (a)

Most of the disadvantages of policy group 1, except as noted in the preceding section persist in this policy group. In addition the following are also claimed:

1. Policy fails to recognize the technological fact that communications switching can, in many cases, be more economically performed by local computers than by carrier switches.

2. In a capital short situation, one of the largest potential sources of Canadian capital is denied access to the computer utility business.

3. Conditions of "natural monopoly" are not obviously present in many aspects of data communications but this policy denies the public the advantages that competition could provide.

4. Optimum system design requires integration of the processing and communications elements but this is precluded by the separation of ownership and control.

Claimed Advantages of Policy Group 2 - Option (b)

There are three significant advantages claimed for this policy over option (a). They are:

1. It recognizes the fact that communications switching can often be more economically performed by local computers than by the telecommunications carriers.

2. It breaks the monopoly positions of the carriers in data communications and thus provides the public with any advantages that may flow from increased competition.

3. Optimum system design, through integration of communications and processing becomes possible.

Claimed Disadvantages of Policy Group 2 - Option (b)

Except as noted under advantages, this policy incorporates all of the disadvantages of option (a) in addition to the following:

1. It is unfair to the carriers in that it denies them access to the data-processing field but permits data-processing companies to compete with them in the communications field.

2. It opens up all of the "cream skimming" possibilities mentioned in policy group 1.

3. It would be difficult to enforce standards and provide for interconnection among the many competing communications systems.

4. It could result in higher communications rates and/or poorer service for consumers in many parts of Canada.

(3.) Privately Owned Total Computer Utility

This policy would establish a single regulated, privately owned entity as a Total Computer Utility, as defined in Part I. It would then become the sole provider of computer power (communications, processing and services) for the nation.

Claimed Advantages of Policy Group 3

1. It would make available very large amounts of capital for research and development, planning and provision of reliable, well engineered facilities.

2. It would permit an optimum overall system design with properly integrated communications, processing and software packages.

3. It would eliminate interconnection and standardization problems.

4. It would prevent wasteful duplication of services and plant.

5. Regulatory problems would be simplified since only a single entity need be controlled.

6. Government financial involvement would be minimal.

Claimed Disadvantages of Policy Group 3

1. The computer utility, impacting as it will upon every facet of our society promises to become not only the prime mover of the future Canadian society but also the foundation upon which that society will be built. This policy, however, would concentrate responsibility for this vital element in one private organization potentially representing the greatest concentration of social and economic power yet seen in this country. Although one can envisage regulatory agencies which could, in theory, represent the public interest, past experience with the effectiveness of such agencies is not reassuring. In fact, it is likely that the computer utility corporation would soon become so powerful as to be, for all practical purposes, completely beyond the control of the people. The potentialities for abuse in such a situation are obvious and it is difficult to see how a meaningful Canadian democracy could continue to exist under such conditions.

2. All of the classic arguments against monopoly would apply, e.g. slow response to technological change, lack of incentive for innovation, protection of inefficient procedures and practices, isolation from consumer needs and pressures, poor service and corrupting influence upon public officials.

3. Although there certainly are economies of scale in the communications and probably in the computer area of the computer utility field, there is no evidence of such economies in the service area. In fact, the contrary may well be true, so that a few highly skilled programmers can be vastly more productive than a large organization with its inherent communication bottlenecks and high overhead. Consequently, there is no current or foreseeable justification for the total computer utility concept, as defined in Part I.

4. The enormous capital investment required for establishing a single "Total Computer Utility" capable of providing the sort of services postulated in Part II would probably require foreign financing and a consequent serious threat to Canadian sovereignty.

(4.) Government Owned Total Computer Utility

As in Policy 3, this policy would establish a single Total Computer Utility but, in this case, the utility would be owned by the Federal Government rather than a private corporation.

The claimed advantages and disadvantages of this approach are essentially those of Policy 3 with two significant differences:

(a) Although the computer utility would still represent an enormous concentration of power, the fact that it was government owned would ensure that ultimate control would rest with the people of Canada. Consequently, the menace to democratic institutions inherent in the private monopoly approach would be alleviated if not totally eliminated.

(b) Very heavy government investment would be needed with something in the order of $8 billion required for purchase of the existing telephone system alone.

(5.) Multiple Carrier Owned Total Computer Utilities

Under this policy, each of the Canadian telecommunications carriers would become a regulated Total Computer Utility franchised as the sole source of computer/communications power within its operating area. By providing for multiple ownership of the Canadian Computer Utility business, this approach would greatly reduce the social dangers inherent in Policy 3, without requiring the heavy government investment of Policy 4. Further, by resting responsibility with the existing carriers it would ensure:

(a) development of integrated systems with a proper melding of the different computer and communications elements.

(b) full utilization of the technical and managerial talents of the carriers.

(c) availability of significant capital resources for the development of the system.

On the other hand, all of the previous arguments against the Total Computer Utility concept would still apply.

(6.) Telecommunications/Computer Utility Carrier

A single regulated entity, which could be either privately or government owned, would be established as a Telecommunications/ Computer Utility Carrier, as described in Part I. It would be prohibited from providing services; i.e. application, software, and instead would supply the communications and computer facilities which others would then use for their own purposes or, in the case of service retailers, for providing services to the general public.

Claimed Advantages of Policy 6

1. The policy divides the industry into a regulated monopoly segment and an unregulated competitive segment with the regulated portion restricted to those areas where elements of natural monopoly appear to be present.

2. The overall system design could be optimized through the efficient integration of the different processing and communications elements.

3. It would prevent wasteful duplication of communications and computer plant and "cream skimming" of business by unregulated organizations.

4. It would facilitate interconnection and standardization.

5. Regulatory problems would be simplified since only a single entity need be controlled.

6. It could insure that adequate financial resources would be available for expansion of the physical plant and incorporation of suitable protective measures.

7. It would simplify long-range planning.

Claimed Disadvantages of Policy 6

1. It would exclude the members of the TCTS from the data field and thus from the fastest growing and potentially largest area of the telecommunications business.

2. Many of the most exciting future applications of the Computer Utility depend upon a combination of conventional TV/voice communications and data, e.g., computerized shopping. To provide such services under this policy would require costly, nation-wide duplication of the telecommunications carriers' facilities by the computer utility carrier.

3. Many existing computer utilities have invested heavily in computer hardware, but this policy would prevent such organizations from making their computer power available to the public.

4. There are serious technical and economic arguments against the general viability of the pure purveyor of raw computer power concept at this stage of development of computer utilities.

5. Historically, regulated monopolies have all too often been plagued with slow response times in meeting new demands for service and incorporating technical advances. Consequently, in a time of rapid technological change like the present, there is a serious danger that the quality of the service provided by the carrier would fall far below that which the state of the art could provide.

(7.) Integrated Network of Telecommunications/Computer Utility Carriers

There are many different forms which this policy could take. All options, however, have the following parameters in common:

(a) The industry would be divided into a "Telecommunications /Computer Utility Carrier" and a "service" sector, as for Policy 6 and as defined in Part I.

(b) Both the telecommunications carriers and any other organizations that so desired would be permitted to supply raw computer power as previously defined, but only the offerings of the telecommunications carriers would be regulated.

(c) All telecommunications facilities, wide band cable and microwave distribution systems, as well as conventional record and voice would become the sole monopoly of the existing regulated telecommunications carriers.

(d) The telecommunications carriers would be forbidden as carriers, i.e., horizontal integration, from participating in the service sector but conceivably, as in option E of Part VI, could do so via an arms length corporate affiliate.

(e) A national integration body, (CCCA) as described in Part IX, would be established to integrate the operations of the different carriers, establish common standards, provide R&D and accomplish overall system planning for the total national network.

Claimed Advantages of Policy Group 7

1. Monopoly status applies only to that area of the industry where there is strong evidence that competition would result in poorer or more costly service than regulated monopoly, i.e. communications.

2. By including the wide-band distribution systems under the carrier umbrella, we ensure that wide-band systems (currently exemplified mainly by CATV, but potentially capable of providing dozens of additional two-way services) will be integrated into the regular telecommunications networks and costly duplication of services thereby avoided.

3. The problem of carrier discrimination is eliminated.

4. Cross-subsidization by the regulated carriers of unregulated areas such as the service sector, if not completely eliminated, is at least made very difficult.

5. The public interest is safeguarded and integrated planning and design of the overall system is assured through the national integrated body.

6. By not excluding any qualified Canadian organization from supplying raw computer power to the network, the fullest possible utilization of the nation's computer power is assured. The element of competition that would exist among the many suppliers would also encourage innovation in the introduction of new technologies.

7. The capital requirements for entry into the service area would be very low. Thus, the number of service retailers and, consequently, the range of services offered could be indefinitely large.

8. The presence of free competition in the service area would encourage innovation.

9. A wide area of capital support would be available.

Claimed Disadvantages of Policy Group 7

1. It is unfair to carriers to prevent them from entering the service area while existing computer utilities are permitted to provide both services and raw computer power.

2. New legislation and agreement of certain provinces would be required in order to fully implement the policy. This is particularly true of the cable TV field where there is currently no federal jurisdiction over closed circuit operations if they are not provided by a federally regulated carrier.

3. The carriers and others have expressed strong doubts as to the commercial viability of the "Purveyor of Raw Computer Power Concept". Consequently, there is reason to doubt the willingness of the carriers to participate on this basis.

4. Although the national integration body might help matters, giving the carriers a total monopoly of all communications, voice, record, data and video could slow down the development of a national digital network by overtaxing their resources and removing competitive pressures.

(8.) Integrated Network of Computer Utilities - The Trans Canada Computer Network.

Under this policy, a national data communications network would be created under one of the policy options discussed in Part VII. Depending upon the selected institutional arrangement the telecommunications carriers would participate either totally or partially in the construction and operation of this network, but they would be barred from providing public data-processing services including both raw computer power and application services except perhaps through a totally arm's length affiliate.

The data communications network would link together every publicly accessible remote data bank and information processing organization in the country so that together they would comprise the TRANS CANADA COMPUTER NETWORK. This network would operate under the overall guidance and planning authority of the proposed Canadian Computer/Communications Agency mentioned in connection with Policy Group 7 and discussed in detail in Part IX. Possible functions for this body could include: broad overall planning for the national network; establishment of common standards, providing for the necessary R&D, providing subsidies where necessary for hardware and software development and facilitating the integrated operation of the many different independent organizations and functional elements that would make up the network.

Other features of the policy include:

1. The term "Trans Canada Computer Network" is not meant to imply the existence of any formal organization by this name. Indeed the network would consist of hundreds or even thousands of completely independent organizations representing the full spectrum of institutional structures from government and crown corporations to independent data-processing companies. Their only common denominator would be the fact that they all utilize the service of the national data communications network and follow the general standards and guidelines set by the Canadian Computer/Communications Agency.

2. A major goal of the Canadian Computer/Communications Agency would be to provide every user everywhere in Canada with convenient access to the widest possible range of data-processing and data bank services. Consequently, it would encourage such measures as:

(a) Performance by the national data communications network and/or the individual carriers of the merchandizing functions for computer services described in connection with carrier data-processing policy option G.

(b) Implementation wherever possible of blanket agreements between the national data communications network and the data-processing organizations so as to minimize the need for special connect charges and long term contractual agreements between users and suppliers.

(c) Techniques such as those being pioneered by the ARPA Network in the United States to permit flexible interchange of programs and data among data-processing organizations and in particular to facilitate the movement by users of their data and programs from one data processing organization to another.

(d) Transaction and other flat rate tariff schemes.

(e) Realistic data-processing and communications standards.

(f) Nationally applicable mechanisms for the protection of privacy.

3. All users would be free to utilize either carrier supplied terminal equipment or their own equipment provided in either case it was properly certified by the appropriate national standards body, possibly the CCCA.

4. The national data communications network and its component elements would be required to meet all reasonable demands for service; to follow the overall plans established by the CCCA; to secure approval from the appropriate Federal Regulatory Body for tariffs, capital budget, rate of return, corporate structure, and general operating practices, procedures and regulations; and to purchase all major equipment and supplies by open competitive bidding.

5. The data-processing industry would be unregulated except with respect to basic standards, privacy, file protection, liability etc.

Claimed Advantages of Policy Group 8

1. It ensures that Canada will have a modern, economical national digital communication network capable of supporting the growth of a viable national computer utility industry.

2. It ensures that the benefits of computer power will be equitably distributed everywhere in Canada.

3. The public interest is safeguarded and integrated planning and design of the overall network is assured through the national integrating body.

4. It recognizes the diversity and competitive nature of the data processing industry by leaving it unregulated except with respect to basic standards, privacy, file protection, etc.

5. It provides a realistic framework for the optimum development in the public interest of a wide range of national computer services.

6. The policy recognizes and is fully compatible with the diversified ownership and regulatory pattern of the Canadian Telecommunications industry and ensures full representation for both federal and provincial interests.

7. It recognizes the "natural monopoly" status of telecommunications and the likelihood that in the Canadian context, competition in public data transmission would result in poorer or more costly service than regulated monopoly.

8. By excluding the telecommunications carriers from public data-processing it eliminates all of the vexing problems that result when a regulated monopoly participates in a competitive unregulated market.

9. It encourages the growth of a diversified Canadian terminal industry.

10. It provides computer users with freedom to choose the terminal that most closely meets their requirements but at the same time protects both the integrity of the communications network and other customers.

11. Since the network is all digital, modems are not required and this results in substantial savings for both customers and data-processing organizations.

12. It makes available a diversity of sources of capital.

13. The construction of the network would provide a major stimulus to both the Canadian electronics and remote data-processing industries.

14. It provides needed capital for development of Canadian software and support of the Canadian industry as well as for the support of services in areas of the country where the immediate economic returns to private investors might be unattractive.

Claimed Disadvantages of Policy Group 8

1. By excluding the carriers from the public data-processing area it eliminates a major potential source of capital from an industry that currently suffers from a shortage of working capital.

2. Large infusions of government capital might be required.

3. New legislation and co-operation of certain provinces would be required to fully implement the policy.

4. The proposed merchandizing function for the data communication network and/or telecommunications carriers has been critized as being unrealistic.

PART IX

Co-ordination and Regulation

1. A Major National Program

The size and complexity of the task Canada faces if her citizens are to benefit fully from the new levels of productivity and intellectual achievement promised by computer utilities implies a focussing of national purpose, creativity and capital into a co-ordinated effort. If most of the promises are to be fulfilled and the majority of dangers avoided, something more imaginative than either total laissez-faire or traditional regulatory restrictions will be needed.

So far we have spoken of systems open to diverse contributions and uses as merely something desirable. But the creation of national systems on the scale and of the potential described in this report appears economically and politically impossible without a concerted effort from the broadest possible base, working within the context of well defined national objectives. The magnitude of the task puts its realization beyond the reach of any single segment or small group in Canada.

It has therefore been suggested in the preceding chapter of this report that the Government of Canada serve as the focal point for a combined effort which might involve governments, computer companies, common carriers, universities, and major users, both actual and potential. This effort, expressed in appropriate institutional form, could examine, and where necessary use, such devices as standardization, coordination, rationalization, joint public-private ventures, and incentives to promote research and development.

Careful attention would have to be paid to the institutional character of any co-ordinating body, its composition and its terms of reference. For while specific programs could be administered by appropriate governmental agencies, a much larger body of opinion and expertise would be essential in examining such questions as the selection of computer services for meeting specific problems; the commercial practices of the computer/communications industry, including charging and costing formulae used in the trade; the inter-connection of computer and communication services and particularly the equipment and technical criteria so that large-scale information systems can be effectively utilized.

Among objectives which could be the concern of a national cooperative undertaking are:

-- The definition of those Canadian social and economic needs which can be fulfilled by an integrated national computer/communications system or systems;

-- The creation, with the assistance of public policies as needed, of systems and programs designed to assure the equitable distribution of computer power across Canada and its availability to the maximum possible number of individuals and institutions.

-- The encouragement, by means of appropriate programs, of research and innovation within Canada in the application of computer/communications technology and systems.

-- The elaboration of policies, public and private, to prevent essential computer and data-processing services from coming under foreign control; to encourage the extension of services and systems on an east-west rather than north-south axis, and to assure that essential computer centers and data banks are established within Canada rather than beyond its borders.

-- The definition of criteria to be applied to the development of computerized information services and data banks utilizing communication links.

Any discussion of how Canadian national purpose is to be brought to bear on solving the problems of computer utilities might usefully examine the concept outlined by the Science Council of Canada's report entitled: "Towards a National Science Policy for Canada". In this important study on the future of Canadian science, the council introduced the concept of "Major Programs". Such programs were defined as "large, multi-disciplinary, mission-oriented projects having as a goal the solution of some important economic or social problem" and were justified as follows:

"A most important, but by no means sole, reason for the major program approach to organization is that it seeks to provide a national focus for efforts aimed at solving national problems...

"Many other arguments can be advanced in favour of the major program approach. First, a concerted, co-ordinated and co-operative program is the most efficient way to make progress toward the solution of large-scale practical problems where many technical disciplines are involved. Traditionally, research and development for the needs of national defence has been carried out on a national scale, and no one would suggest that it would be effectively accomplished by leaving it to small-scale efforts by local units. ...... Today it should be a measure of a nation's maturity that it can apply its problem solving resources on the national scale to progress on matters affecting the public interest other than the defence of sovereignty by military means.

"A major program approach is also called for by the increasing degree of organization that technological advance brings to society. In the past, problem-solving could be piecemeal, the goals of society were those of the individual and the more government stayed aloof the better. Nowadays, with the gathering of people into urban concentrations, with the high degree of interdependence created by technology and with increasing demands for efficiency in transportation, communications, energy supply, manufacturing, distribution of food and goods, waste disposal, etc., society has closed in upon itself. One man's effluent is another man's intake. It has become clear that there is a public interest which is not always coincident with or optimized by the pursuit of private interests..... A total 'systems approach' may be essential."

The main thrust of the Science Council Report was directed towards the growth and development of Canadian science and technology but the arguments in favour of the "Major Program approach" apply just as strongly to any large national undertaking involving many diverse disciplines and, in particular, to the creation of an integrated national complex of computer utility networks.

2. A National Co-ordinating Agency

In the discussion of overall Policy Options 7 and 8 in the preceding chapter, the term Canadian Computer/Communications Agency was used to describe a possible Federal Government organization that could coordinate the activities involved in a major program to assure the development in the public interest of an integrated Canadian Computer/Communications network. There are many different forms that this Agency might take and a corresponding range of different activities in which it could engage. Regardless of its precise nature, however, it is important to note the salient fact that the Agency would be a coordinating and catalytic agent rather than an operator of systems, a regulatory body or even the principal source of funds.

In order to properly meet the obligations discussed in Part VIII such an Agency would of course require substantial financial resources but they would represent only a small fraction of the tens of billions of dollars that many authorities feel will be spent during the decade on computer/communications equipment and services. In this connection it was assumed in Options 7 and 8 that most of the funds for the program would be supplied by private industry and the telecommunications carriers, augmented where necessary by various federal, provincial and municipal government departments, and perhaps some special Crown Corporations or Telesat-like organizations established to build and operate certain critical national services.

In fact, even though some of the figures mentioned in Part V of this report appear enormous by current Canadian standards, it must be remembered that a project of this magnitude could have a boot-strapping impact on the whole economy. Further, as the national system came into existence, its productivity multiplying features could be reflected in the form of a major increase in the gross national product. Consequently, investments that loom very large in 1970 could seem relatively trivial by 1980.

Functions of Agency

The "Core Functions" in which it has been suggested the Agency might be involved include:

-- Planning
-- Research and Development
-- Standardization
-- Licensing of Attachments
-- Financial and Technical Support.

Planning

The planning function would be central to all of the Agency's activities and, broadly stated, would involve the development of overall plans for the timely provision and optimum utilization of computer/communications facilities and services in the interests of the Canadian people. The perspective for such planning would be one which viewed the totality of the nation's telecommunications and computer resources as a basic ingredient of the nation's wealth and one of the principal determinants of national development. Consequently, in its planning role, the Agency would be charged with very broad responsibilities, including:

1. Analyzing and forecasting Canada's national needs for computer/communications services;

2. Forecasting the probable development of technology and analyzing the sociological and technical impact of new developments;

3. Designing in broad outline the national computer/ communications networks required to meet the national needs; and preparing and updating as required the National Computer/Communications Master Plans.

4. Developing the required economic, regulatory and legal measures required for realization of the planned networks.

Research and Development

In the high technological content industries that are the building blocks of the emerging post industrial society, the crucial role of research and development is now well recognized. In fact, in his provocative book "The American Challenge", J.J. Servan Schreiber draws a direct correlation between economic progress and R & D, and shows that the lengthening gap between American and European industry is reflected in a startling difference in R & D expenditures. According to Schreiber, in 1966 for example, the U.S. spent $94. per capita on R & D, compared to $25. in Europe. Corresponding OECD figures for Canada and the U.S. reveal a similar gap. Thus in 1967, the per capita U.S. expenditures were $110.5 and only $32.0 for Canada.

Schreiber also reveals some startling figures for government expenditures in those industries in which the U.S. has developed an overwhelming world lead. These show that, in the Aviation and Spacecraft areas, the government financed 90% of the research and, in the Electrical and Electronic industries, 65%. He also compares two typical French and American Electronic firms with annual sales of $1.7 million and $23 million respectively. In the case of the American company, the research budget was $2 million of which the government financed $1.2 million, while for the French firm, the corresponding figures were only $80,000 and $16,000 respectively.

Although the large military content of the American figures does distort their significance somewhat, the fact remains that the world's high technology industries are largely American dominated. This fact is particularly relevant to the subject matter of this document for it is difficult to envisage an area having a higher technological content than that of modern computer/communications systems. Consequently, if Canada is to mount any sort of meaningful effort in the field of Computer Utilities, it may be necessary to substantially increase our research and development expenditures.

In this connection, a Canadian Computer/Communications Agency could be deeply involved in R & D. This involvement could take many different forms, including in-house work, industrial contracts, university and not-for-profit contracts, and grants to individuals and organizations. In fact, it might be desirable that the Agency employ all of these different mechanisms.

Standardization

One of the most important obstacles to the realization of interconnected national networks on the scale implied by this paper is the chaotic standardization situation in the computer industry. The situation pervades all aspects of the technology; data transmission, internal operating codes, word lengths, input/output interface standards, etc., and the entire field of software. In one sense, this lack of standards is a tribute to the dynamic character of the industry and, in particular, to the astounding rate of innovation that has been its most memorable feature. Consequently, it would be tragic if attempts at the premature imposition of standards were to inhibit such innovation in the future. On the other hand, there are many areas where reasonable standards could result in substantial economies and better service with minimal impact upon innovation.

There are, of course, many different ways in which standards could be established in the computer utility industry. Trade associations, professional societies, government and international bodies of all kinds and even powerful corporations can play important roles. In Canada, however, the proposed Agency could provide a natural focal point for channeling the views of these diverse interests and setting national standards for both computers and communications.

Licensing of Attachments

It was suggested in Part VII that the problems associated with the interconnection of terminal devices to the carrier networks (the foreign attachment issue) might be resolved by the creation of a neutral licensing body. All organizations, including carriers, would then have to secure the approval of this body before offering their devices to the public. The Canadian Computer/Communications Agency would be a possible choice for this body as the approval and licensing of attachments could be regarded as a natural extension of the Agency's standardization activities.

Financial Support

In addition to the previously mentioned financial support of Research and Development, the Agency could provide a number of different forms of direct and indirect financial support to the industry. Some of the possible forms are:

- -- Subsidies to selected industries or organizations to encourage particular developments, finance new construction or lower rates;
- -- Grants to help support socially desirable initiatives like new industries, data centers and cable or satellite TV facilities in underdeveloped areas; educational, medical and consumer information systems, etc.;
- -- Low interest rate loans to encourage development during tight money periods or when rates of return are too low to attract private funds;
- -- Scholarships to encourage deserving individuals to seek careers in the new computer/communications industries and thus help alleviate the probable shortages of trained manpower. These could also be used to help retrain people displaced by automation.

Technical Support

One of the most valuable functions that the Agency might perform would be the provision of technical assistance in the form of advisers, consultants and special training courses to help both organizations and individuals exploit the new computer/communications services.

3. Regulation for Innovation

In order to successfully complete a national program of the scope discussed in this report, it has been suggested that a new approach to regulation may be required. This approach might be termed "regulation for innovation" in contrast to the historic "corrective or reactive" form.

In the conventional approach, the regulatory body usually remains passive until complaints of poor service, discriminatory treatment or high rates, on the one hand, or proposals for new services or higher tariffs, on the other, force the regulators to take some action. This process may have been moderately acceptable in times of slow technological change, although even this seems doubtful when one remembers the conservatism and charges of conflict of interest that have historically plagued the regulation of public utilities. In the current situation, when we are faced with continuously accelerating change, however, it can be argued that such an approach is quite inadequate; that we need to emphasize flexibility and dynamism and, instead of blindly reacting to events, should seek to channel the forces of change along socially constructive paths.

Consequently, proponents of this new approach feel that whatever regulatory bodies are established for the computer/communications field should be involved in functions that extend far beyond the bounds of classical public utility regulation. Quality of service, need for capital for the provision of certain socially desirable services, rate of innovation and social need, for example, are claimed to be as important as the historic rate of return on invested capital in determining rates. The regulatory body or perhaps the proposed Computer/Communications Agency, it has been suggested, might also have funds available which it could employ as subsidies or low-interest loans to keep rates down and still encourage innovation.

Of course, the adoption of the "regulation for innovation" concept would not mean that the historic forms of regulation would disappear. Quite the contrary, telecommunications rates and services, as well as allowable rates of return, could be controlled as rigorously as they ever were in the past, although hopefully, more flexibly. In addition, any new carrier offerings, like raw computer power and wide-band (CATV) distribution systems, might also have to be tariffed. Further, when it comes to the protection of privacy and file integrity, ensuring freedom of access and prevention of censorship, it is possible that many other organizations, in addition to carriers, could find segments of their businesses beneath the regulatory umbrella.

4. Operation of Facilities

In the postulated Trans Canada Computer network, it is likely that the various facilities would be owned and operated by many different types of organizations representing, in fact, every segment of our pluralistic society. In this connection, certain facilities might very well be run by the Federal Government. A special Agency or Crown Corporation, for example, might be authorized to operate certain facilities or systems to provide suitable "yard sticks" for establishing rates and performance standards in private sectors of the industry. Such an organization or organizations might also operate particular systems of critical national importance, a medical information system, sensitive data banks or government data-processing complex for example, or systems in under-developed parts of the country where it might be difficult to attract private capital.

5. Computer/Communications Task Force

On November 27, 1970 the Honourable Eric Kierans, Minister of Communications, announced the establishment of a major task force to investigate the whole question of computer/communications interaction in Canada, including the many issues raised by this report.

The principal task assigned the Task Force is to speedily develop and recommend specific policies and institutions that will ensure the orderly, rational and efficient growth of combined computer/communications systems in the public interest. The Task Force will be expected to produce definite recommendations and firm plans -- technical, financial and institutional -- relating to an integrated network of Canadian computer utilities.

A detailed description of this Task Force is contained in Appendix E.

GLOSSARY OF TERMS

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ALGOL

An acronym standing for Algorithmic Language. A special language created by an International Committee in 1958 and intended to become the standard international language for scientific processing.

APPLICATION SERVICES

A general term for the various tasks that a Computer Utility might perform, for example, payroll processing, information retrieval, invoicing, process control, etc.

APPLICATION SOFTWARE

The special programs which serve to organize the raw computer power provided by a computer so that it is able to perform application services.

ARITHMETIC UNIT

That part of a computer which performs arithmetic operations, i.e. addition, subtraction, multiplication, and division.

ARPA

An acronym standing for the Advanced Research Projects Agency of the U.S. Department of Defense.

ASSEMBLER OR ASSEMBLY ROUTINE

A special program which makes it possible for a computer to accept a set of instructions written in nonmachine language, translate them into machine language, and then assign them to appropriate memory locations.

BANDWIDTH

Bandwidth is the difference between the limiting frequencies of a continuous frequency band.

BATCH PROCESSING

A method of processing in which a number of jobs are grouped and processed sequentially during the same computer run.

BINARY

Pertaining to a system with only two possible states, i.e. ON or OFF, often designated by 0 and 1.

BIT (Binary digit)

One of the two digits in the representation of data in a binary system, i.e., 0 and 1.

CARRIER

A person, usually a company or corporation who for hire conveys between the points of origin and reception, intelligence communicated by wire, radio, optical or other electromagnetic systems.

Carrier is also used to describe a signal which is used to carry intelligence by being suitably modulated, or impressed, by it. Carrier communication is also used to describe the technique of transmitting one or more messages over a single open-wire pair, cable pair or radio circuit.

CATV (Systems)

The term "Community Antenna Television (CATV or Cable Television) System" means any communications facility which makes use of wire, cable or other transmission line installation to distribute, to subscribing members of the public, signals which it receives either directly or indirectly over the air from television broadcasting stations. The system may also carry signals which originate in studios other than those associated with TV broadcasting stations, or which are received from FM or AM sound broadcasting stations.

COAXIAL CABLE

A transmission line in which one conductor is centered inside of a metallic tube that serves as the second conductor. Commonly used for the transmission of radio frequency signals over relatively short distances. Also used as the transmission means for undersea or over-land multi-channel communications systems.

COBOL

An acronym for COmmon Business Oriented Language, a standard language for programming business problems, developed by the Committee on Data Systems Languages of the U.S. Department of Defense in 1959.

COMPILER

A special program which makes it possible for a computer to accept a set of instructions written in nonmachine language as with an assembler and produce as an output a machine language program in which many of the original instructions are replaced by complex sequences of machine instructions called subroutines.

COMPUTER

A device which can store and process and make available information which has been entered in either digital or analog form, e.g. digital computer, analog computer.

COMPUTER CENTRAL PROCESSING UNIT

That part of a computer which processes the information.

CROSS-SUBSIDIZATION

In the context of the telecommunications industry refers to the allocation of cost prior to deriving any rates and represents the influence of other segments of the business on the particular segment of the business for which the rates are being derived. In particular, relates to the sharing of the costs of providing service between relatively lucrative and less or non-lucrative areas of operations in order to offer a common rate schedule.

DATA

Information of any kind but generally, in communications, refers to digital data which is information represented by a code consisting of a sequence of discreet elements.

DATA BANKS

Refers to any central storage of information but is commonly used to refer to related information stored in a computer, e.g., legal data bank, medical data bank.

DATA-PHONE

The name applied by AT&T to the members of a family of devices used for providing data communications over telephone lines.

DATA TRANSMISSION

The transfer of digital information between two or more points via a communication system; radio, cable, wire.

DIGITAL

Pertaining to a system in which the message elements are evaluated in terms of discreet levels or values, and these are represented by a limited set of numbers or digits, e.g. 0 to 9 in the decimal system; 0 or 1 in the binary system.

DIGITAL COMPUTER

A computer which operates with information that is represented in digital form, i.e. in discrete as compared to the continuous form used in an analog computer.

EFFECTIVE RADIATED POWER (ERP)

In a transmitting system, the power of the transmitter multiplied by the gain of the transmitting antenna.

EXECUTIVE

A special program responsible for supervising the operation of a real-time computing system. It must handle input/output, allocate storage, establish priorities, keep track of work in progress, and activate the various operational programs.

FILE

An ordered collection of information.

FLIP-FLOP

A bistable device having two input terminals. It can be caused to switch from one state to the other by application of a signal to the appropriate terminal.

FM RADIO

Radio transmissionsutilizing a method of modulation in which the frequency of the carrier is varied in frequency according to the amplitude of the information transmitted.

FORTRAN

An acronym for FORmula TRANslation, a language and compiler for handling scientific problems, developed by IBM.

FOREIGN ATTACHMENTS

A term used to describe equipment, i.e. telephones, modems, data sets, displays, etc., connected to a telecommunications carrier's facilities but which is not supplied by the carrier.

FREQUENCY DIVISION MULTIPLEXING (FDM)

The process of transmitting two or more messages or signals simultaneously over a common path by employing a different band for each signal. See Time Division Multiplexing.

FULL DUPLEX

Term applied to a communication channel over which both transmission and reception are possible in two directions at the same time.

GENERAL-PURPOSE COMPUTER

A computer which can be programmed to solve a wide variety of different problems whose nature may not even be known to the original machine designers.

GEOSTATIONARY

Stationary with respect to a point on the earth's surface. Thus a geostationary satellite is one located over the equator at a height such that it orbits the globe in the same direction and at the same rate as the earth rotates so that it remains directly above a given point on the earth's surface.

HALF DUPLEX

A term applied to a communications channel over which both transmission and reception are possible but in only one direction at a time.

HARDWARE

The electrical, electronic and mechanical devices from which a computer is constructed.

HORIZONTAL DIVERSIFICATION

A term applied to an organization, i.e. a telecommunications carrier which enters a business different than its normal field by integrating the new activities into the original business organization.

INSTRUCTION

A special code which causes a computer to perform a certain operation.

INSTRUCTION REPERTOIRE

The list of all of those instructions for which wired-in circuitry is provided in a computer.

INTERCONNECTION

A term used to describe the connection between different telecommunications carriers and/or telecommunications carriers and private systems so that signals pass freely from one system or carrier to the other.

INTERFACE

The boundary between two systems, subsystems, or devices.

INTERPRETER

A special program which translates an instruction written in a pseudo code into a machine language instruction and then directly executes that instruction.

LANGUAGE

Any communication code containing a defined set of characters together with the combinatorial rules for forming words or sentences, e.g. English, Russian, ALGOL, FORTRAN, French, Esperanto, COBOL, etc.

LARGE-SCALE INTEGRATION (LSI)

A technique used to produce microelectronic components which contain a large number of circuit elements on a single surface (Chip). LSI refers to any whole-function subsystem on a single chip capable of operating independently of other parts of the system. LSI devices are also used for memory systems.

LASER (Light Amplification by Stimulated Emission of Radiation)

A device for the generation of coherent light energy which results in very intense and sharply defined beams.

LIBRARY

A collection of programs and subroutines for solving problems of many different types.

MACHINE LANGUAGE

The language employed by the computer in its internal operations and thus directly intelligible to the computer's control section.

MASS STORAGE SYSTEM

A high-capacity storage system, external to but under the control of the computer, used for the storage of bulk data such as tables, files, and subroutines.

MASTER/SLAVE SYSTEM

A system in which one computer exercises control over the activities of another computer. Usually the "master" machine controls input and output, and schedules and supplies jobs to the "slave" machine. The slave computer is, in general, the one with the greater capability, and it performs most of the computational tasks.

MESSAGE SWITCHING

The operational procedure of receiving a message at an intermediate point, storing it until the proper outgoing line is available, and retransmitting it.

MODEM

An abbreviation used to designate units or equipment panels containing both a modulator and a demodulator.

MULTICOMPUTER SYSTEM

A computing system containing two or more simultaneously active computers.

MULTIPLEXING

The act of combining signals for many different sources into a common channel. This function is often performed by a multiplexor.

MULTIPLEXOR

A device, often a stored-program computer, which handles the input/output functions of an on-line computing system having multiple communication channels.

OFF LINE

1. Term applied to a system which does not process its input data as they are received but instead stores and processes them at some later time.

2. Also applied to auxiliary equipment, input-output devices, etc., which do not operate under the direct control of the central processing unit.

ON LINE

1. Term applied to a system in which input data are processed as they are received and output data are transmitted immediately as they become available to the point where they are needed.

2. Also applied to auxiliary equipment, input-output devices etc., which operate under the direct control of the central processing unit.

OPERATING SYSTEM

A special program which permits the automatic running of many different programs on a computer without operator intervention.

PULSE-CODE MODULATOR (PCM)

A system of modulation in which the message waveform is sampled at a prescribed rate and each sample is quantized and then coded in terms of pulses, where the height, width or position of a pulse has a definite code meaning.

PROGRAM

The group of related instructions which when followed by a computer will solve a given problem.

RAW COMPUTER POWER

The facilities portion of a Computer Utility. This includes basically the central hardware and executive system but might, in some cases, also include terminal equipment on the customer's premises and certain compilers and information retrieval control programs.

READ-ONLY MEMORY

A memory whose contents can be changed, if at all, only by off-line human intervention usually involving rewiring, the removal or insertion of plugs, or the punching of holes.

REMOTE ACCESS

Refers to a communication service which permits connection to a central facility from a remote point, generally via a telecommunication system.

SPECIAL-PURPOSE COMPUTER

A computer designed to solve a specific problem or class of problems.

STORAGE

1. A memory.
2. A general term for any device capable of retaining information.

STORED-PROGRAM COMPUTER

A computer which stores its instructions in the working memory and can operate on and modify them as though they were data.

SUBROUTINE

A sequence of instructions which cause a computer to execute some particular function not included in the computer's instruction repertoire. A program may contain many subroutines as well as normal instructions.

TIME-DIVISION MULTIPLEXING (TDM)

The process of transmitting two or more messages or signals over a common transmission path by allotting a different portion of time to each signal. Thus, the pulses from a number of channels are interlaced to form a single series of pulses.

TIME-SHARED COMPUTER

A computer which switches from customer to customer at a rapid rate under the control of a scheduling formula that in the simplest case is an ordinary round robin. Each user's program is thus run in the form of short bursts of computation, and all programs are time multiplexed together in a continuously repeating cycle.

VERTICAL DIVERSIFICATION

A term applied to an organization, i.e. telecommunications carrier, which enters a business different than its normal field by establishing a separate corporate subsidiary for conducting the new business.

WIDE BAND

A relative or qualitative term used as a general measure of bandwidth in terms of relatively narrow or broad. A spectrum of energy covering a wide frequency range. (For example, a single telephone channel would be considered as narrowband whereas a cable or microwave system would be considered as broadband.)

WORD

A group of characters or digits usually handled as a unit within a computer.

APPENDIX A

APPENDIX A

SUMMARY OF RESPONSES TO THE COMPUTER/COMMUNICATIONS INQUIRY

This appendix summarizes the answers received in response to a questionnaire that was mailed to interested parties in the Canadian Communications and Computer industries and to major users of computers and communications.

The questions asked were:

1. Should any telecommunication carrier in Canada whether subject to Federal or Provincial jurisdiction, be permitted to provide data processing services for users outside of its own organization.

2. Should any non-carrier data processing organization be permitted to provide communication services for users.

3. Define what are telecommunication services and data processing services.

4. Should a computer service subsidiary of a carrier be allowed to sell its services to the carrier which controls the computer subsidiary.

5. The circumstances, if any, under which any or all of the services indicated in items 1 and 2 should be deemed subject to regulation by an appropriate governmental authority and the nature of the enabling legislation, or, whether the policies and objectives of the Federal Government would be served better by such services evolving in a free, competitive market and if so, whether changes in existing provision or law or regulations are needed.

6. What new telecommunication and processing services are or will be required to meet the present and anticipated needs of the computer industry and its customers.

7. In what respects and to what extent are present-day transmission facilities of common carriers inadequate to meet the requirements of computer technology, including those of accuracy, speed and bandwidth.

8. Does the computer utility as an industry fit the "natural monopoly" format that ultimately calls for regulation.

The questionnaire was sent out to 131 different organizations in Canada. They included computer manufacturers, data processing companies, major users of computers, and the telecommunications carriers. About 60 replies were received from the most interested organizations and users, including the major common carriers. Several companies chose to answer the inquiry through the Canadian Business Equipment Manufacturers Association Inc. which represents 72 major companies and which presented a substantial brief on their behalf.

The text of each of the responses will be made available at the time of publication of the overall Telecommission report on "Policy Considerations with Respect to Computer Utilities".

The following summaries attempt to organize, group and simplify all these views as accurately as possible without judgement as to their validity or justification.

As will be indicated, the responses are summarized here in a very different order to that shown in the terms of reference. The summary deals first with the problem of definition in question 3. It then groups the two questions (questions 1 and 4) concerned with whether telecommunications carriers should be permitted to operate data processing services and, if so, whether a computer service subsidiary of a carrier should be allowed to sell services to the controlling carrier. Next, the summary groups the responses dealing with the converse question of whether data processing organizations should be permitted to offer communications services. Following this are given the responses to two questions (questions 6 and 7) concerned with the anticipated communications needs of the computer industry and its customers and concerned with the present inadequacies of existing communications services. Finally, there are gathered together the responses to two questions (questions 5 and 8) regarding the necessity for and the nature of government regulation of the computer utility industry and the relationship between data processing and communications. Responses were received from the parties listed at the end of this Appendix.

Summary of Responses to Question 3
of the
Study of the Relationships Between Common Carriers,
Computer Service Companies and their
Information and Data Systems

Question 3: Define what are telecommunication services and data processing services.

Responses:

Most respondents provided sound definitions of telecommunications services and data processing services in many different terms. However, all answers but one were consistent with the idea that the two services are distinct. The answers may be summarized as follows:

Telecommunications Services

Telecommunications services provide the means for transmitting information, whether data, images or sound, from one location to another without substantial change being performed in the content or form of the information transmitted.

The Radio Act, Revised Statutes of Canada, 1952, Chapter 233, Section 2(i), as amended, defines telecommunications in this way:

> "The transmission, emission or reception of signs, signals, writing, images or sounds or intelligence of any nature by wire, radio, visual or other electromagnetic systems".

Data Processing Services

Data processing services are concerned with the translation of data into meaningful information and involve such functions as storing, retrieving, analyzing, classifying, correlating, sorting, summarizing and reporting information.

To illustrate the type of definitions received by the respondents, three examples from three different classes of respondents are given below:

User (Definitions proposed by The Canadian Bankers' Association)

Telecommunications Services - the transmission by wire or wireless of voice or data information between two or more points through a network of facilities usually controlled by common carriers.

Data Processing Service - receipt of information in human readable, human hearable, or electronic coded form, followed by the formation of, or updating of records, the processing of this data in accordance with user's requirements, and the subsequent provision to the user of the results of the information processing.

Data Processing Company (Definitions proposed by Computrex Computer Centres Ltd.)

A "Telecommunication Service" supplies lines and necessary switching equipment and in so doing provide no data conversion or processing. As a result, data sent into the line by a user is transmitted to another user, or to a branch of the data processing organization at a remote point from whence the data was initiated. Just as in a business conversation conducted by phone, the telephone service provides the phones and lines that make the transaction possible. The telephone service supplies nothing else.

A Data Processing Service is an organization apart from the common carrier in every respect. It operates on the data by means of a computer and outputs the data in a different form from input. Data is transmitted via a common carrier which enters and leaves the transmission system in the same unaltered form for processing remotely and the results of computer processing may by returned via a common carrier (or telephone service company).

Common Carrier (Definitions proposed by the Trans-Canada Telephone Systems)

Telecommunications services to represent a transportation of generic data via electromagnetic means.

We would, therefore, define data processing to be the manipulation of generic data, possibly changing it, in order to produce new information; where "new" is a value judgment of the user.

Summary of the Responses to Questions 1 & 4
of the
Study of the Relationships Between Common Carriers,
Computer Service Companies and Their
Information and Data Systems

Question 1: Should any telecommunication carrier in Canada, whether subject to Federal or Provincial jurisdiction, be permitted to provide data processing services for users outside of its own organization?

Question 4: Should a computer service subsidiary of a carrier be allowed to sell its services to the carrier which controls the computer subsidiary?

Responses:

Broadly, the respondents who either favoured allowing the carriers to offer data processing or who saw no objection to such services included the manufacturers of computer equipment; some users in the pulp and paper, oil and of course, the carriers themselves. The major opponents of common carrier data processing services were the computer utility companies, the computer leasing companies, a few industrial users, and all but the one of the chartered banks. Two Federal Government agencies expressed reservations about the expansion of the carriers into data processing.

Many representations, both favourable and unfavourable, where stated subject to conditions or qualifications. For example, the Canadian Business Equipment Manufacturers Association - which, as noted, represents all major computer manufacturers - was willing to permit carrier data processing service subject to the following conditions:

(1) Operation of a common carriers data processing service by a separate and distinct subsidiary;

(2) Separate accounting and identification of joint costs shared by a carrier and its data processing subsidiary;

(3) Prohibition of the subsidizing of data processing subsidiaries by carriers;

(4) Non-discriminatory pricing and service by a carrier in the offering of communications facilities to its subsidiaries and to others;

(5) Curbing of disclosure by a carrier to its data processing subsidiary of information which the carrier has obtained from competitors of the subsidiary.

The Association also warned against the dilution by the carriers of the management and other resources available for providing telecommunications, and against the undertaking of undue financial risks by the carriers.

Respondents opposed to permitting carrier data processing services questioned fairness of permitting a carrier to build its data processing upon the base of a communications monopoly barred to its data processing competitors. One Government official compared this danger to "dumping" of excess capacity into Canada by foreign computer utilities.

Some respondents suggested that small data processing companies would be placed at the mercy of a large competitor providing a service essentially to them. Others wondered whether regulation could deceptively separate carrier revenues and charges from communications and data processing. In reply, the supporters of carrier data processing stressed the protection which could be provided by vertical separation of parent carrier communications and subsidiary data processing. They pointed to the advantages of more effective utilization of the computers required for communications, to the benefits of shared technology and to the value of using the expertise possessed by the carriers. Some suggested that carrier data processing would bring data processing services to small users to whom such services would otherwise be denied.

Summary of Responses to Question 2 of the Study of the Relationships Between Common Carriers, Computer Service Companies and Their Information and Data Systems

Question 2: Should any non-carrier data processing organization be permitted to provide communication services for users?

Responses:

Because respondents seem to have interpreted Question 2 in different ways, it is difficult to provide a coherent summary of these responses. Some of the respondents interpreted the question as dealing with whether a non-carrier data processing organization or a group of such organizations should be permitted to establish a communications network independent of the existing common carrier facilities. Other respondents treated the question as dealing with the problem of whether a non-carrier data processing organization which leased communications facilities from a common carrier should be permitted to sublet those facilities to the data processing organizations customers. Still other respondents interpreted the question as concerned with whether a number of data processors could pool their communications needs by jointly leasing a communications facility from a common carrier and then subdividing it among themselves.

In addition a few respondents raised the issue of whether or not interconnection should be permitted between non-carrier data processing facilities and the public common carrier network. Several respondents also raised the issue of foreign attachments -- whether or not a non-carrier data processing organization should have the right to attach to common carrier facilities terminals, couplers or other devices not supplied by the common carrier.

Even among the respondent users of both data processing and telecommunications, opinions differed widely concerning the extent to which data processing organizations should be permitted to offer communications services.

In addition, an analysis of the responses to Question 2 is complicated by the close relationship between that question and Question 1. That is, a number of the respondents who argued in favour of permitting the data processing organizations to offer communications facilities appeared to do so on the assumption that the common carriers were to be permitted to offer data processing services. Thus, Consolidated-Bathurst Ltd. commented, "There seems little point in permitting a small restricted number of common carriers to offer Data Processing Services without permitting Data Processing Organizations to offer communication services."

Symbionics Systems Limited said, "If common carriers are allowed to provide data processing services then data processing organizations should be allowed to provide communication services." Whether these respondents would be willing to allow data processing organizations to provide communications facilities if the common carriers were precluded from providing data processing is not clear.

Affirmative Responses

Those respondents who favoured allowing Data Processing Organizations to provide communications facilities emphasized potential benefits to the public from increased competition and from specialized communications services. Imperial Oil Limited suggested that as a user, it would benefit from competitive services and would expect lower costs and more rapid introduction of technological developments. Canadian Industries Limited reasoned that if Data Processing Companies were permitted to provide communication services, this would foster economies of scale, would recognize the increasingly high proportion of communications used for data transmission and would provide a complete and efficient user service.

Chrysler Canada Limited responded "Yes" and noted that the computer service user would then be able to receive the benefits of data communications if he was unable to obtain his own facility.

The Ontario Paper Company Limited replied, "Data Processing Companies should be permitted to provide communication services if the customer so desires e.g. to obtain private communication to a central processor."

General Motors of Canada Limited replied "Yes, without restriction." The Ford Motor Company of Canada Limited suggested that Data Processing Companies should be permitted to provide communication services to their users, but that the communications should be limited to data processing applications. Ford pointed out that small users then could benefit from "packaged" options and from shared systems.

Noranda Mines Limited replied "Yes -- provided the communication services are leased from the common carrier."

MacMillan-Bloedel Limited stated, "We do not object to a non-carrier Data Processing Organization providing communication services for users" but added that rates for data processing and communications must be economically independent. Consolidated-Bathurst Limited would permit Data Processing Companies to provide communications services.

Collins Radio of Canada Limited distinguished between two types of communications services. The first, such as exchange telephone services,is in the public utility category and requires franchise protection. The other services are more private in nature and require neither dedication to public use nor public protection or privilege. Collins Radio would not limit private types of communication to franchised carriers.

Dow Chemical of Canada Limited replied simply, "Yes".

A number of responses suggested that data processing companies should be permitted to provide communications services subject to existing rules and regulations governing common carriers. The Canadian Business Equipment Manufacturers' Association took the position that a data processing organization should be permitted to act as a common carrier subject to existing rules governing entry into that business. C.B.E.M.A. noted, however, that a data processing organization which used telecommunications as an incidental part of providing data processing services would not be providing a telecommunication service, but rather a data processing service and, therefore, would not be a common carrier through this use of communications.

IBM Canada Limited agreed that any organization should be permitted to provide telecommunications services subject to general regulations. IBM added that a data processing company which provided common carrier communications should be required to offer its communications services to other data processing companies on a non-discriminatory basis. IBM suggested that data processing should be segregated from regulated communication services. IBM also noted that a data processing company which used a common carrier to provide communications ancillary to data processing should not be regulated.

Several respondents suggested that Data Processing Companies be permitted a limited right to provide communications services. Domtar would permit the provision of such services to users of the data processing facilities. Setak Computer Services Corporation Limited also would permit data processing organizations or groups of organizations to provide communication services for their own use but would not permit the provision of communications services apart from such data processing services since (Setak argued) this would foster monopoly. AGT Data Systems Limited again would permit data processors to purchase communications services and to share these with a few customers. Digital Analysis & Technical Assistance Ltd. argued that a data processing company should definitely be permitted to provide communications services provided "There is a data processing content in such communication services."

The response of Kates, Peat, Marwick & Co. was ". . . a qualified yes. Any organization...should be allowed to provide a dedicated leased network for a particular user company... . However, such an organization must not supply a switched network service to multiple users." The Kates firm also suggested that at one or more points on a private network a tie-in interface should be permitted to the common carriers switched network, subject to suitable technical specifications.

Computer Sharing of Canada asked that data processing companies be allowed to provide communication services for users so long as these services do not conflict with present common carrier business of general message switching and communications. Computer Sharing also made the permission to provide such services conditional on the inability of the carriers to meet such data processing requirements as an economical, commercial offering.

Greyhound Computer of Canada Ltd. would permit a data processing company to provide terminal-to-terminal communications as an aid to processing data -- for such needs as correcting programs or editing the data. But Greyhound added that users should not be provided with a means of circumventing normal communications channels for reasons unrelated to data processing. Greyhound noted that the use of a data processing company's computer facilities for routine communications would not benefit a computer utility since it involves high system overhead for the utility. Hence, Greyhound argued, the use of data processing communications facilities probably would be self-policing.

A significant argument in favour of permitting sub-leasing of communications was made by Gulf Oil Canada Ltd. Gulf commented, "The utilization of leased lines for data communication leads to extensive idle capacity which the users effectively pay for. For instance, if we could share time on a broadband link between Montreal, Toronto and Calgary either by subletting on our leased lines or buying time on someone else's lines, long distance transmission could become much more attractive to us and to other companies.

"The inability to sub-lease retards the growth of this function and results in economic waste through locked-in idle capacity."

A possible limitation on the communications service which might be offered by a data processing organization was suggested by Computrex Computer Centres Limited. Computrex suggested that even if a data processing company was not allowed to have a long distance communications network, the data processing company should be able to use new laser techniques or radar or an approved local microwave system within a city. This limited communications network might also include hard wire or coaxial cable within a building or city.

Negative Responses

As one might expect, the common carriers objected to the provision of communication services by Data Processing Organizations. The Trans-Canada Telephone System responded:

> The question as stated must be answered in the negative if the intent is that such service would be provided on a non-regulated basis. If the intent of the question is to enquire whether processing organizations should be permitted to set up regulated telecommunication subsidiaries (in effect set up additional communication carriers) then the following factors must be borne in mind:
>
> (1) It would result in proliferation of telecommunications facilities. Where two structures can transport the same data, duplication is wasteful of resources. The only exception is in situations demanding physical separation of structures for the purpose of improving and maximizing continuity of service under conditions of natural disaster or acts of war.
>
> (2) Telecommunications usage cannot easily be segregated and handled on separate facility structures. In general, the user wants to talk, hear, see, and interact with computers and humans. It would be hard to believe that the public could be best served by having to deal with one company for its voice communications, with another company for its data communications, with another company for its data processing communications, and with yet another company for its video communications, etc. The future need is for simultaneous voice, data computer and visual interaction.
>
> (3) There would be little justice in any arrangement whereby regulated carriers in meeting their charter obligations must provide services to all areas -- while data processing communications vendors could select and service profitable high volume routes; including the sale of voice and non-computer data communications. Further, if the "cream-skimming" were permitted to occur, costs to the public for other communications would of necessity increase since the revenue support for many existing structures would be considerably reduced.
>
> (4) The question implies that there are no economies of scale in existing telecommunications structures. Economy of scale, where expensive physical networks are required, is one of the basic raisons d'etre of telecommunications utilities. There is little doubt, in the case of general random access usage, that one facility carrying many services is more economical and efficient than several arrangements providing one service per facility.

(5) An affirmative answer to the question implies that the carriers need not concern themselves with new telecommunications needs. Growth markets are essential if the telecommunications carriers are to survive.

(6) Regulation of a multitude of carriers is far more difficult that regulation of a few.

(7) Frequency allocation for a multitude of carriers is more difficult than for a few.

CN Telecommunications argued that no more than the present number of carriers can be supported by the business in Canada. The company stressed the need to protect telecommunications investments and referred to the effect of lower interest rates upon communications costs. CN Telecommunications noted that data processing company communications services would need to be funded at higher interest rates than would such services from the carriers, thus increasing the cost to Canada.

CN Telecommunications emphasized the "cream-skimming" argument, pointing out that common carriers must serve light density routes as well as high density routes.

Both CN Telecommunications and CP Telecommunications noted the advantage of economies of scale. The CP Telecommunications response stated, "Provision of telecommunications services should be restricted to a minimum number of competitive carrier groups to provide economies of scale, efficient use of the frequency spectrum and competitive incentives."

The "cream-skimming" argument occurred again in the response from Computer Sciences Canada Limited, a firm controlled by CN/CP: "Localized competition would possibly reduce the cost of data communications in profitable urban areas but would lead to increased costs elsewhere or would lead to government subsidy of common carriers." Computer Sciences Canada Limited denied the economic justification for a dedicated network for any data processing organization: "The total memory capacity of the approximately 2000 digital computers installed in Canada is estimated at 500 Megabits. One dedicated microwave link with a total transmission capability of 25 Megabits/second would be sufficient to exchange all information stored in the memories of all computers in Canada once every 20 seconds. This capability is orders of magnitude greater than any predictable requirement in the data processing industry."

The cream-skimming argument against data processing communications services was made by the Aluminum Company of Canada Ltd., as well as by the carriers.

The Canadian Bankers Association argued that where adequate common carrier communications facilities are available, it should not be necessary for a company engaged in data processing, such as a bank, to own and operate its own telecommunication facilities. The Association suggested that permission to establish private telecommunication facilities might be granted where required service was not provided on a satisfactory basis.

The Canadian Bankers Association also objected to sub-leasing of common carrier communications facilities by a user. The Bank of Montreal dissented on this point from the rest of the Association, believing that such subleasing should be allowed. The Bankers Association suggested that the carriers themselves should be allowed to lease communications facilities on a shared basis to two or more users.

Other arguments against permitting communications services by data processing companies were made by some users. A number of responses stressed the inefficiency of multiple communications systems. Cominco Limited replied, "No, since existence of two separate major telecommunications systems in Canada already creates problems requiring duplicate equipment at some points. Additional systems would compound this difficulty."

The Price Company Limited stated, "Non-carrier data processing organizations should probably not be permitted to provide communication services unless some means can be found to coordinate the various means of communication so that a high degree of efficiency may be maintained."

The reply of Cyanamid of Canada Ltd. stated, "No. Non-carrier data processing organizations should be permitted only to provide terminals and consulting services on a interconnection basis. It would be very difficult to service and to keep track of multiple suppliers."

RCA also favoured restriction of communications services to the common carriers to achieve "equitable and controlled services to any user."

One novel response was made by the Iron Ore Company of Canada, which returned separate responses from its activities as a common carrier and from its data processing department. As a common carrier, the Iron Ore Company favoured the joint operation of an over-all service by a data processing and communications organization. However, the data processing department argued that non-carrier data processing organizations should not be permitted to provide construction, operation or maintenance of outside physical plant. The data processing department warned against duplicate facilities and overcrowding of spectrums.

Summary of Responses to Questions 6 and 7
of the
Study of the Relationships Between Common Carriers,
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Question 6: What new telecommunication and processing services are or will be required to meet the present and anticipated needs of the computer industry and its customers?

Question 7: In what respects and to what extent are present-day transmission facilities of common carriers inadequate to meet the requirements of computer technology, including those of accuracy, speed and bandwidth?

Responses:

The answers received should be discussed from the point of view expressed by three groups of respondents: Users of Data Processing Services, Common Carriers and the Computer Services Industry. The Computer Services associated with Common Carriers have tended to express desirable development of transmission facilities rather than inadequacies of present facilities.

Users of Data Processing Services

The data processing services are provided to the users by the computer services industry at a cost and within the limits of the facilities available and they are more concerned with the quality and the cost of services offered to them than with the problems associated with the development of these services. They also are not giving too much thought beyond the services required for their immediate needs, and their general comments were the following:

a) Cost

- The cost of teleprocessing services is too high. Lesser expensive methods of data transmission are required because the transmission cost often exceeds the computer cost.

- Present and future requirements dictate the need for less restricted and less costly services (e.g. Bell Telephone W.A.T.T.S. requires that a single master station initiates all calls in the network).

- Shared switching services for data terminal as well as for administrative terminal are required.

- The demand from the carriers that a terminal connector or data set be installed at each end of the line as do the transmission/reception devices is most annoying.

- Rates of charges for items considered non-standard appear to be high and unrealistic in view of the cost of the item.

- Common carriers should be required to expand the schedule bulk rates for communications packages based on total volumes of data and total mileage of transmission against charges based on private line circuit mileage or switched network time usage.

- Users must often move to leased line in order to have suitable speed and bandwidth transmission characteristics, and a leased line often exceeds their usage time requirements.

b) Improvement to the Teleprocessing Services

- Need increased capabilities for transmission from 60-48,000 BPS.

- Additional higher speed transmission circuits in a variety of bandwidths are required in smaller areas (e.g. London, Sarnia) to enable computer to computer, computer to CRT and facsimile transmission.

- Need more medium speed channels (1200-9600 baud).

- Need more very low speed channels (less than 200 baud) at low cost.

- Need very high bulk telecommunication facilities between major population centre with connected processing services to store and re-route data across lower speed facilities to nearby plant, zone, region, district customer and supplier locations and offices.

- Need interconnection between the two major common carriers and between the common carriers and the other communication company in order to get greater area coverage and interface at remote distances.

- Legislation should be introduced to require common carriers to permit interconnection of their facilities within competing carriers or private companies.

- One company requires wideband facilities to remote areas like N.W.T.

- Greater effort is needed from the carriers to improve accuracy, reduce noise, both in data channel and in their switching centres.

- Implementation of self-checking transmission codes is vital.

c) Equipment

- No unnecessary restriction should be applied to the linkage between data processing equipment and communications equipment.

- Interconnection of the common carrier switched network system with foreign attachments and user provided communication system should be mandatory, provided equipment meets interface standards.

- Users should be protected against the use of restrictive policies for equipment by the common carriers.

- Delivery time for communication equipment from the carrier is significantly longer than those quoted by other suppliers.

- There is also a lack of compatibility between computers of different manufacturers and users tend to be "locked in" to a manufacturer through use of proprietary software.

- Greater effort should be made to design teleprocessing equipment compatible with telecommunications facilities. All new developments must be compatible with what exists and individual utilities must be compatible with one another to realize the full potential teleprocessing.

d) System Design

- There is a need for system design for data transmission.

- It is difficult to obtain competent technical guidance from the carriers with respect to data communications.

- Users demand appears to be inadequate for the common carriers to develop systems other than those available.

- Common carriers are not flexible in meeting the needs of new systems.

- Need increased effort by common carriers to educate and train their employees in the special requirements of data transmission.

Common Carriers

The Common Carriers seem to have a fairly optimistic view compared to that of the users of data processing services. One contends that it has not experienced significant complaints from the Computer Services Industry in connection with the quality of the services and that sparse information is available on the services required by the industry and on the present inadequacies of existing facilities. A second Common Carrier proudly advances that the telecommunications technology of the Canadian carriers is second to none and is constantly being improved. Common Carriers general comments are the following:

- New rate packages are being developed, designed to meet the new characteristics of computer oriented information systems. New applications of transmission and switching systems are being developed to offer such services as switched wideband data, picture phone, touch-tone for data etc., as well as the possibility of processing in transit.

- New technology is being introduced into a large network on a continuing basis. Transmission facilities can handle data from the lowest bit per second rate into the megabit per second ranges, i.e. voice to full broadcast video.

- Noise has been reduced and new systems (error checking) have arisen to cope with this problem.

- Traditional rate packages have been geared to meeting a low volume market but a series of new rate packages have been put into affect to satisfy the need for higher speeds on a dedicated facility basis.

- On switched networks, costs are set in this way: (a) establishment of connection covered on the basis of minimum charge; (b) toll rates are largely a function of time and distance.

- Telex switched network, there is no minimum charge. Savings are realized by the use of call metering instead of automatic call ticketing.

- It is not the practice of the carriers to establish rates which are related to the number of anticipated errors in transmission.

- Computer to Computer transmission is available on private line or network carrier services to meet the vast majority of needs.

- The need for a very high switching speed network is at this time vague in Canada.

- Computer to and from high speed terminal is part of carrier's present offering.

- One carrier agrees to permit interconnections of users equipment subject to maintenance of technical standards to protect the integrity of the system.

- The other feels that more effort is required in the design of data sets and remote terminal business machines.

- Better cooperation and planning is needed between users, computer suppliers and the common carriers.

The Computer Services Industry

The Computer Services Industry is almost entirely dependent on the telecommunications companies, primarily the common carriers because in most cases data must be brought back and forth to the computer centre over large distances via telecommunications networks. The industry is always on the lookout for new ways to process data at lesser cost and for the creation of new needs which enable it to remain competitive. Since all new services must be matched by improved facilities and more flexibility from the communication carriers, the Computer Services Industry feels oppressed by the policies and high rates imposed by the carriers, and they have this to say:

a) Cost

- Today's transmission facilities are too expensive for long distances. Off-peak use should be available for lower cost transmission.

- Common carrier tariffs should exclude the costs of common carrier provided terminal equipment.

- Common carriers should be forced to minimize artificial pricing structure. Users in remote locations have no incentive to install concentrators or FM multiplexors because of artificial prices imposed by the carriers.

- Rate structure may arbitrarily change and cause new equipment to be obsoleted a few weeks after the product is announced.

- Need a uniform tariff published and readily understandable by the user.

Communications Improvement

- Present day transmission facilities are adequate although by no means outstanding and they stand improvement.

- The 5 level code is inappropriate for data transmission and should be converted to a unified 8 level code (ASCII) to enhance the growth of computer utility.

- Current communications facilities lack transmission capability for effective intercomputer communications (2-3 Megabits per second) and for the development of distributed data banks.

- Need high speed in one direction with option to low speed in the other direction.

- Existing connection possibilities between users of the telephone network, including interoffice trunks are inadequate and not designed for the simultaneous access implied by share time usage in the home.

- To provide service to the widely separated population of Canada, there will be a requirement for a network system which will allow interconnection between low and high speed transmission.

On Common Carriers Policies

- Policies whereby user provided modems may only be used on the switched telephone networks through connector equipment provided by the telephone companies must be liberalized to benefit the majority of data processing users.

- Interconnection of common carrier leased and switched telecommunication services with privately owned communications services using privately owned equipment need to be allowed.

- Restrictions on switched network multiplexing should be abolished.

- Burden of proof of non-compliance with channel performance standards should rest with the common carriers.

- Attachment of data devices should be governed by published uniform technical specifications.

- Common carriers should allow the sharing of package offering by separate users in order to make economic facilities accessible to smaller members of the data processing industry.

Technical Specifications

- There is a need for increased dialogue and liaison between telecommunications carriers, the data processing equipment suppliers and the data processing services suppliers to:

  a) provide a basis for proper planning by all parties;

  b) provide for the proper design and construction of telecommunications-oriented data processing systems;

  c) provide a basis for the interfacing of user equipment;

  d) provide for less conflict due to technological differences of approach.

- Standards and methods for data transmission should be given a complete review with industry participation.

Security

- Effective techniques will be required in both communications and processing to prevent unauthorized access, limit authorized access and to detect the penetration of the security system.

- Adequate legal and administrative safeguards will also be required.

Summary of Responses to Questions 5 and 8
of the
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Question 5: The circumstances, if any, under which any or all of the services indicated in items 1 and 2 should be deemed subject to regulation by an appropriate governmental authority and the nature of the enabling legislation, or, whether the policies and objectives of the Federal Government would be served better by such services evolving in a free, competitive market and if so whether changes in existing provision or law or regulations are needed.

Question 8: Does the computer utility as an industry fit the "natural monopoly" format that ultimately calls for regulation?

Responses:

Because both Questions 5 and 8 were concerned with the extent to which the federal government should regulate either data processing or communications activities, the responses to these two questions have been treated together. Question 8 raised the issue of whether the computer utility could be regarded as a natural monopoly which required regulation in the same way as utilities such as electric line and power companies. Although a full response suggested that there was some possibility of such a monopoly emerging in the future, virtually all responses agreed that the present state of the Data Processing Industry did not justify regarding a computer utility as a "utility" in the judicial sense. Many responses emphasized that the Data Processing Industry is highly competitive and in no way monopolistic. Other points which were raised several times in response were the following:

(1) Entry into the Data Processing Industry is relatively easy.

(2) Capital requirements of the Data Processing Industry are low.

(3) The ratio of revenues to capital investment in the Data Processing Industry is comparatively high.

(4) The types of service which a computer utility may offer are so varied that it is likely that any single company can offer all types of services for which there is a demand.

(5) The demands upon the executive software of a computer and the costs of communication place a limit on the size of a computer utility which can be operated economically. This limit on the size of operation prevents any monolithic monopoly.

(6) The cost and quality of computer utility services are more dependent on the design of hardware and software than on the volume of business.

A very high proportion of respondents also emphasized the necessity of protecting a free and competitive market for data processing. Perhaps the strongest general impression which one obtains in reading through all of the submissions is an emphasis upon competitive free enterprise and a desire to hold government regulation to a minimum.

Several responses commented on the danges that any regulation might fail to keep pace with such a dynamically developing industry as data processing services. CN Telecommunications, for example, warned that the rate of development and innovation in data processing services is so rapid that it would be very difficult to formulate regulations which would remain meaningful for any length of time. Hence, regulations might interfere with the flexibility of the industry to keep pace with new developments.

Although virtually every response stated that regulation of the computer service industry is unnecessary, several responses mentioned that regulation would seem appropriate concerning questions of security and privacy. The Trans-Canada Telephone System also mentioned specific action to provide certification of competence. TCTS added that regulation might apply rather than free competition in some cases where duplication of effort or lack of readily available data might adversely effect the Canadian economy. The TCTS brief referred to cases such as some national statistics, general medical information and perhaps legal data, and some credit information.

A few responses also suggested regulation to promote uniform standards. Imperial Oil Limited noted that controls and standards should be imposed on any interface with the public telephone and telegraph, so as to guard against interference. Canadian Industries Limited suggested that regulation might secure compatability among communication and data processing services. CIL urged standards to permit a user to move his computer system from one supplier of services to another.

Although Question 5 appeared to seek responses only on the extent to which communications and data processing combinations require regulation, a number of responses dealt with regulation of telecommunications more generally. Many responses indicated approval of the regulation of common carriers to insure standard published rates and non-discrimination among communications users. Consolidated-Bathurst Ltd. also noted that government regulation should insure consistency and uniformity where appropriate and should encourage the extension of services to parts of rural Canada where returns would not be immediate.

Some responses emphasized the value of requiring separate costing for the use of computers, and for the use of communications.

One brief, by Northern Electric, which proposed an extensive plan by which the common carriers would act as distributors of programs or information services on behalf of many others, suggested that regulation might govern the duty of the common carrier to act as a supplier on behalf of authors.

A number of comments on the regulation of the relationships between common carriers and data processors reiterated responses to Questions 1 and 2.

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British Columbia Forest Products Ltd.,
1190 Melville Street,
Vancouver 5, B.C.
Attn: W.R. Steen, Comptroller.

Burroughs Business Machines Ltd.,
801 York Mills Road,
Don Mills, Ontario.
Attn: F.J. Matas, Manager,
Sales Promotion Group III.

Canadian Business Equipment
Manufacturers Association Inc.,
1 Greensboro Drive,
Rexdale, Ontario.
Attn: G.D. Wynd, General Manager.

The Canadian Bankers' Association,
P.O. Box 282, Royal Trust Tower,
Toronto 111, Ontario.
Attn: J.H. Perry, Executive Director.

Canadian Datasystems,
2055 Peel Street,
Montreal 2, Quebec.
Attn: H. Botting, Assistant Editor.

Canadian General Electric Company Ltd.,
214 King Street, West,
Toronto 129, Ontario.
Attn: J.G.P. King, Manager,
Information Services Business Sec.

Canadian Industries Limited,
P.O. Box 10,
Montreal, Quebec.
Attn: J.H. Shipley, Vice-President.

Canadian Petroleum Association,
151 Slater Street,
Ottawa 4, Ontario.
Attn: J.M. MacNicol, Manager.

Chrysler Canada Limited,
P.O. Box 60,
Windsor, Ontario.
Attn: H.J. Fyall, Manager,
Organization, Systems and
Data Processing.

Canadian National Telecommunications,
Room 301, Blackburn Building,
85 Sparks Street,
Ottawa 4, Ontario.
Attn: K.J. MacDonald, Manager,
Special Services.

CP Telecommunications
Suite 518, Place du Canada,
Montreal 101, Quebec.
Attn: R.E. Allen, Assistant General
Manager, Computer Services.

List of Respondents to the Inquiry (cont'd)

Collins Radio Company of Canada Ltd.,
150 Bartley Drive,
Toronto 16, Ontario.
Attn: G.J. Bury, Director of Marketing.

Cominco Limited,
1385 Cedar Avenue,
Trail, B.C.
Attn: J.E. Roberts, General Supervisor, Data Processing Services.

Computer Sciences Canada Limited,
1200 Eglinton Avenue, East,
Don Mills, Ontario.
Attn: W.M. Richburg, President.

Computer Sharing of Canada,
4214 Dundas Street, West,
Toronto 18, Ontario.
Attn: B.A. Martin, Vice-President, Technical.

Computrex Computer Centres Ltd.,
2000 Elveden House,
Calgary 2, Alberta.
Attn: G.M. Kernahan, P. Eng., President.

Consolidated-Bathurst Limited,
800 Dorchester Boulevard West,
Montreal, Quebec.
Attn: N.A. Grundy, Director, Planning and Coordination.

Consolidated Computer Services Ltd.,
48 Yonge Street,
Toronto 1, Ontario.
Attn: M. Kutt, President.

Control Data Canada Ltd.,
50 Hallcrown Place,
Willowdale, Ontario.
Attn: W.G. Glover, President.

Cyanamid of Canada Limited,
P.O. Box 1039,
Montreal 101, Quebec.
Attn: J.R. Bruce, Director of Data Processing.

Davis & Company,
Barristers & Solicitors,
14th Floor, Burrard Building,
1030 West Georgia Street,
Vancouver 5, B.C.
Attn: D.H. Paterson.

Domtar Limited,
Domtar House,
395 de Maisonneuve Blvd., West,
P.O. Box 7210,
Montreal 101, Quebec.
Attn: T.H. Lloyd, Director, Computer Systems Development.

Dominion Bureau of Statistics,
Tunney's Pasture,
Ottawa, Ontario.
Attn: W.E. Duffett, Dominion Statistician.

Digital Analysis & Technical Assistance Limited,
510, 310 - 9th Avenue, S.W.,
Calgary, Alberta.
Attn: J. Duby, P. Eng.,B.Sc.,B.A., M.A., D. Phil.

Dow Chemical of Canada Limited,
P.O. Box 1012,
Sarnia, Ontario.
Attn: C. Taylor, Supervisor, Communications & Services.

Ford Motor Company of Canada Limited,
The Canadian Road,
Oakville, Ontario.
Attn: B.P. Prince, Manager, Communications and Data Processing, Finance.

General Computer Corporation Ltd.,
885 Don Mills Road,
Don Mills, Ontario.
Attn: R.H. Parker, President,

List of Respondents to the Inquiry (Cont'd)

General Motors of Canada Limited,
Oshawa, Ontario.
Attn: A.I. Omand, Administrator, Data Processing Department.

Geodigit,
Chevron Standard Building,
415 - 3rd Street, S.W., 3rd Floor,
Calgary, Alberta.
Attn: J. Merland, Manager.

Greyhound Computer of Canada Ltd.,
65 Adelaide Street, East,
Toronto 1, Ontario.
Attn: G.B. Clarke, President.

Gulf Oil Canada Limited,
800 Bay Street,
Toronto 5, Ontario.
Attn: D.S. Blackmore, Coordinator - Systems.

Honeywell Controls Limited,
740 Ellesmere Road,
Scarborough, Ontario.
Attn: R.E. Weber, Director of Marketing, Electronic Data Processing.

IBM Canada Limited,
1150 Eglinton Avenue, East,
Don Mills 402, Ontario.
Attn: J.E. Tapsell, Office of the Director of Data Processing Communications Relations.

Imperial Oil Limited,
111 St. Clair Avenue, West,
Toronto, Ontario.
Attn: E.D. Kingsbury, Manager, Systems and Computer Services Department.

Interprovincial Pipe Line Company,
Box 398,
10015 - 103 Avenue,
Edmonton 15, Alberta.
Attn: C.H. Bucklee, P. Eng., Manager Engineering.

Iron Ore Company of Canada,
Sept-Iles, Quebec.
Attn: H.E. Farnam, Jr., Vice President, Operations.

Kates, Peat, Marwick & Company,
Prudential Building,
4 King Street, West,
Toronto 1, Ontario.
Attn: G.S. Collins, P. Eng., Partner, Electronic Systems Engineering.

MacMillan Bloedel Limited,
1075 West Georgia Street,
Vancouver 5, B.C.
Attn: J.O. Miller, Director, Computer & Operations Research Svcs.

Noranda Mines Limited,
Suite 1700,
44 King Street, West,
Toronto 1, Ontario.
Attn: A.H. Zimmerman, Vice-President-Comptroller.

Northern Electric Company Limited,
P.O. Box 3511, Station 'C',
Ottawa, Ontario.
Attn: G.B. Thompson, Communications Studies Group.

The Ontario Paper Company Limited,
Thorold, Ontario.
Attn: K.T. Waldock, Director, Operations Research.

Olivetti Underwood Limited,
1390 Don Mills Road,
Don Mills, Ontario.
Attn: L. Amato, President.

List of Respondents to the Inquiry (Cont'd)

The Price Company Limited,
65 St. Anne Street,
Quebec 4, Quebec.
Attn: R.E. Membery, Vice-President, Finance.

Québec Téléphone,
Rimouski, Quebec.
Attn: Julien Thuot, L.S.C., C.Adm., Vice-President-Finance & Treasurer.

R.C.A. Limited,
1001 Lenoir Street,
Montreal 207, Quebec.
Attn: H.B. Godwin, Vice-President, Defence Systems.

Systems Research Group,
130 Bloor Street, West,
Toronto 5, Ontario.
Attn: R.W. Judy, Principal.

Science Council of Canada,
7th Floor,
150 Kent Street,
Ottawa 4, Ontario.
Attn: P.D. McTaggart-Cowan, Executive Director.

Setak Computer Services Corporation Limited,
20 Spadina Road,
Toronto 4, Ontario.
Attn: J. Kates

Systems Dimensions Limited
770 Brookfield Road,
Ottawa 8, Ontario.
Attn: G.A. Fierheller, President.

Symbionics Systems Limited,
550 Berry Street,
Winnipeg 21, Manitoba.
Attn: B.A. Hodson, President.

T-Scan Limited,
155 Adelaide Street, West,
Toronto 1, Ontario.
Attn: L.E. Richardson, President.

Trans-Canada Telephone System,
1050 Beaver Hall Hill,
Montreal, Quebec.
Attn: T.O. Carss, Assitant Vice-President, (Planning) Bell Canada.

Sperry Rand Canada Limited,
Univac Division,
250 Bloor Street, East,
Toronto 5, Ontario.
Attn: E.J. Coady, Director of Marketing.

Victor Comptometer Limited,
P.O. Box 10,
Galt, Ontario.
Attn: W.H. Bell, President.

APPENDIX B

DEPARTMENT OF COMMUNICATIONS

SPECIAL REPORT

ON THE

CANADIAN REMOTE DATA-PROCESSING INDUSTRY

October 15, 1970.

Section I

Introduction

In conjunction with the Telecommission Studies an analysis of the structure of the Canadian remote data processing industry was carried out by the Department of Communications. The following report represents the results of this survey which the Department compiled during the latter half of the summer and the early fall of 1970.

The survey questionnaire was designed in order to meet two objectives:

1) To determine the size, structure and capability of the remote data processing industry in terms of equipment, manpower and finance; and
2) To evaluate the present ownership of the industry and to anticipate possible changes in ownership.

To secure such a broad range of data, the questionnaire, consisting of thirteen questions, sought information in six broad areas:

(i) hardware availability
(ii) services and marketing
(iii) rate structure
(iv) hardware ownership
(v) organizational structure
(vi) corporate expansion plans

The questionnaire was sent to twenty-two companies in the remote data processing field and replies were received from nineteen. The names and addresses of the respondents are included later in the report.

Since only a few of the companies contacted are publically-owned, it was difficult to secure complete answers to questions of a financial nature. Furthermore, the information contained in some replies was designated as confidential by the respondents. Consequently, there are certain gaps in the data presented, although, specific figures are used wherever possible. As pointed out above, not all addressees replied to the questionnaire. For this reason an accurate tabulation could not be made but it was possible to draw some relevant data from a recent study conducted by the Canadian Information Processing Society concerning the number and monetary value of computer installations in Canada. Furthermore, two of the respondents possess no hardware but do offer most software services and as such, are in competition with those offering both hardware and software; these firms are Computech Consulting, Vancouver, B.C., and A.G.T. Data Systems, Toronto, Ontario. Because of this, discussion of hardware, operating systems and communications interface will involve the replies of fourteen firms whereas, discussion of software will encompass the complete list of respondents.

It should also be noted that several Canadian universities offer time-sharing services on a commercial basis. However, these were not surveyed since the commercial activity of these schools was considered secondary to their prime function in the educational process.

This report takes the following form:

QUESTIONNAIRE CONCERNING THE CANADIAN REMOTE DATA-PROCESSING INDUSTRY

DEPARTMENT OF COMMUNICATIONS

POLICY, PLANS AND PROGRAMS

JULY 2, 1970.

1. Please describe your system facilities, i.e. central hardware, user terminals, special communications equipment, etc. listing the manufacturer, type or model, number of units and—the main memory size for each location you may have. In this regard, the following format is suggested:

LOCATION NAME

	MANUFACTURER	TYPE OR MODEL	NO. OF UNITS	MAIN MEMORY SIZE (INDICATE WORDS' BYTES' ETC.)	LINE SPEED COMMONLY USED	NO. OF LINES PRESENT MAXIMUM
C.P.U. (s)						
TERMINALS						
COMMUNICATIONS INTERFACE (i.e. IBM 2703, G.E. DATANET)						

2. Of the equipment indicated above, what is the approximate dollar value that is owned, rather than leased or rented?

3. What operating system or executive software do you use on each of the major C.P.U.'s?

Please list the major application programs you offer.

Please list the computer languages that may be used by your clients.

4. Assuming that you use data communication facilities, please indicate the following:

Supplier of Line	Type of Datasets	# of Each (both ends)

5. In addition to your own hardware facilities, as indicated in question 1, do you rent time on computers not owned, rented or leased by you?

6. Do you concentrate your marketing activities in a particular industry or industries?

If you do service specialized industries, please list these below and indicate the number of clients you serve in each.

If you offer service in a diverse group of industries, please indicate the number of clients you serve in total.

7. Please indicate the rates and rate structure for your computer services. (If the billing algorithm is complex, please attach a description)

8. What other computer related services do you offer, i.e. consulting, education, manufacturing, software package development, etc.?

9. What is the organizational structure of your firm?

How many employees do you have in total, and in each division or department. In addition, any information which you could provide us about your key technical personnel, their backgrounds, and their position within the organizational structure would be appreciated.

10. Is your company publicly or privately owned?

What are the major sources you have used to date to finance your operations, i.e. public issue, internal financing from parent organization, small group or private investors, etc.?

If it is possible to provide this, please indicate approximately what percentage of your common stock is held outside Canada.

Please attach any public financial statements for 1968 and 1969, including any prospectus that may have been issued during this period.

11. Do you plan any further financing through public issue or private placement, either debt or equity, in the twelve months starting August 1, 1970?

What sources will you likely use if you are planning additional financing?

Do you anticipate difficulty in arranging for any such financing in Canada?

12. What is the name and nationality of each member of your Board of Directors?

13. Are there any other comments you would like to make on future plans, i.e. do you have reasonably firm plans which might substantially alter any of the above information (such as announced plans for new installations or services, substantial changes in staff, changes in ownership, etc.) during the current and upcoming fiscal years?

Section III

List of Addressees

ACS - Aquila Computer Services
635 Dorchester Street West
Montreal, Quebec

AGT Management System Ltd.
74 Victoria Street
Toronto, Ontario

Aphatext Systems Ltd.
233 Gilmour Street
Ottawa, Ontario

Argus Computer Applications Ltd.
P.O. Box 5008
Victoria, B.C.

Canadian General Electric
214 King Street West
Toronto, Ontario

Computer Sharing of Canada (Com-Share)
41 Voyager Court North
Rexdale 605, Ontario

Dataline Systems Ltd.
40 St. Clair Avenue West
Toronto, Ontario

Grayhound Computer of Canada Ltd.
65 Adelaide Street East
Toronto, Ontario

Multiple Access General Computer Corp. Ltd.
885 Don Mills Road
Don Mills, Ontario

Polycom Systems Ltd.
1300 Don Mills Road
Toronto, Ontario

Symbionics Systems Ltd.
550 Berry Street
Winnipeg, Manitoba

Setak Computer Services Corp. Ltd.
20 Spadina Road
Toronto, Ontario

I.P. Sharp Associates
T-Dominion Center
Bank Tower, Toronto, Ontario

Computech Consulting Can. Ltd.
1177 West Hastings Street
Vancouver, B.C.

Computel Systems Ltd.
1200 St. Laurent Blvd.
Ottawa 7, Ontario

Computer Sciences Canada
400 Laurier Avenue West
Ottawa, Ontario

Comtech Group Ltd.
48 Yonge Street, Suite 300
Toronto 1, Ontario

Datapro London Ltd.
1925 Dundas Street
London, Ontario

Dearborn Computer of Canada
280 Ferndale Place
Kitchener, Ontario

E.D.P. Associates
2256 West 12th Avenue
Vancouver, B.C.

I.B.M. Canada Ltd.
1150 Eglington Avenue East
Don Mills 402, Ontario

Systems Dimension Ltd.
770 Brookfield Road
Ottawa, Ontario

SECTION IV

List of Respondents

A.G.T. Management System Ltd.

Alphatext Systems Ltd.

Argus Computer Applications Ltd.

Canadian General Electric Ltd.

Computech Consulting Canada Ltd.

Computel Systems Ltd.

Computer Sciences Canada Ltd.

Computer-Sharing of Canada (Com-Share)

Comtech Group Ltd.

Dataline Systems Ltd.

Datapro Limited

EDP Industries Limited

I.B.M. Canada Limited

Multiple Access General Computer Corp.

Polycom Systems Ltd.

Setak Computer Services (data is not tabulated nor included)

I.P. Sharp Associates

Symbionics Systems Ltd.

Systems Dimensions Ltd.

Section V

Analysis of Results

A. Hardware Availability

This section presents the data obtained from survey questions 1, 3(a), 4, 8, 10, 12 and 13. To simplify the discussion, the hardware availability derived from the survey has been classified as small, medium and large according to the following table:

TABLE I (includes only that hardware operated by questionnaire respondents)

MANUFACTURER	HARDWARE SMALL	MEDIUM	LARGE
IBM	1460 360/20	360/40 360/50	360/65 360/67 360/85
Burroughs	B 500		B 5500
CDC			6500
Honeywell	200 125	1250	
GE	265	435	625
Univac	1005 II		1108
XDS		940	Sigma 7
DEC			PDP-10

Among those firms in the remote data processing industry who utilize central processing units of the "large" category, I.B.M. and Univac computers are the most popular choices. There are six large I.B.M. installations of which four are owned and marketed by I.B.M. itself for remote data processing services. In addition, there are four Univac 1108 computers in operation outside of the Univac firm itself; two X.D.S. Sigma Sevens; two Control Data 6500 units and one Digital Equipment P.D.P. 10 unit. Also there is a G.E. 625 in operation for remote services in Canada.

There are fewer medium size installations for remote processing service; the X.D.S. 940 and middle range I.B.M. units jointly provide the most service although there is one Honeywell middle range computer in operation.

Between them, I.B.M. and General Electric provide most small units in the marketplace. Although at the present time there are seven firms with small units and six possessing middle range equipment, the dominant trend seems to be leading towards the utilization of larger hardware. The fact that there are more small than middle-range units may be explained by the presence of several different sized units in five of our replying organizations as shown below:

	Small	Medium	Large
C.G.E.	X		X
Comshare		X	X
E.D.P.	X	X	
I.B.M.	X	X	X
S.D.L.	X		X

These figures indicate that four of the seven smaller units are balanced by the presence of medium and large units, thus substantiating the trend towards larger availability. It should be noted that all the foregoing firms show diverse marketing and large clienteles.

In all, the remote data processing industry employs a total of 39 computers of varying size; seventeen of these are owned or leased through I.B.M., five through Univac, five through Canadian General Electric and four through Honeywell. Other computers present in the remote data processing industry are manufactured by such firms as X.D.S., Digital Equipment of Canada, Control Data Corp., and Burroughs.

With the exception of S.D.L., Comshare, Symbionics and Computel, all firms offer extensive systems consulting services. Firms such as I.B.M., E.D.P. and C.G.E., also offer extensive computer related services such as education.

Without exception those firms using equipment manufactured by I.B.M., Univac, General Electric, Digital Equipment and Control Data, also utilize the manufacturer's communications interface equipment. Examples are the I.B.M. 2701 and 2703; the G.E. Datanet; the P.D.P. 680/I; the X.D.S. 7611; the C.D.C. 6600 Cybernet and the Univac CTMC. In addition, the Tymshare Canada division of E.D.P. Industries will manufacture communication interface equipment for its remote data processing cleints.

Terminal equipment shows much greater diversity than does communications interface equipment. For instance, a company such as Comshare who uses the X.D.S. Sigma 7 computer utilizes Teletype, Datapoint, Synerdata and X.D.S. terminal equipment. Similarly, Polycom who use a General Electric 435 computer also utilize a range of terminals from such manufacturers as Friden, Olivetti, Synerdata, Datapoint and General Electric. Symbionics whose central processor is the CDC 6500 use both I.B.M. and C.D.C. terminals.

As can be seen from the fact sheets in Appendix A only five companies from the list of respondents were willing to disclose plans for the upcoming months and even that information is, at best, general in nature. E.D.P. Industries have plans to expand the product lines of their Information Services Group (ISG) involving such activities as data center, data entry, and systems and consulting. Furthermore, as mentioned below under Services and Marketing, E.D.P. will increase its multi-national posture as well as adding new divisions under ISG through acquisition and/or joint ventures into sub-markets of the computer industry. Also, Tymshare Canada Limited, division of E.D.P. Industries (TCL), is now expanding its remote data processing service into a full North American network and will manufacture certain components such as terminal equipment. They have recently opened a Toronto office for T.C.L.

S.D.L. Ottawa, will update its large IBM 360/85 with components of the new 370 line, expand marketing activities in the U.S. and Europe as well as increasing its staff. S.D.L. does not expect that it will need additional financial support for these activities.

Argus Computer Applications, Victoria, B.C. plans to grow in the time-sharing market. However, no mention was made as to whether the firm would diversify its marketing, now confined to engineering and forestry applications.

Alphatext Systems, Ottawa, plans acquisition of the remaining 50 percent of a subsidiary jointly held with a U.S. organization and further liaison with Alphatext Textran, the American firm which originated the photocomposition process used by Alphatext. This association will give Alphatext more exposure to the software innovation and product developments of the American firm.

Because of the success which Datapro Systems, London, Ontario, achieved with their Detroit office they plan more rapid growth in the American market.

B. Services and Marketing

This section of the report analyses survey questions 3(a), 3(c), and 6(a), (b), and (c). It is felt that application services are particularly related to the marketing strategies of the individual firm and to the number of clients served by that organization. Languages offered to the client are also related in the sense that languages are usually related to the nature of the problem which the program is designed to solve. For example, Fortran IV is particularly suitable for advanced business and scientific applications such as operations research.

Of the 16 respondents, only three are what can be termed as specialized in their marketing approach; A.G.T. which is not directly involved in remote data processing, Alphatext of Ottawa, and Argus Applications, Victoria, B.C.

Comshare is an example of a firm which provides a diverse offering of service applications in an attempt to gain a foothold in the Toronto market. E.D.P. Industries, located in Vancouver, have just recently opened an office in Toronto through their Tymshare Division (T.C.L.), and plan to market engineering and scientific applications; their Information Services Group, located in Vancouver, services 300 clients and the two divisions, T.C.L. and I.S.G. will service a diverse clientele.

I.B.M., Computel, C.G.E. and Computer Sciences Canada are examples of diverse marketing firms offering application services in the most lucrative service areas of business and scientific applications. I.B.M. is unique in the sense that its Remote Job Entry and Remote Job Submission Programs provide high speed terminal access to Datacenter computers in Calgary, Toronto and Montreal from every IBM Datacenter in Canada. In other words, a client may, through his terminal, gain access to the regional Datacenter he utilizes and from there to Calgary, Toronto, and Montreal. Following the lead of I.B.M. however, E.D.P. Industries, TCL Division also have plans to form a full North American Network for remote data processing services. As noted in Section I (F), E.D.P. plans will result in substantial marketing activities in the United States. Presently, E.D.P. has offices in San Francisco and Detroit for systems and consulting services.

TABLE II

Data Returns: 3(b), 3(c), and 6(a), (b) and (c)

Firm	Application Services	Languages Used	Marketing (Including Number of Clients)
A.G.T.	Mutual Fund Accounting Brokerage Accounting Payroll Educational Institution Accounting	Cobol Fortran Other	Specialized: Mutual Funds (12) Brokers (1) Educational Institutions (13) (Total Clientele - 80)
Alphatext	Remote Text Entry & Revision Computerized Typesetting & Photocomposition	Assembler Fortran R.P.G. PL/1	Specialized Marketing (Clientele is Confidential)

TABLE II (Cont' d ..)

Firm	Application Services	Languages Used	Marketing (Including Number of Clients)
Canadian General Electric	Not Supplied	Cobol Fortran Basic Algol	Diverse Marketing (No. of Clients is Confidential)
Computech	Not Applicable (as explained above)	Not Applic-able	Software (10-20) Processing (2)
Computel	IBM 360/65 MPS, IMS, ICES, PCA Univac 1108 PERT-Time Cost MATH-PAC STAT-PAC ECAP-CIRCUS PCA	IBM 360/65 Fortran IV Cobol PL 2 Algol GPSS Univac 1108 Fortran V Cobol Algol GPSS Simscript 1.5	Diverse Marketing (Total Clientele-200)
Computer Sciences Canada	All Major Scien-tific & Commercial Software	Fortran Cobol Algol Basic	Diverse Marketing (Total Clientele is Confidential)
Comshare	Diverse Application are Available: PERT-Critical Path Accounting Control Text Editing On-Line Simulation Engineering Appl. Electronic Circuit Analysis Computer Assisted Education	All Languages Specially Adapted to Appl. Programs Fortran Basic Assembler QED, Edit Snobol Cobol	Diverse Marketing (60 Clients)

TABLE II (cont'd .)

Firm	Application Services	Languages Used	Marketing (Including Number of Clients)
Dataline	ECAP STRESS CPM COGO Flat Plate Analysis/ Design Steel Columns Concrete Columns Bourse, Symap	Fortran IV -Interactive Fortran Cobol Basic Lisp 1.6 Aid Snobol 4	Diverse Marketing (No. of Clients is Confidential)
E.D.P.	I.S.G.-Business Applications T.C.L.-Engineering & Scientific Appl.	I.S.G. Fortran Cobol Easycoder BAL T.C.L. Super Basic Super Fortran	I.S.G.-Diverse Marketing (300 Clients) T.C.L. -Newly Formed Division (Clientele Undertermined)
I.B.M.	CALL/360 Interactive:Engineering; Mathematical, Mngt. Science Bus. Accounting DATATEXT-Text Processing Through Commands at Terminal CMS/360 Interactive-Program Develop. & Special Appl. ON-LINE SAVINGS Key-Driven Terminals at Tellers Desk-Automatic Up-Dating of Pass-books Remote Job Entry Remote Job Sub. Cross Country Net.	Basic Fortran H PL/1 Datatext Fortran G Cobol F PL/IF Assembler Cobol E, F PL/IF Assember F; Fortran G,H; Watfor, RPG	Marketing is Diverse Strategy-Marketing Specialized by Industry (Total Clientele is Confidential)

TABLE II (Cont'd ..)

Firm	Application Services	Languages Used	Marketing (Including Number of Clients)
Polycom	Math & Statistics Regression Linear Programming Critical Path Engineering Graphic Bus. & Fin. Stock Analysis Educational	Fortran IV (ASC 77) Dartmouth Basic (Extended)	Diverse Marketing (Total Clientele - 150)
I.P. Sharp	Stock Exchange Analysis Accounting Statistics Actuarial Package Small Machine Simulators C.A.I.	A.P.L.	Diverse Marketing (Total Clientele - 130)
Symbionics	Hospital Info Sys Wide Range of Commercial Programs (Payroll, Receivables Inventory, etc.) Linear Programming Credit Union Processing Engineering Appls, Civil Electrical Structural	Fortran Cobol Algol Simscript Basic Solis (Symbionics Proprietary Language)	Diverse Marketing (Total Clientele - 150)
S.D.L.	Biomedical Business Engineering	Cobol Fortran PL 1 Assembler Algol RPG GIS Margen Simscript I Simscript II	Diverse (Total Clientele - 109 Each Govt Dept. Counts as one Client)

C. Rate Structure:

Because of the diversity inherent in rate charges for remote data processing services and because charges for these services depend upon terminal type, location, and the type of service and may be on a monthly, hourly or per unit basis, it was found impossible to standardize and present these rates in tabular form. For these reasons they are not included in the body of the report but rather appear by respondent in Appendix B.

D. Hardware Ownership:

Because this section deals with the monetary values of computer installations in Canada, much of the data obtained is classified. However, from the replies received it is possible to determine which companies own or lease computer hardware and also whether companies rent time on computers not owned, rented or leased by them thereby permitting an indication of excessive demand upon existing facilities and showing growth potential within the industry.

TABLE III

Firm	Own (Value If Available)	Lease	Rent (When Necessary)
A.G.T.	None	No	Yes
Alphatext	Yes	No	No
Argus	None	Yes	Yes
C.G.E.	Yes	No	Yes
Computech	None	None	Yes

TABLE III (Cont'd)

Firm	Own (Value If Available	Lease	Rent (When Necessary)
Computel	Yes($9.4M)	No	No
Computer Sciences	None	Yes	No
Com-Share	Yes($100,000)	Yes	Yes
Dataline	Yes($1.8M)	No	No
Datapro Ltd.	Yes($400,000)	No	No
EDP Industries	None	Yes	Rarely
IBM	Yes	No	No
Polycom	None	Yes	No
I.P. Sharp	None	Yes	No
Symbionics	Yes($3M)	No	No
SDL	Yes($11.2M)	Yes	No

According to a recent census by the Canadian Information Processing Society, the Canadian computer market grew by one-third in the year ending May 1, 1970. The Society found 2700 computers installed in Canada, 663 more than the previous year. These figures do not represent, however, growth in the remote data processing sub-market itself although they may be indicative of growth on a percentage basis. Using these figures as a basis and the figures posed in Part (a), we conclude that I.B.M. is responsible for approximately 46 percent of the total number of installed computers and that their percentage of the total dollar value fell from 70.8 percent to 66.9 percent during 1970.

Digital Equipment of Canada has made the largest gains during 1970 increasing its market share from 9.5 percent to 13.1 percent though it lags in rental value. Burroughs Business Machines Limited stands third in line, Honeywell and General Electric place fourth and fifth.

These figures do not however agree with those derived in this survey where I.B.M., Univac and Digital Equipment were, in that order, the largest suppliers to the remote data processing industry.

E. Organizational Structure

One of the most important questions and yet probably the most difficult to discuss and summarize is that dealing with organization structure and key personnel. The following table indicates, where data is not confidential, the number of employees presently engaged by each organization.

TABLE IV

Firm	Number of Employees
A.G.T.	259
Alphatex	51
Argus	5 full time; 5 part time
C.G.E.	20,000 total; Number of employees in remote processing-not available.
Computech	17
Computel	Not available
Computer Sciences	Not available
Comshare	Not available
Dataline	40
Datapro	67
EDP Industries	300
I.B.M.	9,300 (4,100 in Toronto)
Polycom	Not available
I.P. Sharp	60
Symbionics	88
S.D.L.	101

With the exception of the smaller firms who specialize basically in single marketing activities, most firms organize according to sub-markets of the computer industry. For instance, Computel is organized into separate branches with each branch having both an operational and marketing division.

In addition, Computel has a Research and Development Branch to carry out development in software, applications and technical consulting. Similarly, C.G.E. is a diverse organization functionally delineated along product lines. A smaller firm, Dataline, is organized into divisions along the following lines; marketing, operations, programming, support and administration. Because of the relatively small size of these firms, they would face less communication difficulty than would a firm such as C.G.E. Thus marketing, programming and operations can be usefully separated rather than combined as in Computel. EDP Industries is a further example of an organization designed for the marketing function. The Information Systems Group and Tymshare Canada Ltd. aim at specific sub-markets.

This approach to marketing and organizational structure seems to be the predominant approach among most firms. It is simply organizing to meet the needs of the marketplace. As Part F of this Section will show corporate expansion plans indeed reflect sensitivities of the market.

F. Corporate Expansion Plans

This section discusses the results from survey question eleven indicating those firms anticipating financial needs in the year August 1, 1970 - July 31, 1971. Again, because of the confidential nature of this material, some firms have requested that their plans remain disclosed. Table V, though, represents the results within the limitations of the above constraint.

TABLE V

Firm	Financing 1970-71	Source
A.G.T.	Yes	Private Placement
Alphatext	Yes	Private Equity Placement
Argus	Probably	Private Investors
C.G.E.	No	Not Applicable
Computech	Probably No	Debt Or Equity
Computel	No	Not Applicable
Computer Sciences	No Comment	No Comment
Comshare	No	Not Applicable
Data Line	No Comment	No Comment
Data Pro	No	Not Applicable
E.D.P.	No	Not Applicable
I.B.M.	As Required	Institutional Investors or Public Issue
Polycom	Yes	Private Investors
I.P. Sharp	No	Not Applicable
Symbionics	No Comment	No Comment
S.O.L.	No	Not Applicable

From the replies, it can be seen that four companies are definitely anticipating financial requirements in 1971; A.G.T. Alphatext, Argus and Polycom Systems. Of these firms Argus Applications, a small, specialized and private firm, anticipates little difficulty in locating financial sources, whereas Alphatext, also private, states they have always had difficulty in locating financial sources. Attractive market conditions and the possibility of favourable sales may play a role since Argus is functionally specialized towards forestry and engineering in Victoria, B.C. where the need could be high and competition minimal. Alphatext, on the other hand, lies in the more competitive market of Ottawa and must contend with diverse marketing firms offering similar services. However, both A.G.T. and Polycom are public companies who feel they will face little difficulty in locating financial sources. It should be noted that Polycom is a closely held public company whose financial sources could be generated from within.

Both Computech and E.D.P. Industries, the former private and the latter public, find difficulty in obtaining financial support. They believe, significantly, that it is the nature of the industry itself and the low risk posture of the Canadian Investor which hinder efforts in locating financial sources. These thoughts are not uncommon in Canadian financial markets.

Investment success may depend upon the nature of the individual firm, its market, the size of the firm as well as the industry itself and the risk posture of Canadians. The more specialized market-oriented firm such as Argus & Datapro experience little difficulty whereas the larger public firms in diverse markets face more difficulty such as that experienced by E.D.P. More discussion of this matter will be found in Section V: The State of the Industry.

Section VI

The State of the Remote Data Processing Industry

On the basis of the information presented in the preceeding sections, a summary picture of the industry can be drawn:

The remote data processing industry, involving interactive time-sharing and remote batch processing, has evolved rapidly since 1968 with the advent of numerous small and medium sized independent companies. In addition, new companies were created to sell the specialized application services associated with remote processing. However, through the latter part of 1969 and continuing in 1970, the industry experienced a period of re-adjustment brought about by an over-optimistic assessment of the potential for market growth and by the general economic slowdown. Because of these conditions, the replies from the questionnaire reflect present financial and market conditions of industry members and must be considered in any analysis of the structure of the industry.

A major trend seems to be the growing proliferation of diverse marketing organizations in the remote data processing sector of the industry. They are considered diverse in marketing because of the wide number of applications they offer to their clients. This trend is particularly evident in Ontario which, until 1970, showed the fastest rate of growth in computer hardware installation. Because of this trend to diverse marketing, a number of the smaller firms have faced apparent financial difficulties and indeed several have been purchased by U.S. owned corporations (i.e. Aquila Computing Services and Central Data

Processors). In the past, smaller firms who have specialized in filling a particular sub-market need have enjoyed some measure of success. However, since the growth of the more diverse firm now seems to be the dominant factor, this specialization may well become a constraint. In other words, the firm offering more services is apt to get the business. Further, because of the previously mentioned financial conditions, it would be increasingly difficult for the smaller firm to enter and compete with these diverse marketing organizations.

It is difficult to conclude that this industry as a whole has faced serious difficulty in securing funds. From the survey results, a mixed picture emerges. The wholly owned subsidiaries of foreign corporations are diverse and large enough to generate funds from within or from their parent organizations while the independent Canadian firms encounter a different kind of problem. One of the most frequent comments was that the industry faced difficulty securing funds because of the nature of the industry and market itself and because of the low risk posture of Canadian investors. The most significant variable could well be the closeness of the organization, public or private, to the investment community and its access to institutional investors. The fact that institutional investors may have more control over financial markets than in most other countries may, through market behaviour, influence the unavailability of speculative funds from individual investors. This is the classic problem of thin markets where institutional investors are able to control the "ups and downs". Relative to the United States, there is a lack of venture capital in Canada to supply needed liquidity to some of the higher risk equity issues common to the independent remote data processing industry.

Concurrent with the trend towards diverse marketing applications is the trend towards the "big computer" necessary to provide simultaneous access from many remote terminals. Circumstances surrounding current financial market performance compound the difficulties, already spoken of, for independent organizations entering a market showing the above trend.

Because of the relative scarcity of investment money and the trend to "bigness" it is likely that rationalization will occur in the industry in the foreseeable future. The capital intensive nature of the industry, the extensive capital resources required to underwrite research and development and to market the resultant products, and the lack of venture capital places a premium on corporate size. In addition, the development of new applications is dependent upon the acquisition of new hardware systems, and major operating systems, as they become larger and more generalized, will require larger and larger amounts of capital for their development. Therefore, the pattern of market growth could be one of rationalization into a relatively small number of large firms, each able to provide customers with a multiplicity of products and services by means of a nation-wide network of data centers.

As mentioned above, the small specialized firm will face immense difficulty in an industry showing these trends. The lack of venture capital will force future development to the large corporation. This fear was expressed by many of the respondents and seems to be a realistic appraisal of the current remote data processing industry situation.

RESPONDENT FACT SHEETS

NAME: A.G.T. SYSTEMS LTD.

ADDRESS: 74 Victoria St.
Toronto 210, Ont.
Canada.

SERVICES OFFERED: Consulting - Remote Data Processing
Education
Manufacturing
Software Package Development
Marketing Responsibilities for some U.S. and Canadian Firms

LOCATION AND SIZE OF COMPUTERS:

a) Manufacturer - Type or Model: Not applicable

No. of Units

Main Memory Size

Operating System

b) Terminals — Line Speed Used

N/A

c) Communications Interface: N/A

d) Data Communications Facilities: N/A

Plans: No Comment

BOARD OF DIRECTORS:

H.S. Gellman - Canadian
H. Lerchs - Canadian
D.R. McCamus - Canadian
G.H. Montague - Canadian
L.W. Shick - Canadian
G.A. Wanless - Canadian
F.T. White - Canadian

CAPITALIZATION:

Long-term debt $4,000
2,000,000 common shares authorized with no par value
1,118,520 issued with a value of 2,780,168

Ownership - very small percentage of common stock held outside Canada

AFFILIATION: None

NAME: ALPHATEXT SYSTEMS LTD.

ADDRESS: 233 Gilmour St.
Ottawa, Ont.
Canada

SERVICES OFFERED: Remote Data Processing
Consulting
Specialized Software Package Development

LOCATION AND SIZE OF COMPUTERS: Ottawa

a) Manufacturer - Type or Model: I.B.M. 2040

No. of Units: 1

Main Memory Size: 128,000 Bytes

Operating System: I.B.M. Disk Operating System

b)

Terminals:	Type	No. of Units	Line Speed Used
I.B.M.	2741	50	135 baud
U.C.C.	DATEL 30	10	135 baud

c)

Communications Interface	No. of Units	No. of Lines
I.B.M. 2703	1	176

d)

Data Communications Facilities	Type	No. of Each (both ends)
Bell Canada	103A	80

Plans:

Purchase Remaining 50% of a 50% held subsidiary investment. Closer relationship with original developers of Alphatext Photocomp. for software development and innovation.

BOARD OF DIRECTORS:

M. Aronovitch - Canadian
J. Bobak - Canadian
G.A. McInnes - Canadian
A. deLobe Panet - Canadian
G. Perley-Robertson - Canadian
S. Sokoloff - Canadian
E. Goodwin - Canadian

CAPITALIZATION:

Privately Owned and Financed
Private Equity Placement

Ownership - 100 percent held in Canada

AFFILIATION: None

NAME: ARGUS COMPUTER APPLICATIONS LTD.

ADDRESS: 222 - 727 Johnson St.
P.O. Box 5008
Victoria, B.C.
Canada

SERVICES OFFERED: Remote Data Processing
Consulting
Software Package
Systems Design
Feasibility Studies
Programming

LOCATION AND SIZE OF COMPUTERS: Victoria, B.C.

a) Manufacturer - Type or Model: Univac 1005 III

No. of Units: 1

Main Memory Size: 4K Characters

Operating System: Univac Exec II and Exec VIII

b)

Terminals	Model	Line Speed Used
		4800 HZ (not yet installed)

c) Communications Interface: Not yet installed

d)

Data Communications Facilities	Type	# of Each (both ends)
TCTS	301A	2

Plans: Time sharing being planned

BOARD OF DIRECTORS:

D.H. Peacock - Canadian
J.A. Carmichael - Canadian
T.J. Halbert - Canadian

CAPITALIZATION:

Private company - private finance sources

Ownership - 100% Canadian held

AFFILIATION: None

NAME: CANADIAN GENERAL ELECTRIC CO. LTD.

ADDRESS: 214 King St. W.
Toronto 129, Ont.
Canada.

SERVICES OFFERED: Remote Data Processing
Systems Consulting
Systems Design
Program Development
Batch Processing
Computer Education

LOCATION AND SIZE OF COMPUTERS: Toronto

a) Manufacturer - Type or Model:	G.E.-265	G.E.-625
No. of Units:	3	1
Main Memory Size:	16K Words	128K Words
Operating System:	G.E. MARK 1 EXEC	G.E. GECOS III EXEC

b) Terminals	Model	Line Speed Used
General Electric	TN-300	
General Electric	GE-115	110 baud
Teletype Corp.	ASR-33	
Teletype Corp.	ASR-55	

c) Communications Interface		No. of Lines
General Electric - DN-30	GE-265	240
	GE-625	40

d) Data Communications Facilities : Confidential

Plans: Confidential

BOARD OF DIRECTORS:

J.A. Beland	- Canadian	R.H. Jones	- American
W.R.C. Blundell	- Canadian	W.F. McLean	- Canadian
R.V. Corning	- American	M. McMurray	- Canadian
P. Desruisseax Q.C.	- Canadian	M.C.G. Meishen	- Canadian
O.L. Dunn	- American	H.B. Miller	- American
H.W. Gouldthorpe	- American	J.H. Smith	- Canadian
H.M. Griffith	- Canadian	W.G. Ward	- Canadian
W.C. Harris	- Canadian		

Capitalization:

Publicly Owned
Financing generated internally

Ownership - 95% held outside Canada

AFFILIATION: General Electric U.S.

NAME: COMPUTECH CONSULTING CANADA LTD.

ADDRESS: 1404-1177 West Hastings St.
Vancouver 1, B.C.
Canada

SERVICES OFFERED: Consulting
Systems Analysis, Design, Programming
Temporary and Permanent Installation Management
Education
(No Direct Remote Service, although Consult on this)

LOCATION AND SIZE OF COMPUTERS: Not Applicable

a) Manufacturer - Type or Model

No. of Units:

Main Memory Size:

Operating System:

b) Terminals Line Speed Used

c) Communications Interface:

d) Data Communications Facilities

Plans: No Comment

BOARD OF DIRECTORS:

J.A. Speight	- Canadian	G.R. Long	- Canadian
W.E.S. Tennant	- Canadian	G.R. Gisel	- Canadian
R.I. Field	- Canadian	I.V. Reid	- Canadian

CAPITALIZATION:

Private - Financing by Cash Flow

Ownership - 100 per cent Canadian held

AFFILIATION: None

NAME: COMPUTEL SYSTEMS LTD.

ADDRESS: 1200 St. Laurent Blvd.
Ottawa 7, Ont.
Canada.

SERVICES OFFERED: Remote Data Processing
Limited Consulting
Education
Software Package Development

LOCATION AND SIZE OF COMPUTERS:

	OTTAWA		TORONTO
a) Manufacturer - Type or Model:	IBM 360/65	UNIVAC 1108	UNIVAC 1108
No. of Units	1	1	1
Main Memory Size	512K Bytes	64K Words (36 bit)	131K Words (36 bit)
Operating System	MFT II + HASP 2.3 MVT + HASP 2.0	EXEC II EXEC VIII	EXEC II EXEC VIII

b) Terminals	No. of Units	Line Speed Used
IBM 1130	14	
MOD 20	1	4800 baud
UNIVAC 9200	3	
9300	3	
1004	3	

c) Communications Interface	Type	No. of Lines	No. of Units
IBM	2701	2	3
UNIVAC	CTS		6
NOVA		6	4

d) Data Communications Facilities	Type	# of Each (both ends)
Bell	Rixon 48-C	20
	201B	9
CN-CP	Rixon 48-C	27

Plans: No comment

BOARD OF DIRECTORS:

R.T. Horwood - Canadian	R.N. Steiner - Canadian
F.B. Brooks-Hill - Canadian	A.M. Wyszkowski - Canadian
G.R. Cogar - American	R.T. Lane - Canadian
C.G. Fleming - Canadian	R.C. Heilig - Canadian
C.E. O'Connor - Canadian	

CAPITALIZATION:

Financing through public issue and private placement
1,000,000 common shares without par value authorized
581,142 issued at a total value of 4,229,997
Total long term debt - 5,964,000

Ownership - 10-15 per cent is held outside Canada.

AFFILIATION: None

NAME: COMPUTER SCIENCES CANADA, LTD.

ADDRESS: 1470 Don Mills Rd.
Don Mills, Ontario
Canada

SERVICES OFFERED: Remote Data Processing
Consulting
Systems Development
Education
Software Package Sales Basic, DRJE, RJE

LOCATION AND SIZE OF COMPUTERS: Calgary and Toronto

a) Manufacturer - Type or Model: UNIVAC 1108

No. of Units: 2

Main Memory Size: Calgary - 131K Words
Toronto - 196K Words

Operating System: Calgary - EXEC. II
Toronto - CSCX

b) Terminals — Line Speed Used

Confidential

c) Communications Interface — Type

Communications Interface	Type
Calgary - UNIVAC	CTMC/CTM
Toronto - UNIVAC	CTML/CTM

d) Data Communications Facilities: Confidential

Plans: No Comment

BOARD OF DIRECTORS: Confidential

CAPITALIZATION:

Private Company
Financed Internally

Ownership - 49% held in U.S. (C.S.C.)

AFFILIATION: 51 per cent CN-CP
Computer Sciences, U.S.
CN/CP Telecommunications

NAME: COMSHARE (CANADA) LIMITED

ADDRESS: 41 Voyager Court North
Rexdale 605, Ont.

SERVICES OFFERED: Remote Data Processing Service Applications

LOCATION AND SIZE OF COMPUTERS: Toronto, Ont.

a) Manufacturer - Type or Model: XDS SIGMA 7

No. of Units: 1

Main Memory Size: 320K Bytes

Operating System: COMSHARE MODIFIED XDS BTM

b)

Terminals	Model	Line Speed Used
TELETYPE	33,35	110 baud or 300 baud
DATAPOINT	3300	110 baud or 300 baud
SYNERDATA	BETA	110 baud or 300 baud
XDS	7670	2400 baud

c)

Communications Interface	No. of Lines Present	Maximum
XDS - 7611	64	

d)

Data Communications Facilities	Type	No. of Each (both ends)
Bell	103A2	50
	201B	10

Plans: Not Available

BOARD OF DIRECTORS:

A.D. Waren - Canadian	R.F. Guise, Jr. - American	E.V. Hibberd - Canadian
L. Sacks - American	R. Crandall - American	W.S. Dyke - Canadian
J.G. Debanne - Canadian	R.S. Willoushby - Canadian	R.E. Hatch - Canadian
	G. Lewis - Canadian	B. Bracewell - Canadian

CAPITALIZATION:

Privately Owned - Not Available

Ownership - 30 per cent held outside of Canada

AFFILIATION: Computer Sharing Corp., U.S.A.

NAME: DATALINE SYSTEMS LIMITED

ADDRESS: 40 St. Clair Ave. W.
Toronto, Ontario
Canada

SERVICES OFFERED: Remote Data Processing
Consulting
Programming
Education
Dedicated System
Turnkey Management

LOCATION AND SIZE OF COMPUTERS: Toronto

a) Manufacturer - Type or Model: Digital Equipment of Canada Ltd.
PDP 10 Model 50

No. of Units: 1

Main Memory Size: 128K Words, 640K Bytes

Operating System: DSL Swapping Monitor Level 50

b)

Terminals	Type	Line Speed Used
Teletype	33, 35, 37	110 baud
Syner Data	BETA	300 baud
Texas Instrument	TI-200	110"300 baud
I.B.M.	2741	134.8 baud

c)

Communications Interface:	Type	# of Lines
Digital Equipment	680/I	127

d)

Data Communications Facilities	Type
Bell Canada	103F
CN/CP	201
	Data-Telex

Plans: None

BOARD OF DIRECTORS:

J.F. Galipeau - Canadian
J.C. Paraoi - Canadian
E.S. Lee - Canadian
J.A. Wright - Canadian
G.S. Dembroski - Canadian

CAPITALIZATION:

1,000,000 authorized common stock without par value
400,000 issued with a value of 2,722,480

Ownership - 100 percent held in Canada

AFFILIATION: None

NAME: DATAPRO LIMITED

ADDRESS: Corporate House
376 Richmond St.
London, Ont.
Canada

SERVICES OFFERED: Off-Line Data Processing
Keypunching
Keyverifying
Customized Programming
Consulting

LOCATION AND SIZE OF COMPUTERS: London, Ont.

a) Manufacturer - Type or Model: Burroughs B500

No. of Units: 1

Main Memory Size: 19.2K Characters

Operating System: M.C.P. II Rev. 4

b)

Terminals	No. of Units	Line Speed Used
N.C.R. Encoder	2	2000 bits per second

c) Communications Interface: No Comment

d)

Data Communications Facilities	Type	No. of Each (both ends)
Bell Canada	201A	

Plans:

Further expansion into U.S. due to success of Detroit office.

BOARD OF DIRECTORS

N.C. More - British
B.J. Bentley - British
F.G. Berlet - British
A. More - British
C. Demeyere, Jr. - British
E. Demeyere - British
G. Demeyere - British

CAPITALIZATION:

1,000,000 common shares authorized without par value
450,006 issued at a value of 781,000

Ownership - Less than 1 percent held outside Canada

AFFILIATION: None

NAME: EDP INDUSTRIES LIMITED

ADDRESS: 401 - 1111 West Hastings St.
Vancouver 1, B.C.
Canada

SERVICES OFFERED:

Information Systems Group (ISG) - Data Center Services including Accounting Service
Systems and Consulting
Data Entry - All collection and entry services
Tymshare Canada Limited (TCL) - Interaction Timesharing
Dimension Personnel - personnel selection and placement
Pacific Leasing Corp. - 3rd party leasing

LOCATION AND SIZE OF COMPUTERS: Vancouver

	ISG			TCL	
a) Manufacturer - Type or Model:	Honeywell 200	125	1250	XDS 940	SIGMA 7
No. of Units:	2	1	1	varies by month	
Main Memory Size:	32K	32K	49K	varying	

Operating System:

ISG - MOD I and MOD I Extended
TCL - Execution Software developed by Tymshare

b) Terminals	Type	Line Speed Used
TCL Teletype	ASR 33 35	Not yet installed

c) Communications Interface:

TCL - Self Manufactured

d) Data Communications Facilities:

TCL - Bell Canada - Not yet installed

Plans:

Expand ISG product lines - Data Center, Data Entry & Consulting
Increase Multi-National Posture
Expand Divisional Entries of ISG - Acquisitions & Joint Ventures

BOARD OF DIRECTORS:

W.R. Wood - Canadian
A.M. Eyre - Canadian
B.J. Kaganov - American
D. Fulton - Canadian
D.H. McVeigh - American (in Canada since 1952)
I.M. Wolfe - American (in Canada since 1965)

CAPITALIZATION:

Public company
Long-term debt - 1,589,000
Preferred shares - 100,000 5% cumulative at $25 par - issued 2,323,000
Common shares - 1,000,000 authorized - no par value - issued 1,753,000

Ownership - less than 1 percent held outside Canada

AFFILIATION: None

NAME: I.B.M. CANADA LTD.

ADDRESS: 1150 Eglington Ave. E.
Don Mills 402, Ont.
Canada

SERVICES OFFERED: Remote Data Processing
Manufacturing of Data Processing and Office Products
Maintenance of Products
Systems Consulting
Custom Contract Services
Program Products
Education

LOCATION AND SIZE OF COMPUTERS: Calgary, Montreal, Toronto, Ottawa

a) Manufacturer - Type or Model: Confidential

No. of Units:

Main Memory Size:

Operating Systems:

b) Terminals: Confidential Line Speed Used

c) Communications Interface: Confidential

d) Data Communications Facilities: Confidential

Plans: Not Available

BOARD OF DIRECTORS

T.J. Bata - Canadian	G.E. Hall - Canadian	R.H. Thomas - Canadian
H. Borden - Canadian	G.E. Jones - American	T.J. Watson - American
J.E. Brent - Canadian	A.T. Lambert - Canadian	S.M. Wedd - Canadian
M. Faribault - Canadian	L.K. Lodge - Canadian	(Honorary Director)
	W.V. Moore - Canadian	

CAPITALIZATION:

Wholly Owned Subsidiary of I.B.M. World Trade Corp.
Private Financing - Canadian Banks and Insurance Companies

Ownership - 100 per cent held outside Canada

AFFILIATION: I.B.M. World Trade Corp.

NAME: I.P. SHARP ASSOCIATES

ADDRESS: Toronto-Dominion Center
Toronto 1, Ontario
Canada.

SERVICES OFFERED: Consulting
Education
Hardware Design and Manufacture
Proprietary Software

LOCATION AND SIZE OF COMPUTERS: Toronto

a) Manufacturer - Type or Model: I.B.M. 360/50

No. of Units: 1

Main Memory Size: 384 K

Operating System: D.O.S. Modified

b)

Terminals	Type	Line Speed Used
I.B.M.	2703 1050	134.5
Datel		
Dura		

c)

Communications Interface	No. of Lines
I.B.M. 2703	88

d)

Data Communications Facilities	Type	No. of Each (both ends)
Bell Canada	103A2	176
AT & T	TC1000 Multiplexor	1 per 28 lines

Plans:

No comment.

BOARD OF DIRECTORS:

I.P. Sharp - British
R.D. Moore - American
R. Murray - Canadian
D. Smith - Canadian
E.A. McDorman - Canadian

CAPITALIZATION

Private company - financed out of profits and small group of institutional investors

Ownership - 100 per cent in Canada

AFFILIATION: None

NAME: POLYCOM SYSTEMS LIMITED

ADDRESS: 1300 Don Mills Rd.
Toronto, Canada

SERVICES OFFERED: All Services Except Manufacturing

LOCATION AND SIZE OF COMPUTERS: Toronto, Ont.

a) Manufacturer - Type or Model: General Electric 435

No. of Units: 1

Main Memory Size: 64K Words

Operating System: MODIFIED SOFTWARE G.E. 400 SERIES, TIME-SHARING

b)

Terminals	Model	Line Speed Used
TELETYPE		
FRIEDEN		110 baud
G.E.	ASC	
OLIVETT		
SYNERDATA		
DATAPOINT	3300	

c)

Communications Interface	No. of Lines Present	No. of Lines Maximum
G.E. DATANET 30	30	60

d)

Data Communications Facilities	Type	# of Each (both ends)
Bell Canada	103A	150

Plans: Not Available

BOARD OF DIRECTORS:

D.C. Webster - Canadian	R.L. Shirriff - Canadian
J.P. Humfrey - Canadian	M.J. McCabe - Canadian
F.B. Rich - Canadian	G.J. Risby - British

CAPITALIZATION:

Invested Capital Raised Privately - Closely Held Public Company

Ownership - 98.6 percent of Common Stock is held in Canada

AFFILIATION: None

NAME: SYMBIONICS SYSTEMS LIMITED

ADDRESS: 550 Berry St.
Winnipeg 21, Manitoba
Canada.

SERVICES OFFERED: Remote Data Processing
Programming
Facilities Management

LOCATION AND SIZE OF COMPUTERS: Winnipeg

a) Manufacturer - Type or Model: Control Data 6500

No. of Units: 1

Main Memory Size: 65K Words

Operating System: CDC Scope

b)

Terminals	Line Speed Used
Control Data 200 UT	2000 baud
I.B.M. 1130	-

c) Communications Interface

CDC Cybernet 6600

d)

Data Communications Facilities	Type	# of Each (both ends)
Western Electric - Sangamo	201A	8
Western Electric	103A	5

Plans: No comment

BOARD OF DIRECTORS:

M.C. Holden - Canadian
B.A. Hodson - Canadian
D.R. Sprague - American
E.E. Erhart - Canadian
J.C. McKinnon - Canadian
R. Friend - Canadian
D. Steele - Canadian

CAPITALIZATION:

Public Company
D.E. Ratio not available through questionnaire

Ownership - 2 per cent held outside Canada

AFFILIATION: None

NAME: SYSTEMS DIMENSIONS LIMITED

ADDRESS: 770 Brookfield Road
Ottawa 8, Ont.
Canada

SERVICES OFFERED: Remote Data Processing
Manufacturing - SDL Model T101 high resolution timer
Education - Seminars, Workshops,
Software Package Development

LOCATION AND SIZE OF COMPUTERS:	Ottawa	Toronto/Montreal/London
a) Manufacturer - Type or Model	I.B.M. 360/85	I.B.M. 360/20
No. of Units	1	3
Main Memory Size	2,000,000 Bytes	8K Bytes
Operating System	O/S HASP MVT	

b) Terminals	Type	No. of Units	Line Speed Used
I.B.M.	2741	27	150 baud
	2780	7	2400 baud
REMCOM	2780	3	4800 baud
DATA	100	2	(New York & Boston - 2000 baud)

c) Communications Interface	No. of Units	No. of Lines Present	No. of Lines Maximum
I.B.M. 2703	2	14	28
I.B.M. 2701	1	16	32

d) Data Communications Facilities			No. of Each (both ends)
Bell Canada	201 B3		9
	201 A3		12
	103 A2		27
	48 C		6
CN/CP	Rixon	4800 baud	2
	Milgo	4800 baud	6
	Lenkurt	26 C	4

Plans:

1. Expand Model 85 with system 370 components
2. Expand marketing in U.S.
3. Market software application, accountpak, in Europe
4. Expand Staff

No additional financing or change in ownership is anticipated

BOARD OF DIRECTORS:

G.A. Fierheller	- Canadian	P. deG. Beaubien	- Canadian
G.M. Morton	- British	J.W. Graham	- Canadian
J.M. Russell	- Canadian	J.R. Lemesurier	- Canadian
R.C. Quain, Jr.	- Canadian	J.M. Tory	- Canadian
		W.S. McCarthy	- Canadian

CAPITALIZATION:

Publicly Owned
3,000,000 Authorized
1,311,240 Issued - Public Underwriting - Feb. 1969 - $17,500,000
Private Placement - May 1970 - $1,500,000
Long-Term Debt - $9,947,000

Ownership - 99.08 per cent held in Canada by 2715 Stockholders

AFFILIATION: None

Rate Structures

A.G.T. Data Systems Limited -

Rates are not applicable because no computer is installed on their behalf. Charges are based upon service bureaus utilized.

Alphatext Systems Ltd. -

(See copy of Schedule of rates)

Argus Computer Applications Limited -

Pricing is, at time of survey, under review and new prices are unavailable.

Canadian General Electric -

Mark I Service: $12.00/terminal hour, .06 per central processor unit; $2.50 per 1500 character storage.

Mark II Service: $9.00 per terminal hour; .60 per 1000 input-out characters; .50 per central processor unit; $1.10 per 1200 characters storage.

Computech Consulting Limited -

Machine time is billed directly to the client by the service bureau used. Charges are based on hourly usage and vary from $125.00 per hour for a 196K Model 40 to $35 per hour for a 1460.

Computel Systems Limited -

(See copy of Schedule of rates)

Computer Sciences Canada Limited -

Calgary: $1200/C.P.U. hour (top priority)
$ 800/C.P.U. hour (2nd priority)
$ 600/C.P.U. hour (3rd priority)

Toronto: Basic - $.60/C.P.U. second
- $11.00/hour connect

File Storage - $1.50/page/month
(Page - 3,072 characters)

RJE & OTC: - 1st priority \$850/C.P.U. hour
2nd priority \$650/C.P.U. hour

File Storage - \$.075/track/day
(Track = 10,752 character)

Comshare -

No figures are provided

Datapro -

Confidential: based on usage of equipment plus some minimum charges, based on per hour use.

Dataline -

(See copy of Schedule of Rates)

EDP Industries Limited -

Rates are competitive

I.B.M. Canada Limited -

Rates are based on the remote data processing service offered. The following are the application services offered by I.B.M. (description of these are found in the body of the report).

CALL/360 - \$8.00 per hour connect
\$13.80 per minute C.P.U.
\$1.30 per 3440 bytes storage
Minimum \$100 per month

CMS/360 - \$10.00 per hour connect
\$24.00 per minute C.P.U.
\$21.00 per 120,000 bytes of storage
Minimum \$100 per month

Datatext - Basic charge \$540 per month

On-Line-Savings - \$.75 per account per year
\$.40 per loan per year for processing storage, additional charges for conversion, line appearances and non-financial file changes.

Remote Job Entry
Remote Job Submission - Hourly rates based on system configuration.

Polycom Systems Limited - rates as of April 10, 1970.

A. Commercial Rates for Time-Sharing

(1) Terminal Connect Time:

Daytime (8:00a.m. - 6:00p.m.) Monday-Friday	$10/hr
Other than hours above	$ 7/hr

(2) Central Processing Units:

Daytime (8:00a.m. - 6:00p.m.) Monday-Friday	$.05/unit
Other than hours above	$.03/unit

(3) Disc Storage:

Monthly based on the average level of storage with a minimum file size of only 100 characters. This keeps storage overheads extremely low.

$.10/100 characters

B. Educational Rates for Time-Sharing

(1) Terminal Connect Time:

Daytime (9:00a.m. - 5:00p.m.) Monday-Friday	$10/hr
Other than hours above	$ 7/hr

(2) Central Processing Units:

Daytime (9:00a.m. - 5:00p.m.) Monday-Friday	$.05/unit
Other than hours above	Nil

(3) Disc Storage $.10/100 characters

C. Additional Service Rates

Off-Line Printing: $2.50 for each 20 pages
Off-Line Card Reading: $2.50 for each 1000 cards
Off-Line Card Punching: $2.50 for each 500 cards
Off-Line Storage: Minimum monghtly charge of $500 plus .01 per 100 characters (loaded or unloaded)

The above charges have a $2.50 minimum for each request.

Tape Boxes: $1500 per 100 boxes
Manuals: $.25 each

Systems Dimensions Limited -

(See copy of Schedule of Rates)

I.P. Sharp Associates -

$10.00 per connect hour
$13.00 per C.P.U. second
$10.00 per month per 32 k storage

Symbionics Systems Limited -

Standard rate and service - $.195/system second
- surcharge for express service and discount for 2nd shift and volume.

Input/Output - 1.45/1000 lines printed
1.00/1000 cards read

(system second accounts for C.P.U. time, peripheral processor time, central memory and priority)

i.e. System Second = .89 C.P. + .150 P.P. + .0079
(CP + PP) (CM) PR

alphatext

Schedule 'A'

Charges for Alphatext's service will be in accordance with the following schedule:

1. Monthly Rental of the Typewriter Terminal $123.50

2. One time installation charge $100.00

   This includes the delivery and installation of a terminal and a communications line with the necessary typewriter connection.

3. Dedicated Access assures availability of connection of the typewriter terminal to the Textcentre computer at all times during each session the computer system is operational.

4. A communications line with the necessary typewriter connection is included in the Minimum Monthly Charge of each of Plan B.1. and B.2.

5. Basic Monthly Contract Options:

	Plan B.1.	**Plan B.2.**
Minimum Monthly Charge	$300.00	$550.00
Access	Dedicated	Dedicated
Positions of Permanent Computer Storage	Up to 100,000	Up to 200,000
Monday to Friday Availability	Either 8:00 a.m. to 1:00 p.m. or 1:00 p.m. to 6:00 p.m.	8:00 a.m. to 6:00 p.m.

6. Overtime usage is available upon request from 6:00 p.m. to 9:00 p.m. Monday to Friday and 9:00 a.m. to 1:00 p.m. Saturday.

   First connect hour of overtime usage in a calendar month $25.00

   Each additional connect hour of overtime usage $4.00

7. Monthly charge for each additional Permanent Storage Record (PSR) $0.30

   (1 P.S.R. = 1550 positions)

   Note:

   A position of permanent computer storage is defined as one keystroke. A keystroke constitutes the depression of any key on the typewriter terminal, including the space bar, tab and backspace.

   The actual number of positions of direct access computer storage used will depend upon the efficiency of the operator, the format of the text and upon the document length.

   Charges for additional permanent storage will be based on the average of the excess daily usages for the month.

8. Archive storage documents may be read from or written onto on-line magnetic tape units at any time in the Textcentre.

   Charges: Per document written onto Archive Tape $0.10
   Per document retrieved from Archive Tape $0.25

alphatext

9. Charges per 1000 lines printed in the Textcentre by the high speed printer:

Line Spacing	Nylon Ribbon	Mylar Polyester Ribbon
Single	$2.75	$3.25
Double	$3.00	$3.50

The standard type style on the high speed printer in the Textcentre is a Courier font with a range of 126 characters including upper and lower case alphabetics, special symbols, and French diacritical marks.

10. Charges for continuous form paper are additional:

Paper Description	Charge Per Sheet	Set Up Charge
15 x 11 one-part white bond (32M)	$0.010	NC
8½x 11 one-part white bond (40M)	$0.015	NC
15 x 11 two-part	$0.030	$1.00
5 x 11 three-part	$0.050	$1.00
15 x 11 four-part	$0.070	$1.00
15 x five-part	$0.090	$1.00
Customer supplied forms	NC	$2.00

11. Charge per delivery $1.00

12. Forms handling charge:
    Decollating and bursting per hour $8.00

Alphatext Systems Limited

The Alphatext Photocomposition Price Schedule

Agreement Number:

Schedule 'B'

Composition and photoprinting from IBM System/360 Magnetic Tape containing the text to be set and the applicable composition codes. Charges for Alphatext's Photocomposition Service will be in accordance with the following schedule:

1.	Textran		
	(a)	Composition per 1000 characters	$ 1.00
	(b)	Pagination per column line	0.01
	(c)	Media per foot - Paper positives	0.50
		Film positives	1.75
2.	Tape to Type		
	(a)	Composition per 8½ x 11 page	$ 6.00
3.	Customer Service Representative		
		Customer service analyst for composition set-up and coding per hour	$15.00

October 6, 1970

computel

COMPUTEL SYSTEMS LTD.,
1200 St. Laurent Boulevard,
Ottawa 7, Ontario.

SCHEDULE OF COMPUTING SERVICES RATES SCHEDULE A

	DEDICATED TERMINAL AND COMPUTING SERVICES COMMITMENT AGREEMENT	COMPUTING SERVICES AGREEMENT	PER
A. UNIVAC 1108			
1. CPU			
Prime	$750.00	$800.00	CPU hour
Demand	600.00	750.00	CPU hour
Batch	500.00	700.00	CPU hour
Priority A surcharge	750.00	750.00	CPU hour

Prime— When the job is submitted to be processed between the hours of 8:00 A.M. and 7:00 P.M. (Ottawa) or between 8:30 A.M. and 7:00 P.M. (Toronto), Monday to Friday inclusive, statutory holidays excluded.

Demand— When the job is submitted for processing during other than the hours defined as prime time.

Batch— When the job is scheduled by Computel, subject to a maximum turnaround of twenty-four hours.

2. Fastrand Storage	6.45	10.00	Block per month

There are 86,016 characters per fastrand block. The monthly charge is based on the greatest number of blocks allocated at any one time during the month.

B. IBM 360/65			
3. SYSTEM OCCUPANCY*			
Memory Rate	$ 1.60	$ 2.00	KB per EH
2314 Disks			
Public	5.00	5.00	MB per EH
Private	17.50	17.50	EH
2401 Tape	22.00	22.00	EH
Mark Sense Reader	19.00	19.00	EH
4. SYSTEM ACTIVITY*			
CPU	280.00	350.00	CPU hour
2314 Disks			
Record Charge	1.25	1.25	KR
Byte Transfer	.15	.15	MB
2401 Tape			
Record Charge	.15	.15	KR
Byte Transfer	.15	.15	MB
Mark Sense Reader			
Record Charge	1.25	1.25	KR
Byte Transfer	:20	.20	MB

WHERE: KB= 1024 Bytes; MB= 10^6 Bytes of Storage
EH= Computed Elapsed Time; KR= 1000 Data Blocks

	DEDICATED TERMINAL AND COMPUTING SERVICES COMMITMENT AGREEMENTS	COMPUTING SERVICES AGREEMENT	PER

5. 2316 DISKS

	DEDICATED TERMINAL AND COMPUTING SERVICES COMMITMENT AGREEMENTS	COMPUTING SERVICES AGREEMENT	PER
(i) On-line Space	$ .65	$ .75	Track per month
(ii) Off-Line Charges			
Shared Private	.002	.002	Track per day
Minimum	1.00	1.00	Month
Non-shared Private	30.00	40.00	Month
Disk Mounts	3.00	3.50	Each

6. Priority Factors

	CODE	% Surcharge (+) % Discount (—)
(i) Prime shift, weekdays, 8:00 A.M. to 7:00 P.M.		
	12	+20
	11	+10
	10	+ 5
	9	0
	8	— 2
(ii) Weekends, 8:00 A.M. to 7:00 P.M. Evenings, 7:00 P.M. to 12:00 Midnight		
	7	— 5
	6	— 7
(iii) Weekends, 7:00 P.M. to 8:00 A.M. Night Shift, 12:00 Midnight to 7:00 A.M.		
	5	—10
	4	—12
(iv) Scheduled by Computel as possible		
	3	—15

If no priority is indicated Code 9 will apply

7. Job Time Factors

ELAPSED TIME OF JOB	PRIME SHIFT % SURCHARGE	Weekdays, 12:00 Midnight to 8:00 A.M. Weekends, 7:00 P.M. to 8:00 A.M. % DISCOUNT
0—30 Minutes	0	0
40 Minutes	+ 8.33	—2.5
50 Minutes	+16.66	—5
60 Minutes or greater	+25	—7.5

Intermediate times are subject to interpolation.

C. UNIVAC 1108 AND IBM 360/65 COMMON CHARGES

8. Printing

Single part	$ 1.50	$ 2.00	1000 lines
Multipart	.40	.40	1000 lines per extra part

Charges are calculated to the nearest 100 lines per job computel

9.	**Card reading**	1.00	1.00	1000 cards
10.	**Card punching**	4.00	5.00	1000 cards
11.	**Tape mounts**	1.50	2.00	each
12.	**Form changes**	2.00	2.00	each
13.	**Magnetic tape rental**	.15	15	day
14.	**Decollating and/or Bursting**			
	Ottawa — per hour	$ 10.00	$ 15.00	
	— Minimum	2.50	3.75	job
	Toronto (decollating only)	.05	.05	1000 lines per part
15.	**Xerox reproduction (Ottawa only)**			
	Less than 6000 copies	.035	.035	copy
	6000 to 10,000	.034	.034	copy
	Greater than 10,000	.033	.033	copy
	Minimum	3.50	3.50	job
16.	**Remote I/O charges (terminal usage)**			
	(i) I/O allowance			
	Univac 1004-I,			
	201A	8 units	6 units	
	48C	10 units	8 units	
	Univac 1004-II,			
	201A	10 units	8 units	
	48C	12 units	10 units	
	Univac 9200,			
	201A	8 units	6 units	
	48C	10 units	8 units	
	Univac 9300,			
	201A	10 units	8 units	
	48C	12 units	10 units	
	IBM 2780 and 1130	8 units	6 units	
	IBM 360/20,			
	201A	10 units	8 units	
	48C	12 units	10 units	

An I/O unit is defined as 10 cards read or 7 lines printed or 7 cards punched.
For each second of 1108 CPU time or 360/65 computed elapsed time which the customer is invoiced, there is an allowance in terms of I/O for which there is no charge, which allowance is designated as I/O allowance.

	(ii) Excess I/O	$ .005	$ .010	unit

17. Plotter rates

(i) Ottawa	$25.00 per hour
Commercial	30.00 per hour
Minimum charge	5.00
(ii) Toronto	
0.0—5.0 hours	40.00 per hour
5.1—49.0 hours	35.00 per hour
Greater than 49.0 hours	30.00 per hour
Minimum charge	10.00

(iii) Common paper charges		
31 inch paper	$28.50 per roll or	$ .25 per foot
12 inch paper	8.50 per roll or	.27 per foot

D. GENERAL

18. Basis for Machine charges

(i) Univac 1108, EXEC 2

Machine Charge = (CPU×CPURAT) + I/O

Where CPU = The measured time applicable to program execution, including time during I/O operations but excluding system overhead, accumulated handling, communications and related system functions.

CPURAT = Rates indicated in Section A1, preceding.

I/O = Charges incurred due to mounting of tapes, printing of lines, reading and punching of cards.

(ii) IBM 360/65

Machine Charge = JTF × PF (CPU + MEM + I/O)

Where JTF = Job Time Factor

PF = Priority Factor

CPU = Published Rates Times the amount of system time used for program execution as well as the handling of job related interrupts and step controls.

MEM = Published rates times the occupancy time attributable to all of the facility operations required by a user program step.

I/O = Charges accumulated on the basis of facility occupancy, facility activity, printing of lines, card reading and punching, mounting of tapes and disks, form changes.

19. Other

Items 14, 15 and 17

These items represent services provided by third party suppliers. The rates indicated are subject to change without notice.

DATALINE
40 St. Clair Avenue West
Toronto, Ontario 964-9515
DATALINE SYSTEMS LIMITED

COMPUTER UTILITY USAGE AGREEMENT

Name and Address of Customer:

Agreement Number:

Date Signed:

Date Effective:

Dataline Systems Limited ("DATALINE"), by its acceptance hereof at its Head Office, agrees to furnish to the Customer its Dataline Interactive System ("DIS") service in accordance with the terms and conditions set forth herein and in any schedule attached bearing the same agreement number as appears above. DIS service shall comprise the availability of the below listed machines and devices (collectively the "machines") and the below listed services (the "services") for the customer's use during the scheduled hours.

Equipment and Service Available for Use:

Item No.	Equipment	Type of Service*	Minimum Usage	Unit Charge	Total Charge
1	C.P.U.	Prime time		See below	$
2	C.P.U.	Off-peak		$390.00/hour	
3	C.P.U.	Weekend		$375.00/hour	
4	Connect Time	Prime Time		$10.00/hour	
5	Connect Time	Off-peak and Weekend		$7.50/hour	
				Contracted Monthly Minimum Charge	$

*See reverse for definitions.

Prime time CPU charges:
 nese charges are determined by the average size of each job, averaged over the total CPU time for the job. One page consists of 1,024 words of main storage.

Job Size	Rate
0—16 pages	$ 400.00 per hour
17—32 pages	$ 500.00 per hour
33—48 pages	$ 650.00 per hour
49—64 pages	$1,000.00 per hour
65 pages or more	$1,400.00 per hour

Price is independent of program size for off-peak and weekend usage.

Special Equipment Charges:

Service	Unit Charge
File Storage (On-line Program Storage Units (PSU))	
Where one PSU=640 characters	$ .20 per PSU per month
Mountable I/O Devices (charges are rounded up to the nearest tenth of an hour)	
Magnetic tape drive (7 or 9 track)	10.00 per hour
DECtape drive	3.00 per hour
Disk drive (RP02, 25 million characters)	20.00 per hour
Calcomp 563 charges	24.00 per hour

Service	Unit Charge
Mount-Dismount	
Magnetic tape	1.00 per reel
DECtape	.25 per reel
Disk pack	2.00 per pack
I/O Charges (charges are rounded up to the nearest 100 lines or 100 cards per job)	
Line printer	$2.00 per 1,000 lines for first 2,000 lines 1.75 per 1,000 lines which are in excess of 2,000 lines
Card Reader	.50 per 1,000 cards read
Card Punch	3.50 per 1,000 cards punched

SPECIAL TERMS:

This agreement shall not be effective unless and until signed by an authorized representative of DATALINE.

All the terms and conditions appearing on the reverse hereof are included herein by reference and form an integral part of this agreement.

Accepted:
DATALINE SYSTEMS LIMITED

____
(Customer)

By______________________
(Name)

____
(Title)

By______________________
(Name)

____
(Title)

The Big Computer Company

billing algorithm

APPENDIX C

The SDL Billing Algorithm consists of the following elements:

1. BASIC ALGORITHM
2. Rate Reduction for PROCESSING OUTSIDE NORMAL HOURS
3. Rate Reduction for VOLUME
4. Rate Reduction for COMMITMENT
5. Rate for TERMINAL USE

1. BASIC ALGORITHM

Operation of the SDL system in a multiprogramming environment has made it necessary to develop a new approach for the accounting of a job in the system. Without multiprogramming, only one job would be processed in the system at any one time. Charges in such an operating environment are usually based on elapsed time. This means that each job has to bear the cost of the total system and, in addition, the cost of delays in operation, such as time required to mount tapes and disks.

By multiprogramming, many jobs can co-reside in the system at the same time and, therefore, each job should bear only the cost of the actual facilities it utilizes. If the same job is run several times, even under varying system loading conditions, the charges should be identical.

In order to achieve this degree of sophistication in accounting, a new form of measurement is necessary. The objective is to achieve an equitable and repeatable system of service charges. ACCOUNTPAK is a proprietary implementation which meets this objective.

The charges for computer services are detailed in the SDL Computer Services Agreement. The following description outlines the various components which comprise the Basic Algorithm.

Charges for System Usage

The Billing Algorithm establishes the Charges for System Usage by measuring and recording five factors:

(over)

a) System Activity
b) System Occupancy
c) Input/Output
d) Operator Activity
e) Supplies

a) System Activity includes charges for the components of the system which can be shared dynamically between jobs which are being processed concurrently. This type of charge applies to the central processing unit, the channels and the input/output control units.

The system activity charge for central processor activity is proportional to a measured quantity called Task Time. Task Time for a job step is the sum of the time intervals during which the central processor is actively and exclusively executing instructions for that job step.

The system activity charge for channels and control units for a job step is proportional to the input and output data traffic which that job step produces. This data traffic is determined from an actual count of the number of blocks (physical records) and bytes (characters or digits) transferred.

b) System Occupancy charges for a job step relate to those system components which are reserved exclusively by that job step. These include peripheral storage devices (tapes, disks or drums) and the region of main core memory used by the job step.

Since the SDL system is operated in a multiprogramming environment, the actual elapsed time depends not only on the job step in question but also on all other jobs being processed concurrently. Actual elapsed time, therefore, cannot be used as an equitable measure of system occupancy. Instead, a pseudo elapsed time, called Step Time, is calculated.

To perform the Step Time calculation, central processor and channel activities are monitored at periodic intervals. The largest individual increments of task time or calculated input or output time for any dataset are accumulated at each interval. Charges for core memory, or public disk or drum space are also in proportion to the number of bytes reserved for use by the job step.

c) Input/Output charges are based on the number of cards read, cards punched and lines printed. These input/output charges apply to the normal mode of operation at SDL in which card input is transferred to disk before a job step is executed and card or printer output is produced from disk after execution is completed.

If input or output is performed on privately reserved or allocated units during job step execution, these charges do not apply. Instead, a system occupancy charge is made for the private use of the card reader, card punch or printer units reserved.

d) Operator Activity charges cover activities such as mounting of private tape reels of disk packs, changing to non-standard printer forms or non-standard cards in a punch or for mounting a non-standard train on a printer.

e) Supplies of single and multiple part forms and standard cards are provided by SDL and charged on a per unit basis.

Charges for On-Line Storage

Permanently resident on-line disk storage space can be rented on an hourly or daily basis. Availability of this space must be scheduled in advance.

Charges for Storage Media

Tape reels and disk packs can, if required, be rented directly from SDL and stored on its premises. Charges for this service are on a daily basis.

2. Rate Reduction for PROCESSING OUTSIDE NORMAL HOURS

Work may be submitted by the customer for processing outside of normal SDL hours and, thus, benefit from a rate reduction.

3. Rate Reduction for VOLUME

All work processed within a month benefits from a rate reduction for volume calculated in accordance with the table contained in the SDL Computer Services Agreement.

4. Rate Reduction for COMMITMENT

Work committed for processing at SDL over a period of six months to two years qualifies for an additional rate reduction according to the table contained in the Computer Services Agreement.

5. Rate for TERMINAL USE

Terminals can be installed on customer premises and connected directly to the SDL system via communication lines. Charges for this service are dependent on terminal type, location and the type of service and may be on a monthly, hourly or per unit basis.

Schedule of Charges – BASIC ALGORITHM

CHARGES FOR SYSTEM USAGE

(a) CHARGES FOR SYSTEM ACTIVITY

Processor Activity System/360 Model 85	$1 200.00/*task hour*
Channel Activity:	
2301 Drum Traffic	$1.00/*KB* + 5c/*Mb*
2314 Disk Traffic	$1.00/*KB* + 15c/*Mb*
2420 Tape Traffic	$0.15/*KB* + 15c/*Mb*
2410 Tape Traffic	$0.15/*KB* + 25c/*Mb*

(b) CHARGES FOR SYSTEM OCCUPANCY

Core Storage	$ 2.00/*Kb/step hour*
Drum 2301 (public use)	$100.00/*Mb/step hour*
Disk 2314 (public use)	$ 5.00/*Mb/step hour*
2314 (private use)	$ 20.00/*drive/step hour*
Tape 2420	$ 25.00/*step hour*
2401	$ 15.00/*step hour*
Reader 2504 (allocated)	$ 20.00/*step hour*
Printer 1403 (allocated)	$ 20.00/*step hour*
Punch 2540 (allocated)	$ 20.00/*step hour*

(c) CHARGES FOR PERIPHERAL INPUT/OUTPUT

Card Reading	$ 1.25/*K cards*
Printing	$ 1.25/*K lines*
Card Punching	$ 3.50/*K cards*

(d) CHARGES FOR OPERATOR ACTIVITY

Tape Reel	$ 1.50/*mount*
Disk Pack	
– using SDL mount procedure	$ 2.50/*mount*
– otherwise	$ 7.50/*mount*
Non-Standard Printer Forms	$ 1.00/*change*
Non-Standard Cards - punching	$ 1.00/*change*
Non-Standard Printer Train	$ 5.00/*change*
Console Message Replies	$ 1.50/*reply*

(e) CHARGES FOR SUPPLIES

Standard Forms	$ 0.01/*page*
Standard Cards	$ 1.50/*K cards*
Multiple Part Stock Forms	$ 0.01/*page/part*

CHARGES FOR ON-LINE STORAGE

Charges in this section are in lieu of charges for System Occupancy for 2314 disk usage and charges for Operator Activity.

2314 Disk Drive (by pre-arranged schedule)	$ 12.00/*set-up* + $ 6.00/*elapsed hour*
2314 Disk Space	$ 3.50/*Mb/SDL working day*

CHARGES FOR STORAGE MEDIA

Tape Reel	Rental	$ 0.05/*calendar day*
	Storage	
	Normal	$ 0.02/*calendar day*
	Vault	$ 0.05/*calendar day*
	Restricted	$ 0.10/*calendar day*
	Access to Restricted Storage	$ 1.00/*access*
Disk Pack	Rental	$ 0.85/*calendar day*
	Storage	$ 0.15/*calendar day*

Abbreviations

KB – thousand blocks. A block is a physical record of data as recorded on a storage medium.

Kb – 1024 bytes of core storage.

Mb – million bytes of data.

APPENDIX C

December 3rd, 1970.

THE ECONOMIES OF INTEGRATION
COMMUNICATIONS AND DATA PROCESSING

D.D. Cowan

L. Waverman

TABLE OF CONTENTS

TERMS OF REFERENCE

The purpose of this study was to investigate the potential economies arising from the integration of the communications function and the data processing function within a single firm or entity. This paper does not investigate the impact on competition of such integration. No recommendations are made as to whether such integration should in fact be allowed. We leave that choice to the policy-maker who has all the relevant information, one piece of which is represented by this study.

Nor do we consider some of the other perhaps related issues which have been raised by either communications firms or existing data processing in companies. For example, this study does not consider the merits or demerits of the arguments that allowing unregulated message switching will lead to entry only in the most lucrative areas -- the cream skimming argument. Nor do we consider the broader national goals under which a decision must be made. We do not for example, concern ourselves (except in the question of research and development) as to the nationality of the ownership or location of the firm.

Nor do we consider this study as the final word on the economies of integration between processors and carriers. Given the time constraint (3-1/2 months), the lack of hard data and the lack of serious qualitative thought on the issue also, this document should be read as a research report. This study should be revised when and if data becomes available and when technology changes. Although we have made the best estimates we can as to the course of future technology, our best prophecy is that we will be proven wrong.

The study itself is divided into four main sections. The first part deals with the possibility of a data processing subsidiary utilizing the hardware facilities of the communications parent. In this section is discussed the possibility of handling both communications and processing on a single computer. Also discussed is the question of advantageous connection -- does the processing arm of a carrier acquire advantages because of its ability to tie directly into the message switching or toll centre of the communications firm? The second part of the paper briefly discusses the factors which may lead to economies of integration through the computer firm's utilization of the existing personnel -- sales, maintenance and management. The third division analyzes whether a processing subsidiary of a large well-known communications firm is able to borrow funds at a lower cost than would an independent computer utility. In the fourth section, the effect of integration on the research and development capability of the communications firm and the processing firm is discussed.

ECONOMIES OF INTEGRATION - TECHNICAL FACTORS

Computing and communications are somewhat inseparable terms. A communications network uses computers to switch messages, connect communication lines and concentrate messages, while a time-sharing system may perform such traditional communication functions as polling and switching.

A communications network is part of a computer utility in that the network is employed to connect users both to the computer and to mass storage and also to connect computers to each other. A computer utility, although primarily used for data processing and data bank functions, can also be considered as a communications system in that it allows various users to communicate with each other and with the services supplied by the system.

Since the communications companies employ computers for communication tasks and since computer utilities and communications networks bear a strong resemblance to each other, it has been suggested that economies might result in the communication companies were allowed to do both data processing and communication functions.

The next few paragraphs will present some of the general terminology of the use of computers in the communications networks before there is a detailed discussion of the technical factors likely to cause economies of integration.

Discussion of Terminology

Electronic Switching Systems

The computers of an electronic switching system are used to set up a physical path between the incoming and outgoing lines. The computer itself does not handle the data transmitted, but mainly scans both incoming and outgoing lines to ensure that calls are connected and disconnected correctly. Electronic switching systems are designed and constructed to be extremely reliable and therefore include elaborate hardware and software provisions to allow recovery from errors and faults via automatic self-diagnostic analysis. [1/]

Existing line switching computers do not have many of the facilities necessary for high speed data processing. The memory cycle time of the electronic switching system (SP-1 - 6 microseconds, ESS 1 - 5.5 microseconds) is far higher than the average cycle time of a modern data processing computer (IBM 360/85 - 100 nanoseconds). Line switching computers presently do not contain arithmetic units capable of multiplication or division, nor do they have means of accessing on-line storage. No standard languages, language compilers or standard operating systems have been designed for these switching processors.

1/ A.T. & T.'s E.S.S.1 is designed to have a maximum of 2 hours downtime in 40 years of operation. Of the 100,000 operating instructions controlling E.S.S.1, 50% are used for fault diagnosis and error recovery. Similar figures hold for the Canadian SP-1 system of Northern Electric.

Message Switching Systems

Unlike electronic switching systems, message switching systems do not create a physical link for the data to flow over; instead messages usually enter the system from one line, are stored and then forwarded to their destination when a line or lines to those destinations are available. Message switching with its storage capability provides better line utilization, thus reducing the overall line cost. In a modern message system, the store and forward ability is usually provided by a digital computer with an on-line storage device. Several types of digital computers are presently used in message switching systems. These are the UNIVAC 418 (Bell Canada, Western Union) and the UNIVAC 1108 (Western Union); CN/CP uses special purpose machines, the Collins C8401 (now used primarily as a reservation system for the railways), the Collins 8500 and the Philips DS714. Many of the digital computers used for message switching are general purpose processors and usually have operating systems, compilers, etc., available.

Hold and Forward Concentrators (17, p. 195)

Hold and forward concentrators are special computers which are also designed to provide better line utilization. They perform two basic functions: namely, the collection of a complete transaction (such as a single line of type) before transmission, and the execution of application programs. The use of the hold and forward concentrators for collecting transactions before transmission results in better line utilization than with the normal multiplexing technique.

The use of hold and forward concentrators (with application programs) as on-line computers also provides an effective mechanism for better line utilization. The concentrator can carry on some conversations with the user locally; line usage is reduced since some of the data does not have to be sent to the central computer.

Computing Services

Computing services presently available cover a broad range, and can be divided into many different categories by functional characteristics but can usually be thought of as special purpose and general purpose. (16. p. 8). The types of services offered on such systems can be characterised for the purpose of this study as limited data processing and general purpose computing.

Limited Data Processing

Limited data processing can be described in terms of the input data supplied to the processing computer. In this case, the input data is not to be run as a program on the processing or host machine. A program is a set of characters which will be transformed into and executed as a sequence of machine language instructions on the host computer.

General Purpose Computing

General purpose computing is defined as any task for which a digital computer program can be written.

Hybrid Services

Hybrid services are usually considered to be a combination of computing services including both message switching and data processing where a message is processed and switched. Either of these two activities may be the primary service offered with the other activity as an incidental offering. While F.C.C. regulation revolves on these notions of primary and incidental activity, they are difficult divisions to make operationally.

Integration of Data Processing and Switching Functions

It has been suggested that economies of integration might arise from the technical possibility of performing two or more functions on the same computer equipment, (not necessarily a hybrid service for the processing and switching might involve different sets of data). Thus, the integration of data processing and communications in a company might produce economies in several different ways:

(i) by allowing electronic data processing and switching to be co-resident on a computer thereby producing economies of scale 2/ and utilizing spare capacity in off-peak periods.

2/ The concept of a rule of thumb such as Grosch's Law that the computing 'power' of a computer installation increases as the square of the cost lies at the heart of belief that vast economies of scale are waiting to be tapped by the company which can create a vast 'utility' of users. Grosch's Law, best empirically measured by K.E. Knight (Datamation, September, 1966, January, 1968), has been called into serious question. Knight himself states "We cannot build larger and larger computers at reasonable costs since at any point in time there are absolute limits to the size and speed obtainable ... The most powerful computing systems we could possibly build today or tomorrow would not be the most economical." (Datamation, September, 1966, p.54). Even Knight's estimates of economies of scale exaggerate true economies because his cost estimates include the costs of operating systems, costs which rise with the size and the number of different tasks to be handled.

(ii) by utilizing the spare capacity available on a stand-by switching computer,

and

(iii) by utilizing the advantageous position that the communications company may have in connecting to its own line and message switching equipment.

These three topics will be discussed in general terms and then applied to specific computer configurations in an attempt to determine the magnitude of any resulting economies.

Integration of Data Processing and Switching Functions on a Single Processor

It has been suggested that the integration of data processing and either line or message switching on a single processor [3/] can produce savings for both activities, since the fixed costs of the machine are spread over two rather than one activity. A look at the criteria for reliability and design of present and possible computer equipment that would be used in switching systems or for data processing should reveal whether this type of integration will actually produce such an economy.

3/ From our discussions with people in the communications business, it would appear that line switching computers (A.T. & T.'s ESS and Northern Electric's SP-1) will not be used for anything but line switching in the foreseeable future. Although many of the arguments presented in this section apply to them also, we intend to concentrate primarily on message switching systems.

The operating characteristics of a communications system and a computer utility are presently quite dissimilar. The input to a communications system consists either of a number of pulses or tones followed by an analogue signal, or a string of pulses. In both cases, the input to the system has little or no effect on its reliability. Most malfunctions are caused by spurious signals such as noise or by a fault in the switching mechanisms or lines. In other words, communications systems failures are rarely caused by input data.

A general purpose computer utility on the other hand, has quite different operating characteristics. While it suffers from the same problems as a communications system, since the utility also attempts to significantly alter its input data and perhaps even allows the data to control the processor as a program, failures (especially software failures) can and do occur with far more regularity. In the ideal situation (one which is yet to be closely approximated) in a computer utility, such failures should only affect the person who caused the problem. Even here, such a failure could be catastrophic, destroying several hours work. This type of failure is certainly not characteristic of communications systems.

Reliability Criteria

It is well known that the reliability criteria for switching and processing are somewhat different under today's technology. In electronic switching systems "system outage is regarded as catastrophic; however, individual errors are not so bad." (17, p. 336). The reason that system outage is catastrophic is, of course, the fact that we have come to regard telecommunications capability both through telephone and message switching [4/] as an almost essential service. Therefore, the entire community cannot tolerate a period when such service does not exist.

At present, general purpose data processing requirements have almost the reverse criteria. Random errors are very serious, while complete system failure is not catastrophic.

A random error in the switching function usually means that a few subscribers re-dial while systems failure may destroy a large number of conversations in a large section of the country.[5/]

Reliability criteria for errors in transmission are, of course, very different for voice and data communications. A random error caused by noise will affect the quality of conversation, but voice communications will not be radically affected (i.e. a small short disturbance in a long spoken message will not change the content of the message). In the case of data transmission, however, noise introduced

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4/ Since non-military message switching is not as essential today as the telephone system, one suspects that system outage is not quite so disastrous. In non-military message switching the degree of catastrophe is perhaps more application-dependent than in the telephone system.

5/ The costs of crashing a switching system vary among systems. For example, A.T. & T.'s E.S.S.1 operates by maintaining a map in memory of the entire system network. A malfunction therefore, destroys all the links. Northern Electric's SP1 does not operate on this 'map' basis, and a crash destroys only those calls in the process of being connected. The crash of a message switching computer destroys the content of all messages which are in the process of being stored or forwarded.

into the line while transmitting data can cause errors which could be quite serious. At the present time, most systems appear to error-check data received to ensure that it has been received correctly.

Random errors in processing cannot be tolerated since their presence does not become known and may be propagated through many hours of computation thereby completely destroying the validity of any answers.

At the present time, a significant and lengthy system crash can be tolerated since it is fairly easy to recover from such crashes without too much loss of data; our tolerance of such crashes, however, is decreasing as business comes to rely more and more on access to computer facilities in its day-to-day activities. It would appear then, that although a communications system can tolerate some random errors and no system crashes, the computer utility in the future will probably be at least as stringent (if not more so) in its reliability requirements as the communications system.

The software and hardware presently used in data processing systems are such that fairly frequent system crashes do occur. Therefore, at present, it would be an intolerable situation to allow general purpose data processing and switching functions to reside on the same machine; however, limited data processing with carefully written and tested programs should be feasible. [6/] Certainly, the user must not

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6/ Intolerable in that expected crashes would increase and thus total costs. Appendix I explores this area more fully.

be allowed to generate or modify code for the machine. Since future requirements on computer utilities probably will be as stringent as communications systems, and software and hardware used in a computer utility will become more reliable, we anticipate that it may be possible for communications functions and general purpose data processing functions to reside on the same computer. However, considering the problems we have today designing large operating systems, we would anticipate a delay of some years before general co-existence is feasible. 7/

Design Criteria

It was mentioned previously that the input data to a communications system and a computer utility would be manipulated in a completely different manner and would have a different effect on the computer and communications system.

In particular, in a line switching or message switching system, the input data is transferred from input to output while in a general purpose computer utility, the input data may actually be a program which will be allowed to control the computer. These constraints on the input data can make the design of switching computers and general purpose computers quite different. In the case of switching computers, the volume of data is well-known and therefore the design problem is specified. In the case of the computer utility, the nature of the input data is so ill-defined that all cases cannot be enumerated or

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7/ A continual problem will be the divergence between social and private costs. The individual crashing the system is not asked to bear the costs incurred by the third parties whose conversations are also destroyed. Thus private costs of crashing a system are less than the costs to society of such crashes. As a result, too many crashes will occur.

even anticipated. Therefore, the design becomes more general and introduces many added features such as paging, segmentation and memory protection in order to handle many different problems. From this discussion, it would appear that the general purpose computing and switching functions should not reside on the same computer.

It should be clear from the presentation to this point, that although general purpose computing should not be on the same computer as switching; well-defined data processing tasks use time which must be stolen from the communications function of the computer, thereby limiting the number of terminals it can handle at any given instant. Also systems design is significantly simplified by specializing the jobs to be done. Therefore, in a large system, the amount of data processing done in the message switching processor should be severely limited or completely curtailed.[8/] This means that the two tasks should really be run on separate but interconnected computers.

Numerous discussions and observations have led us to this conclusion reached in the previous paragraph. The presence of specialized electronic and message switching computers suggests that there are advantages to specializing the technology for switching away from general purpose computers. Three companies (CN/CP, Northern Electric and Western Union) stated that it is less expensive to split the communications and processing tasks and to process them on two

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8/ A message switching system with a relatively light load such as a specialized application might also be able to accomplish significant data processing tasks.

interconnected machines, one of which was a specialized switcher.[9/] Of course, reliability considerations, at least for the present, also point the way to separation of the tasks of switching and general purpose data processing on different interconnected computers.

To conclude this discussion, it appears that since switching and processing should be offered on two separate but interconnected computers, (a fact which appears to be forced by both reliability and design considerations), no economies of scale or economies from use during off-peak loads can occur.

Utilization of Spare Capacity on a Standby Computer

Electronic switching and message switching systems have spare capacity. The spare capacity exists in two ways: first, the machines are installed with the capacity to handle peak load traffic. Therefore, at times other than peak loads, these operating processors have spare capacity (this was discussed in the section on integration of data processing and switching functions on a single process). Second, both electronic switching systems and message switching systems maintain spare processors for reliability purposes. In the case of line-switching, two computers often are operated in parallel so that a continual check on the status of the system can be maintained. Message switching systems on the other hand, contain a

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9/ "In the case where there is a significant communications load to be processed, it is more feasible to interface the communications terminal with a separate computer, dedicated to communications functions, which is, in turn, coupled to a processor dedicated to computational and retrieval functions." Western Union, Response of Western Union Telegraph Company, before the F.C.C. Docket No. 16979, March 5, 1968.

fall-back processor for every two (CN/CP) or three (Western Union) operating processors.[10/] This scheme is used so as to minimize any serious system outage.

It has therefore been argued mainly by Western Union, that allowing telecommunications utilities to offer data processing services will generate economies of integration by spreading the overhead of the spare message switching computer over both communications and processing. Of course, such data processing services will have to be on an interruptable basis since at any time, the stand-by processor may be asked to take over the switching function. It would appear that in this case, assuming the use of a general purpose computer for message switching (perhaps not a valid assumption) that some economies of integration would arise. Although no specific figures are readily available, it would appear that these economies would be rather small. Total investment in computers in a message switching system is rather small compared to the cost of the entire network, and as the number of computers in a message system increase, there may be fewer and fewer stand-by computers. In the future, the failure of one computer system may be relieved by distributing the load of the failed computer over other computers in the remaining message switching network.

10/ Western Union feels that this spare computer will be used only 5% of the time for switching purposes.

Advantageous Interconnection

Single company ownership of both the message switching computer and data processing computer may produce economic advantages, since the two interconnected computers can be placed close together, thereby almost eliminating transmission costs between the two machines.

Consider a message switching system with attached data processor. If these were both in the same company (not necessarily a communications company) and physically close to each other (within 50 to 100 feet), then a message which required some data processing would travel the path shown in Figure I.[11/]

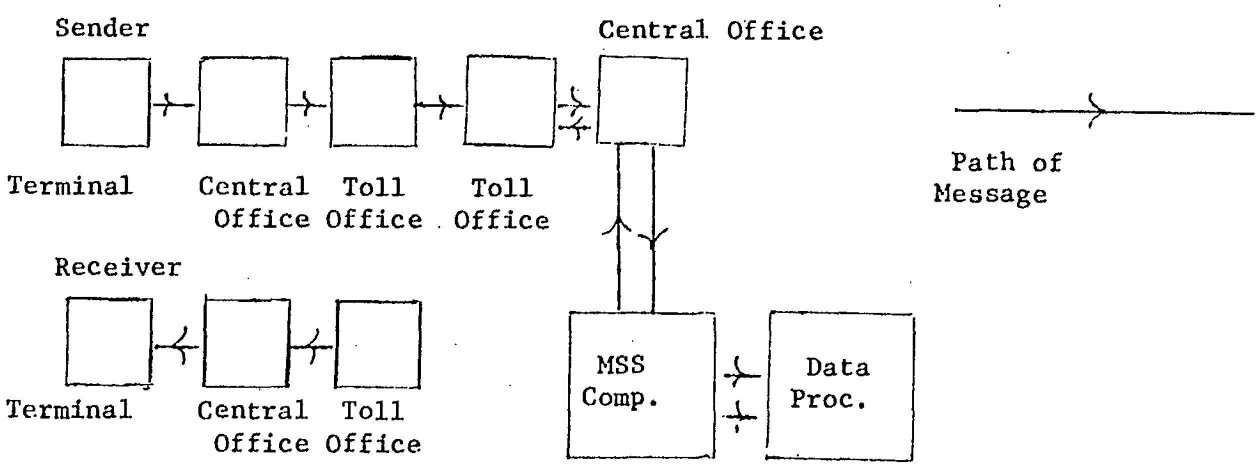

Figure I

11/ It is assumed that the message switching computer(s) and the data processing computer(s) are close together and do not use telecommunications links to transmit data between themselves. This assumption may not be correct.

If the message switching computer and the data processing computer were in different companies (perhaps in different cities), then a message which required some data processing might travel the path shown in Figure II.

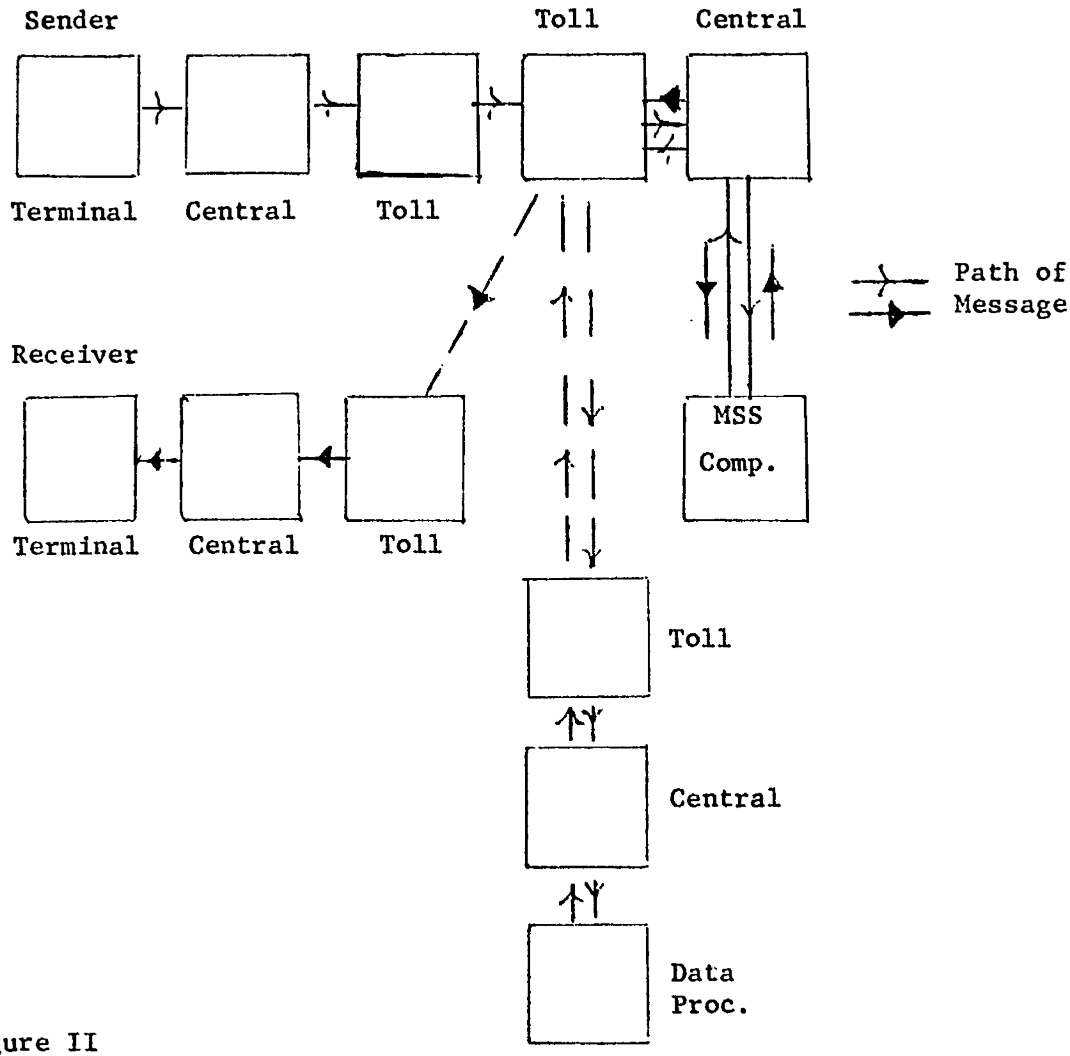

Figure II

The number of toll offices shown in Figures I and II may vary considerably, depending upon the communication distances between transmitting and receiving terminals and the data-processing computer. Of course, no switching may be required if the computers are connected by a private line.

The costs for a communication link between the two computers are given in Table I. These are the costs for intracity transmission and Multicom (intercity transmission) for a period of one month at an average daily two-way transmission rate of 600×10^6 bits per day. Table II gives these costs for a five-year period, the normal depreciation period for a computer.

Table III presents the marginal economies of integration after table II has been adjusted by the five-year monthly rental of a short direct communications link.

Such a discussion would seem to indicate that substantial economies of integration exist in advantageous interconnection, although only if the computers are separated by large distances, since in intracity transmission costs appear to be quite low. However, this is not an argument suggesting that existing communications firms have an advantage over independent utilities in offering processing services. From Table II, it can be seen that the company which incorporates switching and processing at the same location can save $1,000,000.00 over a company 200 miles away at a transmission rate of 6×10^8 bits. If all the customers for data processing services were in Toronto, then the utility located in

Mileage \ Transmission Rate in Kilobits /second	19.2	50
Intracity		3400
Up to 200	22292	17550
200 - 425	28012	21950
425 - 650	33754	26350
650 - 1000	38474	30750
1000 - 1400	45216	35150
1400 -	48076	37350

Monthly Charge for an Average
Daily Transmission of 6×10^8 bits

Table I

Mileage \ Transmission Rate	19.2	50
Intracity		204
Up to 200	1340	1054
200 - 425	1680	1310
425 - 650	2030	1580
650 - 1000	2300	1850
1000 - 1400	2710	2110
1400 -	2880	2240

Charges for 5 years for Multicom Service for An Average Daily Transmission of 6×10^8 bits in thousands of dollars.

Table II

Mileage \ Transmission Rate	19.2	50
Intracity		187
Up to 200	1320	1030
200 - 425	1660	1290
425 - 650	2010	1560
650 - 1000	2280	1830
1000 - 1400	2690	2090
1400 -	2860	2220

Marginal Economies over 5 years for an
Average Daily Transmission of 6×10^8 bits
in thousands of dollars

Table III

Toronto would have costs $200,000.00 a year lower than its competitor in Ottawa. Note however that the only savings that a communications firm which located its processing unit in Toronto would have over a Toronto based utility would be approximately $40,000.00 per year (the cost of intracity transmission). This saving of $200,000.00 per year is available to any utility which located in the neighbourhood of its customers. If all customers were in Toronto, it is unlikely that any utility would locate outside that city. This $200,000.00 annual savings is not an economy of integration but it merely represents the savings available to the firm which best discerns the market.

Up to this point, this section has considered only configurations of two computers. Consider the distributed network in Figure III which consists of four message switching computers and two data processing computers.

Here the data processing computers are part of a large computer network and data is sent to them for processing purposes as it moves through the network. Of course, some of the data in the network may be passed on as a 'pure' message while other messages may be transformed or generate special data using the data processing computers.

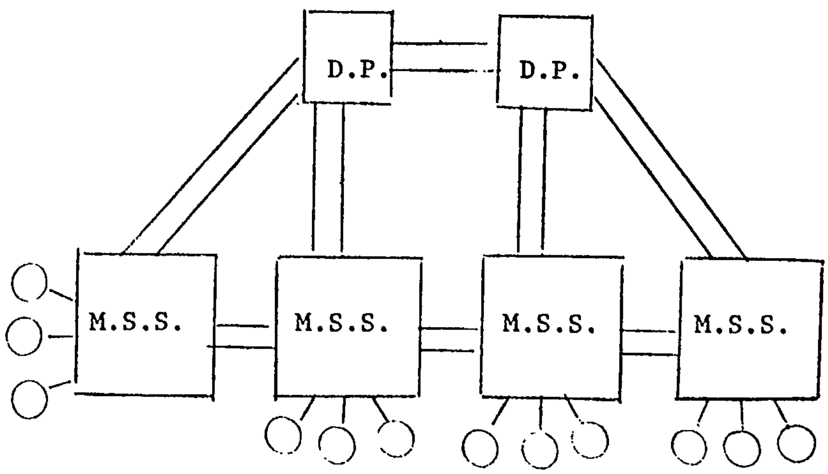

Figure III

Such a network is perhaps more realistic than the simple interconnection that was shown in Figures I and II. Since there would probably be many different areas of the country wishing to use such a system, it might be reasonable to centralize all dynamic files and do most of the data processing on a large centralized computer to take advantage of economies of scale.

The message switching computers on the other hand, may be relatively small but rather numerous in order to provide better line utilization and thereby reduce transmission costs.[12/]

12/ This statement assumes, of course, that the present trends will continue i.e. costs of computation are decreasing rapidly while transmission costs remain quite high.

In such a distributed network, it would be expected that the optimum location for the data processing computer would be dependent upon the geographical distribution of the data transmission traffic and transmission costs. It is very difficult to assess where it should be located since the computation of transmission costs for any network such as this, are quite complex and beyond the scope of this report. It may well be that the data processing computers should be in a location remote from any of the message switching machines in order to minimize transmission costs.

Potential Economies from Technical Factors

The next several paragraphs deal with possible computer-communication configurations in an attempt to summarize the conclusions of this section.

A number of assumptions have been made about the capability of individual companies to provide communications services of various kinds. These are described in the next few paragraphs and will be assumed unless stated otherwise.

Assumptions

It is assumed that:

(i) Any company can obtain the same communications services as the communications firm can supply itself.

(ii) As a consequence of (i), that any company can obtain a computer and offer a message switching service.

and

(iii) The communications firms are the only companies allowed to offer line switching service.

Assumption (i) implies that a situation similar to the one which gave Western Union (SICOM) an advantage over Bunker-Ramo (Telequote) could not occur. (19, p.73) In this case, Western Union was providing a cheaper communications service to its own system (SICOM) than it was to its customers, Bunker-Ramo, and Scantlin Electronics. This cheaper service was not an economy of integration, but rather an abuse of its monopolistic position.

Sample Cases

A number of examples will be examined to see if technical economies of integration exist in various configurations of line switching and message switching systems.

Case I Message Switching and Data Processing on the Same Computer.

This situation should only arise when (i) a very limited data processing load exists which can be run in conjunction with a message switching service, or (ii) a message switching service with a small load and limited data processing can absorb some of the spare time without hampering the message service.

In both cases, the reliability and design criteria would severely limit the data processing load. Under the assumptions made at the beginning of this section, it would appear that under the ownership by one company, both communication costs and computer costs should be the same for the same services.

The only economies that might occur would be small economies of scale where the new service might be integrated with the already existing Public Message Service.

Case II Message Switching and Data Processing on Two Separate Interconnected Computers.

If the message switching and data processing are performed on two separate but interconnected computers, then there are two suggested configurations of equipment as shown in Figure I and Figure II. In Figure I the two computers are in the same company and located close together. This represents the most economical configuration since the communication distances are short and data might be transmitted over a dedicated cable.

Figure II represents the configuration of equipment when the computers are separated by a significant distance. In this case, the data must travel over a communication line between the message switching computer and data processing computer at least twice. The marginal economies here are represented by the difference between communication costs over a five-year period (the usual depreciation period for a computer) and the rental of the direct link represented in Figure I. These marginal economies were given in Table III.

If the two computers connected together, have a five-year depreciation period and the data processing machine initially costs a total of $4,000,000.00 then the marginal economy from advantageous interconnection would be about 4.7% ($187,000.00 approx.), if 50 kilobit transmission was used.

By having the two computers located next to each other, there may be some economies associated with reliability of service. If we assume that the data processing and message switching computers are the same type, then probably only one computer needs to be available for standby service. If the computers are owned by separate companies, then at least one extra standby computer will be required for high reliability service.

Of course, there are two points to be raised here. Will the message switcher and the data processor both be the same type of computer? It is not clear that this would be an optimum design decision. Also since the message switcher is a store and forward system, can it retain all data processing tasks when the data processing computer is being serviced. Such a situation would obviate the need for a standby computer. Of course, the need for a standby machine is highly application-dependent and it would be difficult to discover if there are any economies here without looking at the reliability requirements of individual applications.

Summary and Conclusions

This section has examined technical factors which influence the design and implemention of computer systems which offer both communications and data processing services. It has defined the terms associated with this subject and considered the problem areas.

In particular it has examined -

(i) reliability criteria

(ii) design criteria

and

(iii) interconnection of computers.

We have concluded that communication functions and data processing should probably be implemented on different interconnected computers except where the data processing functions are very limited or where the message switching load is very light. This conclusion was borne out by the actual practices of many of the communications firms.

Since these functions were to be carried out on interconnected computers, we examined the methods of interconnection in order to determine if the communications companies could realize an economic advantage in this situation.

An investigation of two interconnected computers led us to conclude that small economies would result if the two computers were not remote from each other since communication costs would definitely increase the cost of the total message switching-data processing package.

An examination of the more general network problem indicates that it is not clear if any interconnection advantages exist since the "best" possible location for a data processing computer may be remote from the message switching computers. Economies caused by interconnection advantages are in fact, dependent on both the applications under consideration and the density of data transmission.

It would appear from a consideration of the technical factors involved in computing and communications, that any economies of integration are associated with advantages of interconnection. It is not clear in many cases whether such advantages exist. A comprehensive study of various computer networks might provide a more definitive answer.

TECHNICAL, SALES AND MANAGEMENT CAPABILITY

Three potential economies of integration mentioned are the economies of utilizing more fully the existing technical sales and management capability of the communications firms. These firms, it is argued, have extensive technical staffs which could be used with a minimum of training to maintain both existing equipment and additional data processing equipment. (The economy of technical integration on the research and development side will be discussed later.) While maintenance expenses are a significant portion of the operating costs,[13/] (20% to 30%), for there to be an economy of integration in this area, the carrier must have an excess maintenance staff which would have the time necessary to maintain data processing equipment. This staff must also have the necessary skills to repair and maintain sophisticated data processing hardware or be able to acquire these skills with a minimum of expense, so that combining communications and data processing in one firm would result in a lower maintenance expenditure for this combined firm as compared to two separate companies.

The estimates of maintenance costs given in the above paragraph are the costs incurred in maintaining the entire communications system i.e. local loops, microwave and coaxial equipment, terminals and switching equipment. It is obvious that maintaining a wire pair or microwave antenna or a telephone handset bears little resemblance to the maintenance required for sophisticated computer hardware. The President's

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13/ For example, in 1968, Bell Canada spent $131 million dollars on maintenance or 28% of its total operating expense budget.

Committee on Communications Policy suggested that out of the total cost of the telephone network, long distance transmission represents 17%, terminals 23%, local loops 15% and switching 45%. (20, p. 7)

If maintenance expenses for each of the functions of communications firms are incurred in proportion to the amount of the total network invested in such functions, then at most 45% of total maintenance costs are incurred for switching equipment. However, even this figure exaggerates the costs of maintaining electronic switching machines since the maintenance of step-by-step or cross-bar switching equipment is also very unlike the maintenance of a large scale computer system. It is only the proportion of the cost which is incurred in maintaining electronic switching equipment which represents an area available for integration savings. Assuming that 20% of total switching maintenance costs is applicable to electronic switching equipment is probably an exaggeration but can be used to show the magnitude of possible economies of integration. Under this assumption, 9% of all maintenance costs are open to integration economies (.20 x .45) or 2-3% of all operating costs (.09 x .30).

Table IV presents estimates of the relationship of maintenance costs to total rental costs for the major components of an average general purpose computer. While maintenance costs are as significant for general data processing machines as electronic switching equipment, general processing maintenance costs are expected to decline as computers become more self-diagnostic.

TABLE IV

Category	Maintenance Cost as a Percentage of Total Rental
Core Storage	6.7%
Central processors with core storage	7.2%
Controllers	8.4%
Central processors with no core storage	10.8%
Drums	12.4%
Disks	14.6%
Mass storage devices	15.5%
Tape Drives	16.2%
Card readers and punches	19.8%
Printers	20.0%

Source: W.F. Sharpe, The Economics of Computers, p. 275.

One question is whether in fact carriers do have excess technical staff and if these technicians have the skills necessary to maintain large scale data processing installations. We have no data to answer whether such spare capacity exists. As was suggested earlier, electronic switching systems are extremely reliable. When an error or breakdown occurs, elaborate self-diagnostic procedures are used in tracing the breakdown and technical maintenance of electronic switching equipment involves repairing a comprehensive known error. The maintenance of data processing equipment is far more a matter of isolating the problem than actual repair. At this time therefore, the requirements of technical maintenance for electronic switching systems and large data processing installations are different and thus diminishes the possibility of achieving economies of integration today. The introduction of general purpose computers for message switching purposes increases the possibility of achieving maintenance economies although the reliability of a machine's operating system is presently different when the machine is used solely for message switching than when it is used solely for data processing.

Economies resulting from integration in the sales and management force areas can be analysed in a fashion similar to the above discussion. The possibility of economies rests on the ability of the existing sales and management staffs to handle new ventures. This ability itself depends on the number of people or the time available for data processing and whether the existing staff has the skills to handle this new function. The degree to which economies will be possible then depends on the type of data processing service being offered by the carrier. For example, if the carrier offered a simple calculator service which would be utilized by any touchtone telephone, then the business office representative who sells coloured Princess phones could easily sell this new service as well. If the service offered was a large scientific program to be used by major oil companies then it is unlikely that the existing sales force would be competent enough in the specific area to adequately represent and sell this program.

While the possibility of economies of integration in sales is present, no measure of its possible magnitude can be made since there is little information available on the type of data processing service which would be offered, the size of the existing sales force and the cost of sales and promotion.

The economies of management are traditionally mentioned in all studies of integration and scale economies. One company rather than two avoids the duplication of bureaucratic structure of president, officer and directors, etc. In 1968, the aggregate direct renumeration of the directors and senior officers of Bell Canada was $1.3 million dollars or 0.2% of total costs. Savings on management would therefore not appear to be very significant. A related issue pertaining to management economies is not directly concerned with the pure savings of dollars achieved through aggregating bureaucracies but in the management talent which a large company has and small companies may be unable to find, afford or exploit. We make no judgments on the relative capabilities of carrier management as compared to the management of private data processing firms.

FINANCE

It is widely believed that a large diversified company can by issuing its own securities (debt or equity) finance a new subsidiary (say, in data processing) of size X and risk σ_X at a lower cost of capital than an independent processing firm of identical size X and risk σ_X. This belief therefore implies that investors prefer to purchase the securities package of a large, safe company, with a risky subsidiary to the alternative of buying separately the securities of a large safe company and the securities of a risky company.

In addition, risk elements aside, it is believed that a large company can issue securities at a lower cost of capital than can a smaller company.[14/] Therefore, these two reasons -- risk and scale -- are used to suggest that the economies of integration between a communications firm and a data processing frim would yield substantial advantages for the integrated processor which are unavailable to the independent.[15/]

There is no doubt that overall costs of capital differ. The cost of capital in some sense is a function of the overall business risk of the company (i.e. the risk of the net operating income). A

14/ A third element, the transactions costs of a securities issue which are not a function of the size of the issue, leads to lower per unit costs of financing for large versus small firms. This economy will be discussed later.

15/ There are, in fact, data processing firms which are the subsidiaries of large, non-communications firms (General Electric, IBM). Differences in scale economies between these firms and Canadian communications firms are not large. Therefore, arguments that a data processing subsidiary of a communications firm would have a lower cost of capital than these other integrated processors rests on some subjective analysis of the relative risk inherent in the respective parents.

large diversified company can be thought of as a weighted average of smaller companies each with its own risk. If the earnings streams of the subsidiaries are not perfectly correlated then the overall risk of the total earnings of the company will be reduced by diversification. However, a distinction must be made between the overall risk (or the overall cost of capital) and the marginal risk (or the marginal cost of capital). The marginal risk is the increase in risk due to adding another risky earnings stream. The fact that Canadian communications firms have lower overall costs of capital than do independent processing firms does not imply that the communications firm should have a lower marginal cost of capital in offering processing services than the cost of capital of independent data processors.

The average (overall) cost of capital is the mean cost per unit of capital inflow. The marginal cost of capital is the cost of the last unit or project to be added to the company. In this case, while the utility's average cost of capital is low because of the low overall risk in the area where it has a monopoly -- communications, the utility's marginal cost of capital for a new data processing project is higher than the average cost of capital because of the risk in competitive data processing which is not inherent in monopolized telecommunications. If there are no reasons why the data processing subsidiary of a telecommunications firm has a lower risk than an independent processor, then the cost of capital to the communications firm for this subsidiary should be no different than the cost of capital to the independent firm.

In order to understand this point let us define first the marginal cost of capital as the implicit cost of raising funds (debt and equity) and determined so that the current shareholders are no worse off after the investment of the funds at the rate of return equal to the marginal cost of capital. The marginal cost of capital can be considered a minimum rate of return that the investment project (in this case the offering by the communications firm of data processing) must earn. The cut-off rate used will depend on the risk of a data processor. This risk is therefore the same regardless of who undertakes the project, i.e. IBM, Bell Canada or an independent data processor, unless it can be shown that the communications firm cum processor has advantages over an independent computer utility (which we disproved in an earlier section). Therefore, we can conclude that a communications firm does not have an inherent advantage due to its diversified status in issuing securities for a data processing subsidiary; since the marginal costs of capital are equal and the issue prices and returns of the securities should reflect this fact.[16/] In other words, if the market is composed of rational investors, the investors do not prefer corporate diversification to personal diversification. Abstracting from true economies of scale, the individual investor can obtain the same degree of diversification as a large integrated firm and will not pay a premium (i.e. give the integrated firm a lower marginal cost of capital) to purchase the diversified earnings stream (3,4).

16/ While Bell common stock has changed little in the past six months, the shares of its subsidiary Microsystems International have dropped over 50% suggesting that investors do look at marginal not overall risk.

There is another common misunderstanding which would imply that the communication firm's marginal cost of capital is less than that of an independent data processor. Suppose the communications firm can issue debt at a 5% cost while their stock is selling to yield a 15% return to the investor. Assuming that interest payments are not tax deductible and the firm issues debt at 5%, the marginal cost of capital is not 5% but greater. Due to the issuance of debt the earnings stream of the existing shareholders becomes riskier and therefore the shareholders require a higher realized return to offset the increased risk. If the debt-equity ratio is unity, the marginal cost of capital is 10% and made up of the cost of debt funds and the implicit cost of equity funds. Therefore the cost of capital is not the cost at which funds are raised. (7) Even if the tax-deductivility of interest payments are introduced, the marginal cost of capital is not equal to the explicit cost of the funds raised.

Armed with this knowledge of the cost of capital we will determine the extent of economies of integration for the communications firm under various assumptions regarding the method used to finance its data processing subsidiary and the size of its subsidiary *vis-a-vis* its competitors.

I. Independent Subsidiary, All Processors of Equal Size

Assume that the subsidiary is independently financed (i.e. its own capital structure), there are no production economies of scale, and the subsidiary and its competitors are of the same size and risk. To raise funds the processing (subsidiary and independent) companies issue stock at a cost of capital of σ^K where σ^K is the after-tax cost of capital to firms of risk K. This cost of capital is the same to the subsidiary of the communications firm and to its competitors since it is the risk of the net operating income which is the crucial factor in determining σ_T^K and this risk is the same.

If the companies issued debt instead of stock, the cost of capital is $\sigma^K(1-TL)$ where T is the marginal tax rate and L is the long run ratio of the proportion of debt used to finance investments (7) 17/ This cost of capital when debt financing is used is less than the cost of capital when using equity issues. To the extent that L is the same for the subsidiary and its competitors the costs of capital will be identical. However, L is determined by management and may differ for each company in the data processing field. A priori there is no reason to believe that the subsidiary in the long run will have a greater propensity for debt (lower cost of capital) than its competitors. However, in the short-run the subsidiary's debt-equity ratio may be greater than that of independents since a new company will initially issue equity and shy away from issuing debt since debt will be purchased only if debt holders

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17/ Some companies in the long-run wish to finance 50% of their assets by using debt. This does not mean each investment is financed by 50% and 50% equity but that in the long run their capital structure will be half debt, half equity.

can place some important constraints on the behaviour of the company (e.g. payment of dividends, kinds of investments, etc.) However, the subsidiary may be able to use the parent's reputation to ensure that these restrictions are minimal and in the short-run, the possible debt-equity ratio may well be higher for the subsidiary than for the independents. In the long run, the new independent companies will move to their target L, and since the cost of capital depends on L there will be no gain to being a subsidiary, as long as the differences in debt equity ratios between independent and integrated processors are not functions of integration itself.

II. Independent Subsidiary, Subsidiary larger than Independents

Assume that all data processing companies issue equity, but that the subsidiary's issue is larger than its competitors. Since the issue is sold through an investment banker a fee must be paid. Let this fee be θ, measured as a percent of the dollar value of the issue. To the extent that there are economies of scale in issuing equity, $\theta_B < \theta$ where θ_B is the cost to the subsidiary and θ the cost to the competitors. Therefore the larger issue would have a lower cost of capital.[18/] However, the difference between θ_B and θ is usually small. There are two theoretical arguments on the effect of the size of the issue on the cost of equity capital. First we have the perfect market proponents who would argue that the size of the issue does not affect the cost of capital. A large issue can be sold at the same price as a smaller issue. On the other hand there are the imperfect market proponents

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18/ Since the cost of capital (net of fees) to the subsidiary is $\sigma^K/(1-\theta_B)$ and to the independents $\sigma^K(1-\theta)$ where $\theta_B < \theta$, $\sigma^K/(1-\theta_B) < \sigma^K/(1-\theta)$.

who argue that the larger the equity issue the lower the price. Therefore the cost of capital is greater for larger issues. The empirical evidence is mixed. Johnson (8) finds that the size of the issue is not important in determining the price of an issue. Archer and Faerber (1) however, find that the cost of capital is negatively related to the issue size; this result is inconsistent with both the perfect and imperfect market hypotheses. Therefore, a firm conclusion cannot be made on the effect of the size of the issue on the cost of capital. However, there is considerable evidence to support the perfect markets hypothesis and a priori we would lean toward their analysis that size of the issue is immaterial in determining the cost of capital.

III Completely Integrated Subsidiary

The last alternative we will investigate is that the communications firm incorporates a data processing subsidiary directly into its capital structure and issues its own debt or equity to finance the new company. This company is identical in size and risk to its existing competitors in the capital market.

The solution to this problem has already been presented; the marginal costs of capital are identical. The investing public will not pay a premium for the new package of communication firm cum data processor, over the independent purchases of stock in a communications firm and in a data processing firm. This case is introduced, however, to consider another problem, the effect of the size of the company issuing the securities. It is possible that if the communications firm is very large relative to independent processors the marginal cost of capital is less than the marginal cost for the independent data processors. The empirical evidence on this problem seems to indicate that the absolute size of the company issuing the equity does not have any effect on the cost of capital (1,6).

Summary - Finance

To the extent that economies of scale in production are absent, whether the communications firm financed its data processing firm as a subsidiary or as an independent company, there are no economies to be gained vis-a-vis the existing data processing companies. The marginal cost of capital will be the same for all companies since the risk is the same. The only economies that could be obtained by the communications firm would occur if the subsidiary were financed by a large equity issue since there may be some economies of scale in stock financing. However, the size of these economies of scale are not major. If they were, the economies would be available to all companies which had the same sized issue. Therefore, any new competitors in the data processing field would have larger equity issue.

The introduction of economies of scale in production would not affect the marginal cost of capital. The price paid per share for the equity issue would reflect the higher expected earnings and the marginal cost of capital remains unchanged. The price per dollar of expected earnings is equal to the inverse of the cost of capital and scale economies have no impact on the capital market price of earnings.

i.e. $P_1 = X_1/\sigma^K$ where X_1 is earnings of subsidiary without economies

$P_1' = X_1'/\sigma^K/\sigma$ where X_1' is the earnings of subsidiary with economies of scale present, $X_1' > X_1$ and P_1' is the price per share if there are economies of scale.

and $P_1/X_1 = P_1'/X_1' = 1/\sigma^K$.

Finally, there is one reason why a subsidiary of a known communications firm may have a lower cost of capital than a new unknown independent processor; there could be imperfect information among investors. While investors may have no reasons to believe that a subsidiary of a communications firm had any advantages over its independent competitors, the investors still have the proven record of the management of the communications firm in other ventures as compared to the unknown talent of the managers of the new independent processing firm. This 'track record' could well lead to a lower cost of capital for the subsidiary. In addition, the ability to raise money at the minimum rate may depend not only on what you do but who you know. The managers, officers and directors of a larger established communications firm will have all the necessary contacts, contacts which may escape the managers of the smaller, independent processor. It is difficult to evaluate these effects on the cost of capital, but they are small. The capital market is the nearest market to the economist's dream of perfect markets and investors are rational; if they were irrational in a perfect or near perfect market, they would not remain investors but would become paupers. We therefore expect that the subsidiary of a communications firm could attract capital at a rate only marginally lower than an independent processing firm.

ECONOMIES OF RESEARCH AND DEVELOPMENT

It is argued that the juxtaposition of processing and communications in one firm will result in significant economies of scale in research and development in a number of ways. First, unnecessary duplication of research and development expenditures will be avoided. Secondly, an operation under one roof, so to speak, allows the free flow of information and testing of ideas which are so important in adequate innovation. Third, there are substantial economies of scale in R & D, and communications firms are larger than independent processors. Finally, the carriers have established skills in electronics research and development including sophisticated electronic switching machines. To maximize Canadian expertise in this area, it would be unwise to refuse the firms with the largest established research and development activities, the right to enter the area. Each of these points will be discussed below. The first necessary question is to enunciate exactly the connection between data processing equipment and communications equipment which requires integration so that developments in either data processing or communications ensue.

Communications facilities affect the computer only when distant terminals must be connected to the processor. When this occurs, the data processor is dependent on the ability of the communications network to forward the data without error and at the fastest possible speed at minimum cost. A carrier need not however be a data processor to realize the problems of transmission, since the complaints voiced by data firms involve transmission and not processing. In addition, it is difficult to see how being a processor will yield more information to the communications firm on the problems of a low speed high frequency analog voice system for data use. We do not feel that being a processor would add significantly to the research and development ability of a carrier to innovate better modems, etc., since the problem is one of interface and the problems of interface are well catalogued. That the carrier cum processor would develop new processing tools (rather than the new carrier tools as described above), is also of probable negligible importance. It is difficult to envision any possible changes in information flows or risks resulting in new hardware emanating from the merging of communications and processing in one firm. The carriers themselves already have large internal processing departments, many of which are interactive systems and yet communications firms have not developed better ways to build either mousetrap (i.e. processor or transmission device), it is therefore unlikely that the addition of processing which is to be offered outside the carrier will lead to any new such economies.

Returning to the general question of whether the greater size and increased diversification of communications firms cum processors will generate substantial economies in research and development, the evidence is inconclusive but tends to show few such economies. It has been argued that only the very large firm can afford R & D and that therefore there are substantial scale economies. (9) Quantitative evidence shows in general slight scale economies up to a minimal scale of firm and thereafter negligible or decreased economies (10, 11, 12). Moreover, the change in the size of communications firms resulting from entry into data processing is hardly significant enough to generate new scale economies in R & D where none existed before. The arguments on the impact of diverisification suggest that the ability to counterbalance different risks and uncertainties leads to economies of diversification in R & D (13). Again, available quantitative evidence is inconclusive with various studies showing contradictory results (12, 14). The available literature on the effects of monopoly power, concentration and barriers to entry on R & D activity does suggest a slight positive effect on research of market dominance (12, 15).

However, the relevant issue is that Bell Canada and Northern Electric do have significant research departments and the degree to which they direct their efforts in the computer field will be a function of the degree of business which computers and data processing offers the two companies. It is therefore unlikely that while any economies per se of research and development will occur, integration would direct research efforts in Northern Electric and Bell towards data processing.

OTHER POSSIBLE CONFIGURATIONS

This report, up to this point, has discussed possible savings emanating from economies of integration in the internal operations of a communicator cum processor. This section will deal with the savings which may accrue to the customer of a processing or communications firm as a result of the combined offering of data processing and message switching (i.e. savings external to the communicator cum processor).

A firm today which wishes to implement a complete communications and processing system for its many branches may well find itself dealing with three separate firms - a communications utility, a hardware manufacturer and software development compny. If a company which needed a complete information system could deal with one rather than three separate firms, savings in negotiations, in clerical time spent in the accounting and payments functions would occur. In the following paragraphs we attempt to show that there are several configurations and relationships among suppliers other than which will yield the same economies to the customers as the case where the communications firm itself offers the data processing service.

Consortium or Joint Venture

As an alternative to the communications firm, offering of a complete package of communications hardware and software, consortia or joint ventures could be established among existing communications firms, hardware suppliers and software merchants to develop special systems for large users. Such consortia could offer the savings advantages of the reduction in transactions costs which eminate from dealing with a single firm. Such joint ventures would allow the development of a group with sufficient size, skill and flexibility to meet the demands of any larger user. The question of responsibility and integrity could be met as it is met in other industries by designating one of the three component members of the venture as the prime contractor (not necessarily the communications firm). We feel that this idea is an appealing one, since it would increase the information flows and working ties between companies who could act together. The joint venture idea would allow the communications firm to be involved in the new developments in teleprocessing, allowing the communications utility to shape the environment so that it can best fulfill its diverse functions without necessarily involving the communications firm directly in the offering of data processing or software services.

Communications Firm as Broker

While the special venture approach is a useful way of meeting the needs of large users while minimizing transactions costs for such users, the small user is obviously not in a position to afford such special services. Having the communications firm act as a general broker for diverse software packages while maintaining their availability on a number of hardware systems would assist greatly both the small user and the small software purveyor. The idea of the communications utility as the Sears-Roebuck of software is at first glance a most promising idea, however, the nature of the communications utility as a regulated monopoly unlike the standard mail order house requires strict regulation to ensure that unfair business practices do not arise. The software mail order house would have to agree to catalogue and to sell with equal effort, all software packages which meet certain minimal standards since there is no competitor to the software Sears-Roebuck. Naturally, the standard mail order house does not have to stock all the goods available since there are competitors available to the mail order house. The potential user of this software order house (any telephone user) would have complete information on all software available for certain tasks. The software Sears-Roebuck firm (Bell Canada) would offer real savings to both the independent software merchant and user since it could undertake individual billing, a task at which it excels. This concept would require examination in depth before implementation since there are many factors which tie users to certain purveyors of computing services.

SUMMARY AND CONCLUSIONS

It has been concluded from this study that there may be economies of integration in allowing communications firms to offer data processing services, but any economies which do exist appear to be quite small.

In the technical area small economies might result by minimizing communications costs and by slightly improving hardware utilization; however, the indications are that these will not have a large affect.

It is not obvious either that the existing sales, maintenance or management staffs of carriers have the excess capacity or necessary skills to handle the new venture of selling computing power and applications outside the firm.

Given that the interface between communications and processing is well defined, that the carriers have significant internal processing departments, and that the addition of data processing units to sell outside the firm would not alter the scale of the carrier significantly, we can see no advantages of integration in the research and development acitivity.

The literature in the field of finance has been cited to suggest that there are few economies of large size or integration in the cost of capital. The recent 50% decline in the share value of Micro Systems International (a Bell Canada Subsidiary) also suggests that investors are interested in the marginal cost of capital, the riskiness of the new venture's earning stream, and not in the parent's average riskiness.

It was shown that although integration yields economies external to the firm, savings of transaction costs to the user, there are several alternative configurations of existing communications firms, hardware suppliers and software developers which can offer both the large and the small user these same savings of integration.

Finally, the integration discussed in this paper consisted of the new venture becoming an operating division of the carrier, sharing equipment, manpower and financing. If there are negligible economies in this type of close knit integration, the economies of integration between a carrier and a separately managed, separately financed, arms length subsidiary are nil.

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APPENDIX I

A Simple Model Illustrating the Cost Trade-off Between Economies of Scale and the Increased Probability of System Crashes

Assume that the communications firm wishes to offer data processing services on its message switching computer.

Let i be the number of messages moved through the telecommunications system per unit time. If we assume for simplicity, that each message is of the same length, then i*, the number of minutes of computer time used per message, can be determined. The total cost, C_t, of the telecommunications system can be written as -

$$C_t(p,i^*) = \alpha+f(i)+p(i^*)r$$

where α is the fixed cost (computers)

$f(i)$ is the variable cost $f(i)>0$

$p(i^*)$ is the probability of systems failure per unit time at usage rate i^* $p(i^*)>0$

and r is the cost of a systems failure including both out of pocket costs and goodwill costs.

We assume that the probability of failure increases with increased usage. The expression $p(i^*)r$ is the expected cost of a failure at usage level i*.

Suppose we allowed data processing as well as telecommunications and assume that the probability of a failure does not change. The introduction of data processing increases the usage rate of the computers per message to i** where $i^{**}>i^*$ for a given i. Therefore, the total cost at the new usage rate i** is

$$C_t(p,i^{**}) = \alpha+f(i)+p(i^{**})r$$

The average cost C_a per minute used is

$$C_a(p,i^*) = \frac{\alpha+f(i)+p(i^*)r}{i^*}$$

for usage rate i^*, and

$$C_a(p,i^{**}) = \frac{\alpha+f(i)+p(i^{**})r}{i^{**}}$$

for usage rate i^{**}

This means that

$$C_a(p,i^*) > C_a(p,i^{**})$$

since $C_t(p,i^*) = C_t(p,i^{**})$

and $i^{**} > i^*$

This analysis implies that economies of scale are generated from the excess capacity of the computer and that the variable costs are functions of the number of messages and not the time used in data processing per message.

We assumed that the data processing function will not alter the probability of a system failure. This is not the case. Adding the data processing function increases the probability of a systems failure at every given usage rate.

If we denote this increased probability of failure by q then,

$$q(i^{**}) > p(i^{**})$$

for all i^{**}.

The probability increases since the telecommunication function requires a simple storage and forwarding of data, whereas data processing requires manipulation.

Therefore, the total cost which is a function of usage level and probability of failure is

$$C_t(q,i^{**}) = \alpha+f(i)+q(i^{**})r$$

and the average cost per message is

$$C_a(q,i^{**}) = \frac{\alpha+f(i)+q(i^{**})r}{i^{**}}$$

Since the cost per system crash has increased, i.e.

$$q(i^{**})r > p(i^{**})r$$

then $C_a(q,i^{**}) > C_a(p,i^{**})$

This means that apparent economies of scale caused by performing data processing tasks on messages on the same computer will be at least partially off-set and may be completely off-set by the increased cost of system failure.

APPENDIX 11

Transmission Costs

Rates for Multicom Service

Intercity

Half Group Service - 19.2 kilobits/second

Full Group Service - 40.8 kilobits/second or
50 kilobits/second

Minimum
Monthly Charges

Transmission Rate (kilobits/sec.)	19.2	40.8	50
Flat Rate	$375.	$275.	$275.
Access Line	$250.	$300.	$300.

Transmission Charges (in 6 second increments, distances used are airline distances)

Mileage \ Transmission Rate (kilobits/sec)	19.2	40.8	50
Up to 200	$.175	.35	.35
200 - 425	$.225	.45	.45
425 - 650	$.275	.55	.55
650 - 1000	$.325	.65	.65
1000 - 1400	$.375	.75	.75
1400 -	$.400	.80	.80

Cost of Communications Adapters

IBM 2701 $500.00/month - 2 needed

Cost of Direct Computer Connection

Central Processing Unit to Central Processing Unit	= $290.00/month
or	
Channel to Channel	= $290.00/month

Sample Calculation

Amount of data to be transmitted = 3×10^9 bits/month

Transmission Rate = 50 kilobits/second

Number of six second increments required

$$= \frac{3 \times 10^9}{50 \times 10^3 \times 6} = 10^4$$

Cost of transmission over a distance of 500 miles

$= 10^4 \times .55 =$ \$5500/month

Total Cost = Minimum Monthly Charges x 2

+ Transmission Cost

= 1150 + 5500

= \$6650.

APPENDIX III

Transmission Costs

Rates for Intracity Service

Monthly Charges for Short Distance Communication
(two or three city blocks)

$1,000.00 per month including modems.

Monthly Charges for Short Distance Communication[1]
(up to 20 miles)

Local Loop and Modems	=	$1,100.00/month
Transmission Charges	=	$ 100.00/month

A distance of 2 miles will be assumed in all calculations involving transmission charges.

1. These figures obtained from a conversation with Bell Canada, are only estimates of the costs, since accurate figures were not available. No price quotes for intracity communication at 50 kilobits per second have ever been requested.

APPENDIX D

COMMENTS

ON

APPENDIX C

THE ECONOMIES OF INTEGRATION

COMMUNICATIONS AND DATA-PROCESSING

(Dr. D. Cowan and Dr. L. Waverman)

by

Dr. John deMercado

February 5th, 1971

SUMMARY

This report deals with economies of integration associated with lumped computer-communication networks, and as such its findings are not applicable to distributed computer-communication networks.

The concept of a lumped (localized) computer-communication network, ie, one in which a computer is attached to a switching node in a telecommunication network, leads to considerations about reliability, redundancy, downtime, sharing and economies of integration, etc., which are completely different than those of a distributed network. In distributed networks, compatible computers are distributed geographically and in such a situation, redundancy, reliability, etc. cannot be identified in terms of parallel standby computers, but rather depends on switching properties of the network, and load versus time operation of the other computers in the network. The distributed approach is seen from some Carrier viewpoints, as the probable realization of their nation-wide computer-communication network. Thus this writer wishes to emphasize that the findings of the Cowan and Waverman study must not be applied to such cases.

This report is an excellent readable study of space-switched lumped computer-communication networks. Its finding are for the most part not relevant or applicable to analog and/or digital, space or time switched distributed computer-communication networks. Thus it does not really deal with the real questions of whether or not there will be economies of integration in a distributed network*) that is a probable ultimate realization of a national computer-communication network.

As far as the specific report is concerned, too much attention is devoted to the question of whether or not (ESS) computer-controlled cross bar switching systems could perform as computer processors. The well known conclusion, is of course that they cannot, in any real sense of the word. Furthermore, less than 8% of the switching in the Bell Area is ESS and outside of the Bell Area there is almost no ESS switching. It appears that what the authors are saying is that if telephone companies adopt ESS switching facilities in their analog network, then such a network could not in any stretch of the imagination be thought of as a realization of the computer utility. This is of course another reinforcement of the widely advanced argument that the telephone network which is optimized for voice traffic is not capable of meeting the heavy loading demands that a nation-wide computer utility could make of it, and that a "separate" dedicated network would be required. Thus, it would have been appropriate if the authors had gone on to a detailed discussion of the economies of integration in store and forward distributed computer-communication networks, that were separate (or integrated with) the existing networks. For example, they could have

*) This writer is not saying that there are economies of integration in distributed networks, only that the Cowan & Waverman's arguments cannot be used to resolve the question one way or another.

examined what sort of economies of integration were involved if the Carriers were to adopt the IMP (of ARPA fame) to realize a distributed network.

The authors touch lightly on message switched (or store and forward) networks, but neglect to discuss the real questions such as, how much hardware? versus how much software?, and the relevance of various types of errors, such as channel errors, system errors, and signal processing errors, and their effect on the reliability and performance of such networks. The case for multiplexor-concentration could have been stated in a more quantative terms, as is done for example in the papers of Rudin*).

There are a number of specific statements that the authors make that this writer cannot understand, for example on page 9, the statement that "the input to the system has no effect on its reliability" should be qualified. It is not true for time switched systems where source errors can play havoc with switching. In addition even in analog systems it is well known that by "tampering" in a certain way with tones in the signal, "free" long distance calls can be made, etc.

In addition their discussion of reliability criteria has to be qualified. Catastrophic failures have different significance in lumped networks then they do in distributed networks; the authors make no reference to the latter. In addition while their reliability analysis of parallel standby in a lumped system is straightforward, it only confirms that the obvious namely, that without standby redundancy, the reliability of a lumped system leaves a lot to be desired.

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*) H.R. Rudin, Jr. "Data Transmission - A Direction For Its Future Development" IEEE Spectrum, Vol. 7 February 1970

H.R. Rudin, Jr. "Performance of Simple Multiplexer Concentrators For Data Communication" IBM Systems Architecture Research Labs, Zurich. Report RZ 347, Feb. 16, 1970.

However, their discussion is virtually meaningless in the context of distributed networks, because in distributed networks there is a tremendous amount of redundancy which cannot be identified in terms of standby computers.

This writer agrees with the authors, that it does not matter as far as economies of integration in lumped networks are concerned, whether a Carrier or some other party placed a computer next to a switching centre. However, he wishes to emphasize again that this conclusion in the distributed case does not follow from the authors arguments; and feels that the authors should have examined this result in the context of distributed networks.

Again, on page 15, the writer cannot understand the statement that in a message switching system, computer costs are small compared to overall system costs. This is difficult to reconcile with the fact that in the relatively simple telephone system, more than 40% of the costs are switching. The authors also agree with this figure (on page 31 of their report).

Their statement on page 15 that as "the number of computers in a message switched (store and forward) system increases, there may be fewer and fewer standby computers", is true, and is related to the reliability and distributed redundancy considerations outlined earlier. At this point the authors could have profitably pursued this idea further and modified their reliability analysis accordingly. Had they done this, they would have come to the real problem, namely, "are there really economies of single ownerships and integration to be achieved in distributed computer-communication networks, and conversely does a split of ownership of computer and communication hardware and software make economic sense in terms of reliability, maintain ability and flexibility of service offerings".

Finally, in this writer's opinion, Appendix I on page 55 lends nothing to the otherwise generally high quality of the report. The conclusion that "apparent economies of scale caused by performing data processing tasks on messages on the same computer will be at least partially off-set and may be completely off-set by the increased cost of system failure", is not proved by their model which virtually assumes this to begin with. It seems that one corollary of this statement, is that large general purpose computers do not make "economic" sense, or that special purpose computers should take preference as far as achieving economies of scale in lumped networks is concerned.*).

A more general and different argument has to be used to examine the trade-off's between economies of integration and probability of failure (reliability), before the conclusions of Appendix I, could be established one way or another. One possible approach (used by him in a different context) is presented by Howard**).

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*) The writer suspects that in a "properly designed" distributed network, this statement might be true.

**) R.A. Howard - Dynamic Programming & Markov Processes MIT Press 1960. In particular, Chapters 6 and 7.

APPENDIX E

The Canadian Computer/Communications Task Force

In a public announcement (copy attached) dated November 27th, 1970 Communications Minister Eric Kierans announced the establishment of a major task force designed to develop and recommend specific policies and institutions that can ensure the orderly, rational and efficient growth of combined computer/communications systems in the public interest. The Task Force is organized as an Activity Center within the Policy, Plans and Programs Branch of the Department of Communications according to the organization chart shown in Figure D-1.

There are five main sections in this organization:

1. The Task Force Proper

This consists of full time personnel housed in office space to be supplied by the DOC at 100 Metcalfe Street. The members of the Task Force will be a mixture of contract personnel drawn from universities and industry, and government officials, seconded from their regular departments for the duration of the program.

2. The Professional Advisory Committee

In order to ensure widespread public involvement in the Task Force work, the various non-government interested parties, e.g. the carriers, independent data-processing companies, Electronic Industries Association, Canadian Business Equipment Manufacturers Association, Consumers Council, etc., will be encouraged to set up their own independent study groups. These groups will work in parallel with the Task Force and will channel their ideas and comments to and from it via a Professional Advisory Committee made up of the chairmen of each of these independent groups.

3. Interdepartmental Advisory Committee

This body will contain representatives nominated by all of the Federal Government departments having an interest in the work of the Task Force and will provide a forum for transfer of ideas and comments between these departments and the Task Force.

4. Executive Committee

This committee will consist of the Task Force Director and senior officials of the Department of Communications and will provide a forum for management review of the work of the Task Force.

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5. Provincial Advisory Committee

The work of the Task Force is of direct concern to Provincial Governments for a number of important reasons:

1. Many telecommunications carriers are provincially chartered and some are owned by Provincial Governments;

2. Some provincial carriers have expressed a desire to enter the data-processing business and, in at least one case, Quebec Telephone, public data-processing services are currently being offered;

3. The construction and operation of national computer/communications systems networks are likely to involve the direct participation of provincial carriers and provincially chartered data-processing organizations;

4. Provincial Governments or their agencies may be involved in the provision of certain computer utility services e.g. educational networks, certain data banks, provincial police and hospital networks, etc.

These factors have been recognized in the organization of the Task Force, where a special Provincial Advisory Committee will be formed to provide a convenient mechanism for transfer of ideas and comments between the Provincial Governments and the Task Force.

Objectives

The major program objectives include:

- the analysis and forecast of national needs for computer/communications services;
- technological forecasts and analysis;
- the analysis of sociological and economic impact;
- the evaluation of possible Institutional Arrangements for the Agency;
- conceptual designs for, and cost/benefit analysis of, possible specialized networks; i.e., legal, financial, medical, S.T.I., resource, industry, consumer, raw computer power, etc.;
- conduct of certain critical experiments with small scale pilot systems;
- legal, constitutional and regulatory analysis;
- description of the required Research and Development;

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-- determining the required Government actions;

-- recommending a final Implementation Plan which will contain:

1) Description of and cost benefit analysis for a number of possible national networks.

2) Description of and justification for recommended institutional arrangements for the Agency including:

- Roles and responsibilities of all parties
- Administrative structure
- Agency organization
- Agency financial requirements
- Required legislative actions

3) Recommended implementation schedule

4) Manpower requirements

5) Technical/Sociological/Economic impact evaluation

6) Recommended government policies and actions.

Figure D-2 illustrates the relationship among the many project tasks involved in achieving these objectives.

CANADA

DEPARTMENT OF COMMUNICATIONS
MINISTÈRE DES COMMUNICATIONS

TASK FORCE ON COMPUTER/COMMUNICATIONS.

OTTAWA, November 27, 1970. -- Communications Minister Eric Kierans today announced the establishment of a task force designed to investigate the whole question of computer/communications interaction in Canada.

The chief task assigned the Group, the Minister said, was to speedily develop and recommend specific policies and institutions that will ensure the orderly, rational and efficient growth of combined computer/communications systems in the public interest. The Task Force will be expected to produce definite recommendations and firm plans -- technical, financial and institutional -- relating to an integrated network of Canadian computer utilities.

The merging of computers and communications systems, Mr. Kierans said, had given rise to a new industry, called the computer utility, which could become one of the most important elements of our economy within the next ten years or so.

If the promise of the computer utility is fulfilled, he continued, the general public may have as ready access to data-processing systems as they now have to telephony.

The impact that this development could have on social, economic and political institutions and habits make it a focal point in any system of concerns about the quality of Canadian life, he said.

It was therefore essential that policies and programs in Canada should favor Canadian control without excluding essential contributions of outside expertise and capital; and, he concluded, to achieve this the Government of Canada must establish a suitable system of priorities and provide the framework of institutions or policies in which systems may develop.

Amongst those present at the press conference, was Mr. Douglas F. Parkhill who, as assistant deputy minister, will be responsible for the Task Force on Computer/Communications. Possible objectives of a national system could include, he said: achieving the most rapid expansion of services and systems that is possible without unduly disturbing our ability to meet other urgent social priorities; ensuring the widest possible range of services to

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all social and regional groups in every part of Canada; ensuring adequate Canadian control and ownership; ensuring that the overall system design is flexible enough in concept and implementation to minimize problems of obsolescence and permit the rapid incorporation of improvements resulting from technological change; ensuring adequate protection for privacy, right of access and freedom of speech in all elements of the national system.

A special group formed within the Task Force will prepare a separate report on the critical area of privacy.

The task force on computer/communications in Canada will be headed by Dr. Hans Jacob von Baeyer, former president of Acres Intertel Limited. Earlier Dr. von Baeyer served as consultant to the Science Secretariat's study of scientific and technical information in Canada and Federal Government studies of domestic communications facilities, data transmission and systems, with an emphasis on the comparison of terrestrial and satellite communications.

Mr. Jules G. Nadon will be Executive Secretary and Director of administration. Mr. Nadon joined the Public Service Commission in 1966 as Director, Administrative Manpower Recruitment and Development Program. He also served in Paris where he was Attaché (Personnel) at the Canadian Embassy.

The Task Force will recruit some 25 experts from government, industry and universities. A preliminary report is expected by May 1971.

Mr. Kierans stressed that the task force's objectives will require cooperation with industry, users and other governments. He outlined some of the steps in the task: an analysis of national needs; technological forecasting; a study of social and economic impact, and, a definition of possible institutional arrangements. The Group will bring cost-benefit analysis to bear on particular networks that might be able to provide such services as legal, financial, medical and consumer information as well as raw computer power.

In order to assure widespread public involvement, various non-governmental interested parties, the common carriers, Canadian civil liberties associations, data-processing companies, the Electronic Industries Association, the Consumer Council and others, will be encouraged to set up their own independent study groups. These groups will work in parallel with the task force and will channel their ideas and comments via a Professional Advisory Committee made up of the chairmen of each of these independent groups. The task force will also make extensive use of contracts to universities and industry for specific studies.

Active cooperation of the provinces has also been requested.

The accelerating rate of advance of many countries in the field of computer/communications systems makes it imperative, said Mr. Kierans, that positive and rapid action be taken if we do not want to find ourselves far behind other technologically advanced societies. Quoting from a Telecommission Report, the Directorate for Scientific Affairs of the O.E.C.D. asserted recently in Paris: "Out of this widespread availability of 'information power', there will flow social changes and opportunities for human development that promise to make the next few decades among the most critical that mankind has ever faced". So we must make sure, concluded Mr. Kierans that this technology will serve us and not the contrary.

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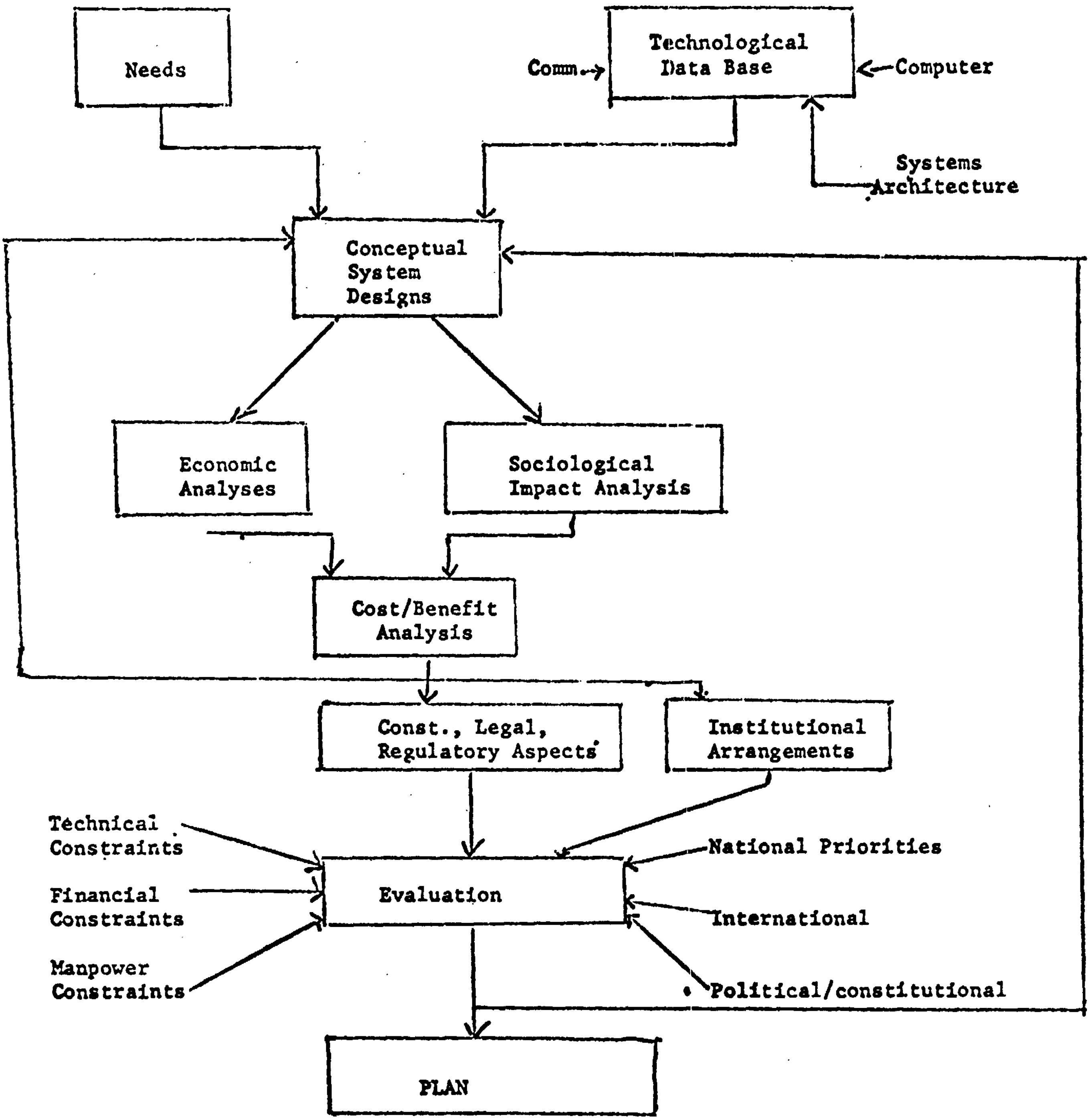
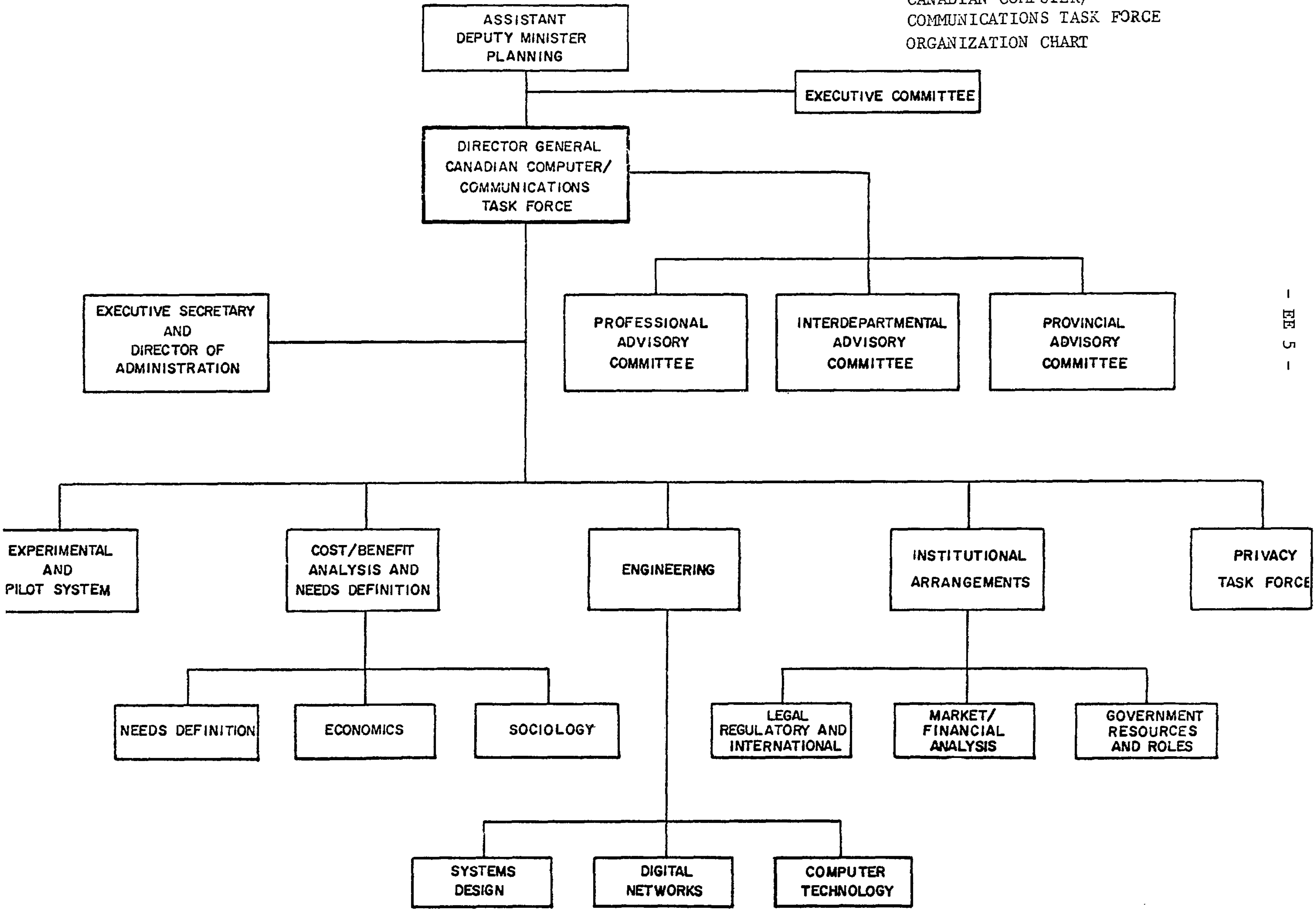
Figure 1

WORK FLOW



CANADIAN COMPUTER/
COMMUNICATIONS TASK FORCE
ORGANIZATION CHART



December 1, 1970