ECONOMICS OF INTEGRATING COMPUTERS
AND COMMUNICATIONS SYSTEMS IN CANADA

by

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B. Comm. (Bus. Ad.), University of Windsor, 1967

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF BUSINESS ADMINISTRATION

in the Faculty
of
Commerce and Business Administration

We accept this thesis as conforming to
the required standard.

THE UNIVERSITY OF BRITISH COLUMBIA

August, 1969
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Department of Commerce and Business Administration

The University of British Columbia
Vancouver 8, Canada

Date August 15, 1969
ABSTRACT OF THESIS

The success of the computer utility is extremely dependent upon the efficient interaction of electronic data processing equipment with high speed communication circuits. It is the purpose of this thesis to identify and examine some of the problem areas of a new and rapidly expanding industry. Emphasis is placed on the Canadian environment. However, the obvious influences of the related activities in the United States, are not to be neglected thus, the study includes numerous references to the American situation.

This is not a report on computer capabilities, nor a technical analysis of the computer-communications interface. Rather, this study deals with the overlapping concerns of the computer and communications industries, and the implications of these mutual interests. Major issues are the economic considerations, government involvement and the examination of social effects.

The paper consists of four main sections. The first of these is a general introduction, including a brief summary of data communication terminology.

The second section concentrates upon the present Canadian situation and serves to describe the current state of teleprocessing in this country. Also, it involves a survey of the present services provided by the common carriers and the available interface equipment which developers of a computer utility might employ. One of the traits of
common carrier services is regulation and this implies
government involvement. Pertinent jurisdictions of both
federal and provincial government bodies is described.
It is felt, that within this realm, extensive reference
to the actions of the Fédéral Communications Commission
in the United States is warranted. It's pertinence to
the Canadian scene will be brought directly into Section
Two, and this is supplemented by Appendix B which des­
cribes some of the relevant occurrences in the United
States as stimulated by the FCC.

One prime undertaking serves to tie these econo­
ic, political and social factors together. As a result
the thesis includes a review of progress towards a
Canadian telecommunications satellite and what it might
mean to cross country computer interactions in the future.

Section Three looks at some of the management
problems which are a part of data communication systems
development. The generalities which are characteristic
of any development recipe are applied to a specific case
study.

A study of this type leads to opinions and con­
cclusions being drawn by the author and these are outlined
in Section Four of the thesis.
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SECTION 1

INTRODUCING

DATA COMMUNICATIONS
CHAPTER 1
INTRODUCTION

No person will dispute the dynamic growth of electronic data processing in the last twenty years. A significant part of this growth has been the evolution of the computer telecommunications system. The introduction of third-generation computer machinery and the awareness by the common carriers that data communications has specific needs, these two events especially have provided catalytic influence to an already dynamic situation.

As usual, rapid economic growth in a business environment waits not for the desirable documentation of events. To this author's knowledge the present status of computer telecommunications in Canada has not been organized into a factual collection of pertinent data. The expanding fields of timesharing and information retrieval applications indicate a continued growth pattern for data communications systems in the foreseeable future.

This infers a need for relevant data by more and more people. The business manager requires comparative information on common carrier services available to him. The economics of developing a data communication system necessitates cost figures for various channel offerings, terminal equipment and data conversion units. Also of great importance to those who must consider development of teleprocessing networks is past experience of others. The
guidelines which might be the result of theoretical study and their practical application to a real-life system, when analysed, can prove extremely helpful when one reaches the stage of systems planning.

Advantages of such a study are not limited to the commercial environment. A need for government involvement and some indication of possible areas of concentration might be exemplified. References to experience in the United States and to qualified comments on the social effect of computer telecommunications might clarify the role of government in its position as the aegis of society.

To a lesser extent a collection of relevant data in this area might contribute to social awareness. Any technological developments which will probably have more effect on the individual in the next five years than will the placing of an astronaut on the moon certainly warrant some form of publicly available documentation.

These economic, political and social needs now become the purpose for this thesis.

A Brief Description of the Study

This is not a study of advanced electrical theory which influences the technological advances of data transmission. It is not an analysis of computer economics. It is intended as an all-inclusive report on the dependencies of the data processor and transmitter upon the interrelationships of equipment manufacturers and the common carriers.
Section One includes the introductory remarks and a summary of basic data communication concepts. The only technical knowledge required to understand 'industry terms' and the general implications of data flow are hopefully supplied in Chapter 2.

Section Two of the paper is intended to provide a detailed description of the Canadian telecommunications environment. The first of three chapters in this section describes the economic traits of the available channel services of the common carriers. This includes both public and private line services. Also some indication of costs of terminal and interface equipment is provided although a complete description of available equipment is beyond the scope of this paper. This chapter should clearly indicate to the system builder exactly what services are on the Canadian market.

A second chapter in this section deals with the governmental and social implications of data communications development in Canada. This is supplemented by an appendix (Appendix B) which describes events and regulatory policies already established in the United States by the Federal Communications Commission. Analysis in this area stimulated some personal opinions as to the direction regulatory policy might take in Canada.

The final chapter of Section Two is devoted to one technological development which is and will greatly influence the economics of data transmission. The development of the
communications satellite is described and forecasts of its commercial availability schedules and economic effects are offered.

Section Three is devoted to a case study of the planning and implementation of a data communication system. Although this author does see some useful purpose in articles which suggest systems planning procedures, it does not seem reasonable to develop another variation of this general theme. Rather, by describing a practical application in terms of more general systems development plans the reader might derive more insight of the problems involved in data communication systems design.

The author's investigations into these pre-described areas have produced some conclusions on his part. Section Four will deal with these conclusions and the rationale behind them.

To complement the main body of the thesis two appendices exist. Appendix A extols the virtues of graphic analysis in a study of data communications systems.

Appendix B develops a summary description of the recent activities of the Federal Communications Commission in the United States. It is felt that the newly established Department of Communications in Canada might be heavily influenced by past experiences of this body. Of special interest to the data communicator is Notice of Inquiry 16979, "Regulatory and Policy Problems Presented by the Interdependence of Computer and Communication Services and Facilities".
The main portion of data resulted from personal interviews carried out in Vancouver, British Columbia. This included discussions with representatives of the national common carriers, some of the computer manufacturers and various users of the available communication services. This was supplemented by correspondence with the Canadian Federal Government and other corporations such as Comsat and the Canadian Overseas Telecommunications Corporation. Also available printed material has greatly influenced the content of the final product.

Canada is a communications oriented nation. In 1967 there were more telephone calls in this country per capita than in any other country in the world.\(^1\) Although employment of data transmission systems is still minimal within this country it is now that a firm understanding of what exists and of future trends and desirable goals should develop.

Many questions must be asked. What service facilities exist for data transmission? What will exist in two years? five years? ten years? What controls can the common carrier impose upon the user? Should data processing as well as transmission be allowed by the same company? What degree of government control should exist?

The problems will not be answered as the result of

---

\(^1\) This data comes from an AT&T summary of facts on worldwide telephone usage entitled "The World's Telephone, 1967".
one research study. Rather it will take a devoted effort from government bodies, business corporations and academic faculties to create sufficient awareness of the field of data communications. Only when knowledgeable people can represent the attitudes and desires of these groups will there develop an adequate path to progress.

This author tackles the problem only with the hope that he will aid the readers comprehension of the subject by a matter of degree. As he enters this task the true feelings of the author are best summarized in the words of Robert B. Forest, editor of Datamation:

I can tell you exactly when the headaches started, Doctor. It was one hour after I decided I would write...about communications and information processing - yeah, computers - and how things are really. What communications services are available to computer users, and how the tariffs - no, not like duties. Like rates - are set and...Maybe if I try to explain it to you, it will help me clarify things and ease the nervous tension? Well, I doubt it but its worth a try.¹

CHAPTER 2
CONCEPTS OF COMMUNICATIONS AND DATA TRANSMISSION

Although, as previously mentioned, it is not the intention of this paper to concentrate on the technical aspects of telecommunications, it is hoped that the following brief will aid the reader with little technical preparation in understanding the basic principles underlying a computer-communications system.

To facilitate the transmission of commercial data, the common carriers have developed a wide range of telephone, telegraph and wide band networks to support demands of the business community. To employ these networks, acceptable input for network terminals must be prepared by computer output equipment. Also, a code conversion to provide suitable signals for the communication channels is necessary.

Figure 1 illustrates a sample computer-communications system to show the applications of electronic data flow.

Electrical transmission of information is carried from one terminal to another over a communication channel. The channel might be one of three basic types. A simplex circuit can carry information in only one direction, i.e. a doorbell. Half-duplex circuits can carry information in either direction, but only one direction at a time. A full-duplex or duplex circuit can transmit information in both directions at once.

Also of importance are the channel grades. Presently available grades are telegraph, sub-voice, voice grade and
Generally the major function of a data set is to convert business machine signals into tones suitable for transmission over telephone facilities or vice versa. In this illustration the signal conversion unit (i.e., data set) also performs code conversion. Although computer manufacturers market separate units for this purpose there is no reason why it cannot be a function of the data set.
broadband. The grade is determined by the capacity of the circuit to transmit data per time unit, i.e. by the basic line speed. This speed is usually referred to in terms of bits per second, characters per second or words per minute. Because different codes require varying numbers of bits per character, and due to the vagueness implied by the phrase words per minute, all comparative references to different services will be made in terms of bits per second - in the common ASCII code one word = 6 characters = 48 bits.

There is a direct relation between line signal capacities and channel bandwidth. Practical applications have indicated that in general a ratio in the vicinity of two to one is necessary where 2X cycles are required to transmit X signals per second efficiently. The services of the common carriers are an example (see Tables 3-I and 3-II). At present, however, technological advances are apparently outdating this statement.

Line speeds for telegraph grade channels, 150-200 cycles, range from 45 to 75 bits per second. Sub-voice

---

1 Until recent advance in technology the limit between bandwidth in cycles and data transmission is one signal per cycle (i.e. a channel with a 4K bandwidth has a theoretical limit of 4000 signals per second). A technique called duo binary signaling however has been developed which allows the transmission of two bits of information per signal unit.
circuits generally range from 150 to 600 baud (bits per second) where bandwidth is between 400 to 2000 cycles. Voice grade channels range from 3 to 4 kilocycles, while line speed might vary from 1600 to 2400 baud or even higher.

Different grades of wire use different signaling methods. The more common techniques are serial start-stop, serial synchronous, and parallel (18). Serial codes are transmitted one bit at a time, with all coming over the same channel. Each code requires a set number of bits per character. Where it is necessary to indicate the beginning or end of a character by bit signals we are talking of serial stop-start transmission. Synchronous serial signals do not require the start and stop signals for a specific character. Parallel transmission refers to all the bits for one character being transmitted simultaneously over individual channels.

Adaptation of computer signals to facilitate transmission over communication lines requires data sets. Data sets are also referred to as modems, modulator-demodulators, sub-sets and line adapters. The data set forms the interface between communication lines and computer equipment. The data set receives, translates and transmits coded data. Obviously, the bit rate or rate of handling of the data set is very important, as this like any other part of the system could prove to be the limiting factor in systems speed. The computer communication system is only as fast as its slowest link.
Another important consideration is the coding system. The common unit to all codes is the bit. It is easily seen that the fewer bits per character within a code, the faster the character might be transmitted. However this advantage is counteracted by the limited variations in bit configuration. The character set might be much more extensive for instance with an eight bit code than with a five bit code. It is sufficient for our purposes to isolate the ASCII and Baudot codes which are commonly used for data transmission. The American Standard Code for Information Interchange (ASCII) is an 8 bit code that has been approved by the American Standards Association for use on all public communication lines. Other services employ the Baudot code although its character set is somewhat limited because it is a 5 bit code.

One further code component should be introduced. To improve the reliability of transmission, many codes employ a parity bit. This is a one bit per character checking device and could call for either even or odd parity. Using odd parity, for example, each character transmitted would require an odd number of 'on' bits. If not, this would indicate a transmission error. The parity bit would be 'on' only when needed to make the odd bit. The receiving terminal would detect a transmission error if it did not receive an odd number of 'on' bits. This is one of many methods to enhance reliability.

Data can be transmitted, not only over telephone
lines but also microwave communication systems. Transmission speed is limited only by the bandwidth and terminal equipment speeds as well as data set speeds. (Most microwave channels are of the broadband or wideband nature). Telpack services have bandwidths of 48 KC, 96 KC, and 240 KC and maximum transmission rates of 40,800 baud, 84,000 baud and 100,000 baud respectively.

Long distance broadband data transmission employs a Trans-Canada microwave system. Microwave transmission uses frequencies above 4 million cycles to transmit in a straight line between repeater stations with their dishlike antennae. These reamplifiers are necessary every 20 to 25 miles across Canada to transmit the signal.

One further distinction should be drawn - that is the difference between analogue and digital communication systems. Information flow within the system may remain in a continuous form, simply by translating one continuous variable (i.e. distance) into another continuous variable (i.e. electric current). Such a technique is one means of analogous data transmission. Human recognizance of information, however, often requires a more discrete format to become meaningful. This necessitates a digital breakdown which expresses with meaning, the 'message' in terms of symbols such as numbers or characters (4, Ch. 2). An example of an analog signal system is an amplitude-modulated broadcast system. Pulse-code modulation is one form of
digital data transmission.\footnote{Baghdady Elie J., Lectures on Communication System Theory, 1961, pp 3-4.}

It has been projected that the techniques of digital transmission will likely replace analogue methods in TV and voice systems (1, Ch.1). The major importance of digital communications in the computer environment is that it facilitates the processing of data by digital computers.

This completes a brief introduction to some of the terminology necessary to discuss meaningfully data communications. Further insight into the technical aspects of data transmission may be found in (1,4,18,23).
SECTION 2
THE PRESENT STATUS OF
DATA COMMUNICATIONS
IN CANADA
CHAPTER 3
COMMUNICATION TRANSMISSION FACILITIES IN CANADA

Communication transmission facilities available to computer users in Canada can be classified into three general groups. This breakdown is based on the bandwidth and transmission rate of the different services. Sub-voice or narrow band services include all facilities using a bandwidth below 2 KC and having transmission rates below 1000 bps. Voice grade channels might range between 2 and 4 KC with present maximum transmission capabilities approaching 9600 bps.\(^1\) Wideband services involve the grouping of many voice channels to develop a bandwidth extended from 8 KC to 240 KC by additives of 4 KC or one voice channel.

The two major communication systems in Canada provide competing and yet distinctive services. An analysis of these services, their significant traits and the related rate struc-

\(^1\) To avoid confusion when referring to maximum transmission rates it is necessary to differentiate between signal units and bit transmission. Most of the common carrier reference data as discussed in this chapter defines maximum line capacities in terms of bits per second. This approach assumes a relationship of one bit per signal. Actual line capacities should be referenced in terms of signal units per second. The confusion arises with the innovation of duobinary signaling (and possible multiples of duobinary) which allows for the transmission of two bits within one signal unit (p. 9). Therefore while a Schedule 4C line (see Table 3-I) is said to have a maximum rate of 2400 bps this actually means 2400 signal units per second. Technological advances allow for 4800 or 9600 bits to be transmitted at this signal rate.
tures, and the existing networks within which these services are available, will provide the analyst with that data most pertinent to any specific feasibility study of a computer-communications system in Canada.

A summary of these services is given in Tables 3-I and 3-II. Table 3-I lists the transmission facilities of the Trans-Canada Telephone System, and Table 3-II shows the corresponding facilities provided by the Canadian/National/Canadian Pacific network.

For comparative purposes, it will suffice to divide these services according to transmission rate. Separate segments regarding low speed, medium speed and high speed transmission will be presented.

The area of data sets will only be discussed generally while describing the services. They will be dealt with specifically after the various services have been described.

LOW SPEED TRANSMISSION FACILITIES

CN/CP TELEX

Service Description: Telex is an international 50 baud (bits per second), full-duplex network, which is equivalent to a capacity of 100 words per minute transmitted in Baudot code (5 bits/character, 6 characters/word). Telex is a dial up system. By employing a regular telephone-type dial which is a part of the terminal, initial contact can be made with any of 16,000 terminals in Canada or one of the 200,000 users
Table 3-Ⅲ-

BRITISH COLUMBIA TELEPHONE TRANSMISSION FACILITIES

<table>
<thead>
<tr>
<th>Name of Service</th>
<th>Bandwidth</th>
<th>Transmission Rate</th>
<th>Transmission Mode &amp; Code</th>
<th>Cost</th>
<th>Interface Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schedule 1</td>
<td>Narrow Band (150-200 cycles)</td>
<td>45 bits/sec</td>
<td>Most services are serial mode and ASC II code</td>
<td>Transmission rates are shown in Table 3-V, 3-X and 3-XI and an indication of terminal rates appears in discussions of the various services</td>
<td>Data sets are bought by the carrier and leased at monthly rates which include servicing</td>
</tr>
<tr>
<td>Schedule 2</td>
<td>Narrow Band</td>
<td>55 bits/sec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schedule 3</td>
<td>Narrow Band</td>
<td>75 bits/sec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schedule 4</td>
<td>Voice Band</td>
<td>1200 bits/sec</td>
<td>Datasync 5# is parallel mode. (see discussion of voice-grade transmission)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schedule 4A</td>
<td>Specially conditioned Voice Band</td>
<td>1600 bits/sec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schedule 4B</td>
<td>Specially conditioned Voice Band</td>
<td>2000 bits/sec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schedule 4C</td>
<td>Specially conditioned Voice Band</td>
<td>2400 bits/sec</td>
<td>(2800 bps possible)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telpak A</td>
<td>48 kilocycles</td>
<td>40,800 bits/sec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telpak B</td>
<td>96 kilocycles</td>
<td>84,000 bits/sec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telpak C</td>
<td>240 kilocycles</td>
<td>100,000 bits/sec</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* The optimal capacity of telephone voice grade channels is 2800 bps. However with minimal maintenance and testing only the Schedule 4 level of 1200 bps can be ensured. Schedules 4A, 4B, and 4C necessitate more frequent testing and maintenance of facilities and are optional at a higher cost.

** These are collectively referred to as TWX services.

# This is a voice grade terminal service referenced later in this chapter.
<table>
<thead>
<tr>
<th>Name of Service</th>
<th>Bandwidth</th>
<th>Transmission Rate</th>
<th>Transmission Mode and Code</th>
<th>Cost</th>
<th>Interface Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telex International*</td>
<td>Narrow Band</td>
<td>50 bps</td>
<td>Serial</td>
<td>See all data sets</td>
<td>all data</td>
</tr>
<tr>
<td></td>
<td>or Sub Voice</td>
<td></td>
<td>Baudot</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(approximately</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>200 cycles)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Telex*</td>
<td>same as Telex</td>
<td>110 bps, channel</td>
<td>Transmission</td>
<td>To client wishes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>capable of 200 bps, restricted by output terminal gears.</td>
<td>Transmission rates (8 bits/char)</td>
<td>and leased monthly at rates which include servicing</td>
<td>Table 3-VII</td>
</tr>
<tr>
<td>Broadband</td>
<td>4KC</td>
<td>0-2400 bps</td>
<td>Serial</td>
<td>See</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>ASC II</td>
<td></td>
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<td>of 272 KC)</td>
<td>data set or</td>
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<td>terminal restrictions</td>
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* Both Telex and Datatelex employ the same channel network. The variation in services is actually restricted to terminal differences.
Line Charges: Charges are based on fixed monthly terminal rental plus variable line charges related to usage. Canada has been subdivided into 24 regions to develop a rate structure. All locales and their regions are listed in "Schedule of Telex Toll Charges and Tel-tex Information" available through CN/CP Telecommunications. The corresponding rate-region relationship is supplied in Table 3-III. To supplement this, Figure 3-I shows the regional breakdown of the United States, and Table 3-IV indicates representative rates between these areas and major Canadian cities.

It is natural that a system of rigid geographic boundaries to determine rates should lead to inconsistencies. An example of this irregularity are comparative rates of a Brantford-London transmission and London-Windsor transmission. Both would occur in the province of Ontario. However the first call which covers a distance of 51 air miles would cost $ .20 per minute. This involves Area 7 and Area 8. On the other hand, the London-Windsor transmission covers 102 air miles between Areas 9 and 10 and the cost is half as much, $ .10 per minute. This is one of the many situations which serve to defend the argument that a thorough study of existing rate structure is advisable when undertaking a specific project. An ad hoc analysis of distances between desired terminals might lead to a distorted picture and improper decisions when developing a computer-communications...
### TABLE 3-III

**TELEX AND DATATELEX**

**TOLLS PER MINUTE BETWEEN EXCHANGES IN CANADA**

| RATE AREAS                  | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13   | 14   | 15   | 16   | 17   | 18   | 19   | 20   | 21   | 22   | 23   |
|-----------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1 Newfoundland & Labrador  | .10  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 2 Maritimes                 |      | .37  | .10  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 3 Quebec East               |      |      | .45  | .37  | .10  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 3A Quebec North East        |      |      |      | .45  | .30  | .15  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 4 Quebec Central            |      |      |      |      | .52  | .37  | .10  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 5 Quebec North West         |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 6 Ontario East              |      |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 7 Ontario Central           |      |      |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 8 Ontario South West        |      |      |      |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 9 Georgian Bay              |      |      |      |      |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |      |      |      |      |      |      |      |      |      |      |      |
| 10 Algoma                   |      |      |      |      |      |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |      |      |      |      |      |      |      |      |      |      |
| 11 Lakehead                 |      |      |      |      |      |      |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |      |      |      |      |      |      |      |      |      |
| 12 Manitoba South           |      |      |      |      |      |      |      |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |      |      |      |      |      |      |      |      |
| 13 Manitoba North           |      |      |      |      |      |      |      |      |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |      |      |      |      |      |      |      |
| 14 Saskatchewan South       |      |      |      |      |      |      |      |      |      |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |      |      |      |      |      |      |
| 15 Saskatchewan North       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |      |      |      |      |      |
| 16 Alberta South            |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |      |      |      |      |
| 17 Alberta North            |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |      |      |      |
| 18 Peace River              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |      |      |      |
| 19 Okanagan-Kootenay        |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |      |      |
| 20 Lower B. C.              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |      |      |
| 21 Northern B. C.           |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |      |
| 22 North West Territories   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      | .52  | .45  | .37  | .10  |      |      |
| 23 Yukon                    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      | .52  | .45  | .37  | .10  |

| 1   | 2   | 3   | 3A  | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  | 21  | 22  | 23  |
FIGURE 3-1
WESTERN UNION TELEX RATE AREAS
IN THE UNITED STATES
### TABLE 3-IV

**TELEX TOLLS PER MINUTE**
**BETWEEN AREAS IN CANADA AND THE UNITED STATES**

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A practical analysis which incorporates this data will appear in Section 3.

**Terminal Charges:** Terminals suitable for this system are limited by transmission speeds. Two terminals marketed solely through CN/CP are the Model 32 KSR and Model 32 ASR. The KSR is a dial-and-type unit with copies typed at each end. Rental fees are $45.00 per month plus tolls.

The ASR rents for $77.00 per month and allows perforated paper tape prepared in advance to be transmitted at maximum terminal speed when operated automatically. Copies are developed in both on and off line positions.

A lack of compatibility between line and terminal capacities should be noted. While the maximum capability with CN/CP supplied terminals is 66.7 words per minute, the line capacity is 100 words per minute.

A representation of the British Columbia Telex network and subscriber capacities is shown in Figure 3-II.

**CN/CP DATA TELEX**

**Service Description:** Data Telex is a 200 baud capacity network. Terminal flexibility allows for transmission in 5-level, 6-level, 7-level, and 8-level codes. Although this service is marketed separate from Telex, it employs basically the same channel network. The major difference

---

1. A 5-level code is a 5-bit code.
2. A high level of line quality must be maintained to facilitate 200 baud transmission.
Figure 3-II
THE BRITISH COLUMBIA TELEX NETWORK

Source: CN/CP Telecommunications
Figure 3-III
THE CANADIAN DATATELEX NETWORK

( ) = subscriber capacities

Source: CN/CP Telecommunications
is in terminal capacity. Figure 3-III shows the 200 baud network in Canada.

**Line Charges:** Line charges are exactly the same as Telex and again, reference can be made to Table 3-III and Table 3-IV. Figure 3-III shows the 200 baud network across Canada and gives subscriber capacities in brackets.

**Terminal Charges:** The user has a choice of transmitting through use of Teleprinter or any privately selected data handling equipment. The CN/CP unit transmits at 110 bits/second in ASCII code which is synonymous with 137 1/2 words per minute (1 word = 6 characters, 1 character = 8 bits). This terminal may be leased for $110.00 per month. This unit also allows for the advanced preparation of perforated paper tape.

Other terminals which have been tied into the Data Telex system are the IBM 1050 and the IBM 2741. These units transmit at 135 bps., but monthly rentals are somewhat higher. Exact rates are available through IBM offices. The main additional feature which these units have is a built in error detection-correction. The economic merits of such a unit become a trade-off between cost and transmission reliability. This relationship is discussed in more detail in the introduction to Section 3.

It is not intended to develop the merits of different terminal equipment in this thesis. Such a topic is a complete project in itself. Those which were briefly introduced were chosen because of their frequency of usage in the Vancouver
area.

Private Line Charges: Telex and Data Telex wire facilities are also available on a private basis. The schedule of private tariffs is built on the following format. A half-duplex channel capable of transmitting 60 words per minute (one word = 6 characters = 48 bits) for a four hour period per day may be leased for $0.69 per air mile per month. The same service is available for eight hours per day at a rate of $1.10 per air mile per month. Comparable services which are capable of transmitting 75 words per minute and 100 words per minute are available for basic rate plus 10% and basic rate plus 25% respectively. Full duplex channels which allow simultaneous two way communication can be leased for 125% of basic rates. Thus a full duplex, 100 words per minute channel with private usage eight hours per day costs $1.65 per mile.

TRANS-CANADA TELEPHONE TELETYPEWRITER EXCHANGE SERVICE (TWX)

Service Description: TWX competes with the Telex and Data Telex services provided by CN/CP. This service utilizes the regular dial network to interconnect stations in Canada, the United States and many other countries. Three levels of service are provided with transmission rates of 45 bps., 55 bps., and 75 bps. These rates are dependent on the terminal unit. All services are transmitted in 8-bit ASCII code. TWX is available anywhere there is a telephone service. Line Charges: Charges are fixed monthly rental for the terminal and a timed toll charge based on usage. Figures
BRITISH COLUMBIA TWX ZONES AND RATES

ZONE 604 A

ZONE "A" .10
ZONE "B" .10
ZONE "C" .20
ZONE "A" TO "B" .20
ZONE "B" TO "C" .25
ZONE "A" TO "C" .27

ZONE 604 B

ZONE 604 C

Source: British Columbia Telephone Co.
NOTE: BRITISH COLUMBIA IS DIVIDED INTO THREE ZONES FOR INTRA-PROVINCIAL TWX.

Source: B. C. Telephone Co.
### Table 3-V

**TWX-TELEX RATE COMPARISON BETWEEN B. C. COMMUNITIES**

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</tr>
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<td>Victoria</td>
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<td>NA</td>
<td>10</td>
<td>NA</td>
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<td>10</td>
<td>NA</td>
<td>10</td>
<td>NA</td>
<td>10</td>
</tr>
</tbody>
</table>

**TWX Rate** (Per minute) **TELEX Rate** (Per minute)

NA = TELEX service not available.

Source: B. C. Telephone Co.
### Table 3-VL

**TWX-TELEX RATE COMPARISON FOR MAJOR CANADIAN CITIES**

Source: B. C. Telephone Co.
3-IV and 3-V illustrate the rate relationships between the three British Columbia TWX zones and the Canadian zone structure.

In addition to this, Tables 3-V and 3-VI are included to show comparative rates for Telex and TWX between communities in British Columbia and the major cities of Canada. These rates are subject to change, but have appeared very stable over a period of time.

**Terminal Charges:** B.C. Telephone Company has two terminals which they lease for use with TWX lines. The Model 33 ASR Set is capable of transmitting pre-punched paper tape at a rate of 80 bits per second or 100 words per minute for a monthly rental fee of $90.00 per month plus message charges. There is a one-time connection charge of $20.00. The Model 35 ASR is a comparable heavy-duty machine designed for continuous operation. The cost difference is in the monthly rental charge, which is $110.00.

**MEDIUM SPEED FACILITIES**

The competitive services in the voice grade channel range of approximately 3,000 cycles per second are Broadband and Dataline (Dataline includes Schedule 4, 4A, 4B, and 4C services of Table 3-I). They are transmitted over a microwave or radio relay system for long distance communication and over voice-grade wire for shorter distances.

---

1. The characteristics of microwave transmission were briefly introduced in Chapter 2.
While Broadband is a fairly well defined service and most references to the system are made under that name. Data-line services need a more thorough introduction.

Different subservices are offered by the Telephone System under such labels as Dataline I, II and III, Data-speed, Dataphone services and Datapak. A systematic look at this trans Canada service will be carried out under these subheadings.

**CN/CP BROADBAND**

**Service Description:** The CN/CP Broadband service is a flexible, dial-up, coast-to-coast, microwave toll data transmission system. Line bandwidth is presently restricted to 4 KC (2400 bps) but can be expanded as required, in increments of 4 KC, to a maximum of 48 KC. The maximum will allow transmission at speeds up to 40,800 bits/sec. No firm announcement of the availability of the maximum facility has been made.

The system employs a push button voice data set with all subscribers assigned a seven digit code. Full duplex channels are standard. Ideally, this can reduce line time and cost to half that of one way transmission.

If preferred, the user can be assigned a group of 99 two-digit numbers for a limited location system to establish faster contact. Cost is $2.00 per number location per month. Security and screening features are available to deny entry electronically into a 'private' network.
Table 3-VII
BROADBAND EXCHANGE LOCATIONS
AS OF JANUARY 31, 1969

<table>
<thead>
<tr>
<th>Location</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calgary</td>
<td>Ottawa</td>
</tr>
<tr>
<td>Charlottetown</td>
<td>Prince George</td>
</tr>
<tr>
<td>Corner Brook</td>
<td>Prince Rupert</td>
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<td>Edmonton</td>
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<td>The Pas.</td>
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<td>Toronto</td>
</tr>
<tr>
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<td>Vancouver</td>
</tr>
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<td>Moncton</td>
<td>Victoria</td>
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<tr>
<td>Montreal</td>
<td>Whitehorse</td>
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<tr>
<td>Nelson</td>
<td>Windsor</td>
</tr>
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<td>North Bay</td>
<td>Winnipeg</td>
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Table 3-VIII

CN/CP Broadband Exchange Rates

<table>
<thead>
<tr>
<th></th>
<th>VCR</th>
<th>CLGY</th>
<th>EDM</th>
<th>SKN</th>
<th>REG</th>
<th>WPG</th>
<th>FT</th>
<th>WLM</th>
<th>WIND</th>
<th>TOR</th>
<th>LDN</th>
<th>HAM</th>
<th>OTT</th>
<th>MTL</th>
<th>QUE</th>
<th>HFX</th>
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<td>.15</td>
<td>.10</td>
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</tr>
</tbody>
</table>

(Per minute)

Source: CN/CP Telecommunications
**Line Charges:** Cost consists of a fixed monthly connection charge plus toll charges based on distance, bandwidth used and line time.

The monthly connection charge is $100.00 which includes the Voice/Data set. Table 3-VII shows a list of the cities where a Broadband exchange is presently located. Table 3-VIII gives the rate schedule for the major exchanges in the system. The table shows the per minute rates for exchange connections. For each call there is a minimum charge of 30 second usage and charges are based on six second increments. Charges are only made on a completed increment (i.e. a 35-second call between Vancouver and Ottawa would cost 30 cents).

**Private Line Charges:** Broadband is also available on a dedicated line basis. Line rental is available on a monthly rate scale as follows. Charges are $4.00 per mile for the first 100 air miles, $3.25 per mile between 100 and 500 miles and $2.25 per mile over 500 miles. This schedule applies to between exchanges with a system. In other words if terminals were located in Vancouver, Calgary and Toronto, rates from Vancouver to Calgary (422 air miles) would be $(100 \times 4.00) + (342 \times 3.25) = 1,511.50$. Calgary to Toronto rates (1690 air miles) would be $(100 \times 4.00) + (3.25 \times 400) + (1190 \times 2.25) = 4,377.50$.

This presents an alternative to the user. If, over a certain line route the monthly usage reaches a high enough level there could be an economic advantage in
leasing a dedicated line. For example let us look at line services between Vancouver and Toronto, with a distance of 2078 air miles. Private line charges would be determined as follows: 

\[(100 \times \$4.00) + (400 \times \$3.25) + (1578 \times \$2.25) = \$5,250.50.\] 
The switched Broadband rate between Vancouver and Toronto is \$0.50 per minute. From this it can be seen that usage up to 175 hours per months is more practical on the switched lines. Any amount over that, if line costs are the only real consideration, justifies leasing of a private line.¹ Graphic analysis is used to develop a sample comparison in Appendix A.

**TELEPHONE SYSTEM VOICE-GRADE DATA SERVICES**

**Service Description:** Data-phone is a dial-up-data service, marketed by the Trans-Canada Telephone System, and competitive with Broadband. It permits both voice transmission and data transmission at speeds up to 2800 bps. The Telephone Company classified all operations which require data sets under the general heading of Dataphone services. Line services in this classification are marketed under the title Dataline. A complementary terminal service exists under the heading Dataspeed (i.e. a Dataphone service consists of the two subcomponents Dataline and Dataspeed).

---

¹. This neglects such considerations as flexibility of private lines (i.e. double as voice line for a part of the day).
**Line Charges:** The line services provided by the Trans Canada Telephone System, and description is broken down under the different classifications.

**Dataline I**

This is a Trans-Canada pay-as-you-use data service. It is an optional half or full duplex (add 25% to standard rates) dial system with transmission rates to 2000 bps (Schedule 4B, Table 3-I). Connection charges are $20.00 for the main station connection and $10.00 per extension terminal. Monthly rentals are $100.00 for the main connection and $10.00 per extension. Data set rental is based on normal tariff rates (see specific section later in this chapter). Table 3-IX outlines the usage rate structure.

<table>
<thead>
<tr>
<th>Rate Distance (air miles)</th>
<th>Rate per minute *</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-350</td>
<td>$0.10</td>
</tr>
<tr>
<td>351-700</td>
<td>0.15</td>
</tr>
<tr>
<td>701-1050</td>
<td>0.20</td>
</tr>
<tr>
<td>1051-1400</td>
<td>0.30</td>
</tr>
<tr>
<td>1401-1750</td>
<td>0.40</td>
</tr>
<tr>
<td>1751-2100</td>
<td>0.50</td>
</tr>
<tr>
<td>2101-2500</td>
<td>0.60</td>
</tr>
<tr>
<td>2500-UP</td>
<td>0.70</td>
</tr>
</tbody>
</table>

* Add 25% for full duplex lines.

Charges are based on a 30 second minimum and 6 second increments.
Figure 3-VI

DATALINE I RATE BANDS FROM VANCOUVER

Band
1 - 350 miles, 10¢/min.
2 - 700 miles, 15¢/min.

Terminal $100/month

Source: B. C. Telephone Co.
## Table 3-X

**Rate Schedule for Dataline II and Dataline III Services**

<table>
<thead>
<tr>
<th>Mileage Band</th>
<th>Interexchange Mileage</th>
<th>Rate Per Month</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Up to and</td>
<td>Dataline II</td>
</tr>
<tr>
<td></td>
<td>Over</td>
<td>First 10</td>
</tr>
<tr>
<td></td>
<td>Including</td>
<td>Each Station</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>$40.00</td>
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<tr>
<td>2</td>
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<td>225</td>
<td>100.00</td>
</tr>
<tr>
<td>5</td>
<td>350</td>
<td>135.00</td>
</tr>
<tr>
<td>6</td>
<td>550</td>
<td>185.00</td>
</tr>
<tr>
<td>7</td>
<td>750</td>
<td>235.00</td>
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<td>950</td>
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<td>1950</td>
<td>535.00</td>
</tr>
<tr>
<td>13</td>
<td>2350</td>
<td>635.00</td>
</tr>
</tbody>
</table>

Source: B. C. Telephone Company
Figure 3-VI represents the Dataline I rate bands 1 and 2 with Vancouver as the central locale.

Dataline II and III

These systems provide one way data transmission only, from the originating station to a centrally located terminal (i.e. computer). Dataline II is designed to operate at speeds up to 200 bps. (Schedule 3A lines) and Dataline III (Schedule 4B lines) up to 2000 bps. All terminal locations must use Telephone Company supplied data sets. All points in the system must be in Canada. Usage rates for a data station are determined by the mileage band in which it is located. Figure 3-VII shows this band structure with Vancouver being the location of the central terminal.

The access lines to a central terminal cost $300.00 per month for Dataline II or $450.00 per month for Dataline III. The rate structure for originating stations is given in Table 3-X.

The purpose of this service is to accommodate systems which are designed to transmit data from many originating stations to a central terminal. While the per access line costs are relatively low, a minimum system cost goes into effect six months after a system is started. During the six month period charges will be only for equipment and facilities actually in service. This limits start up costs as an incentive to initiate the system.
The minimum monthly charge after six months will be the total rate for:

(a) five access lines

(b) two originating data stations in each mileage band in which an originating station is located. If the total number of stations is less than ten, the difference is charged at Mileage Band I rates.

This is to say that if a Dataline II system was to have 4 access lines in Band 1 and one line into Band 3 (see figure 3-VII) the minimum charge requirement for five access lines would be fulfilled but Band 3 minimum requirements would not. Charges for Band 3 are a minimum of $150 (from Table 3-X, 2 x $75 for Dataline II) to meet the two station per band minimum.

Private Line Charges: The private line services and their characteristics are described in Table 3-XI. This table includes the significant data in terms of the different schedule classifications and also shows monthly rates per mile and conditioning charges for the various data circuits.

Datapak is an offering designed to provide an economical and efficient multiplexing\(^1\) service on a private line basis. This service allows the carrier's customer to contract for a single channel and derive several

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1. Multiplexing may be defined as the splitting of a transmission facility into two or more channels.
<table>
<thead>
<tr>
<th>CLASSIFICATION</th>
<th>TYPE OF SERVICE</th>
<th>NOMINAL DATA RATE</th>
<th>MONTHLY RATE PER MILE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>5 DAYS PER WEEK</td>
<td>6 DAYS PER WEEK</td>
</tr>
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<td>Schedule 1</td>
<td>Digital Data Transmission 2 Point or Multi Point</td>
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<td>4 hr</td>
<td>8 hr</td>
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<td>Schedule 2</td>
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<td>57 BPS</td>
<td>.76</td>
<td>1.21</td>
</tr>
<tr>
<td>Schedule 3</td>
<td></td>
<td>75 BPS</td>
<td>.8625</td>
<td>1.375</td>
</tr>
<tr>
<td>Schedule 3A</td>
<td></td>
<td>200 BPS</td>
<td>-</td>
<td>1.75</td>
</tr>
<tr>
<td>CLASSIFICATION</td>
<td>TYPE OF SERVICE</td>
<td>NOMINAL DATA RATE</td>
<td>SCHEDULE 4 MONTHLY RATE PER MILE</td>
<td>CONDITIONING CHARGES</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------</td>
<td>-------------------</td>
<td>----------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Schedule 4 Type 4</td>
<td>Analog or Digital Date/Voice Alternate Transmission 2 Point or Multi Point</td>
<td>600 BPS</td>
<td>1 - 100 miles - 4.00/mile</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Schedule 4 Type 4A</td>
<td>&quot;</td>
<td>1200 BPS</td>
<td>101 - 500 miles - 3.25/mile</td>
<td>10.00 per month each end.</td>
</tr>
<tr>
<td>Schedule 4 Type 4B</td>
<td>&quot;</td>
<td>2000 BPS</td>
<td>501 &amp; over miles - 2.50/mile</td>
<td>35.00 per month each end.</td>
</tr>
<tr>
<td>Schedule 4 Type 4C</td>
<td>&quot;</td>
<td>2400-2800 BPS</td>
<td>For Full Duplex/4 Wire Service Add 25%</td>
<td>Special Assembly</td>
</tr>
<tr>
<td>Wideband</td>
<td>Digital Data Transmission</td>
<td>19.2 to 230.4 Kilobits per second</td>
<td>TELPAK A Equivalent to 12 voice grade c/kts. 25.00/mile</td>
<td>TELPAK B Equivalent to 24 voice grade c/kts. 40.00/mile</td>
</tr>
</tbody>
</table>

TABLE 3-XI (continued)

TRANS-CANADA TELEPHONE SYSTEM
PRIVATE SERVICES
sub channels.

A schedule 4 Type 4A private line can be multiplexed to provide a maximum of eight transmission channels with speeds up to 82.5 baud or four channels of 180 baud. Rates for these services are $45.00 per month per channel plus regular private line charges. The graph in Figure 3-VIII serves to illustrate the large savings possible by multiplexing a large channel into sub channels.

It can be seen that this service would be of major importance to such customers as time-sharing concerns with users in distant localities. For instance, if such a company had eight users in a city 1000 miles away the differences in total cost between eight individual lines and one multiplexed line is very significant ($11,000 total versus just over $3,300).

Obviously, the combinations represented in figure 3-VIII are meaningless in a specific situation. They do serve to indicate the effect of economies of scale on data circuit costs.

Terminal Charges: DATAspeed terminals are offered by the Telephone System for highspeed transmission in the form of punched tape. They can be attached to existing PBX, WATS, or private lines.

1. PBX is a private branch manual ordeal exchange connected to the public network from its location on the customer's premises.

2. WATS is a telephone company service which allows a customer, by use of an access line, to place unlimited calls in a specified zone on a direct dialing basis, for a flat monthly charge.
FIGURE 3-VIII
COST BENEFITS OF MULTIPLEXING USING THE DATAPAK SERVICE

Note: All cost data for the private line services is from Table 3-XI.
Two terminal groups are presently available. Both are capable of transmitting in 5-6-7-8 channel paper tape. Model 2 transmits a maximum of 1050 words per minute (840 bps). Model 5 is capable of 750 words per minute (600 bps).

Different configurations of the two models and their corresponding rate structures are listed in Table 3-XII. Also shown are the data set requirements for the units.

This concludes our discussion of line services available on a Trans-Canada basis. Before turning to a discussion of data sets, however, one further alternative should be mentioned.

In different geographic regions of Canada small independent carrier facilities exist. These private networks have usually been developed by a Company to fulfill a specific corporate communication requirement. Most of these are developed in sparsely populated areas where past facility demands and subsequent common carrier supplied lines were inadequate or uneconomical for a company's purpose.

In British Columbia, one such system is that of the Pacific Great Eastern Railway¹. The PGE microwave system extends northward from Vancouver along the coast. The major purpose of the system is to fill the private voice and data communication needs of the PGE Railway. However,

---

¹. Government regulation which affects this particular system would be the Railways Act. External rates (i.e. to Westcoast Transmission) are also governed by the Public Utilities Commission in British Columbia.
<table>
<thead>
<tr>
<th>Data Speed Terminals and Rental Rates</th>
<th>Data Set (2)</th>
<th>Rate per Month</th>
<th>Service Charge (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Included</td>
<td>Extra</td>
<td></td>
</tr>
<tr>
<td>1A or 2A transmitter</td>
<td></td>
<td>202</td>
<td>$135.00</td>
</tr>
<tr>
<td>1B or 2B receiver</td>
<td></td>
<td>202</td>
<td>175.00</td>
</tr>
<tr>
<td>5A transmitter, table model</td>
<td>402C</td>
<td></td>
<td>87.50</td>
</tr>
<tr>
<td>5C transmitter, floor model</td>
<td>402C</td>
<td></td>
<td>122.50</td>
</tr>
<tr>
<td>5B receiver</td>
<td>402D</td>
<td></td>
<td>240.00</td>
</tr>
<tr>
<td>5AB transceiver</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>table model TX</td>
<td>402C&amp;D</td>
<td></td>
<td>312.50</td>
</tr>
<tr>
<td>floor model TX</td>
<td>402C&amp;D</td>
<td></td>
<td>347.50</td>
</tr>
</tbody>
</table>

(1) One-half the service charge applies for a change of location on the same premises.

(2) Some terminal equipment is designed with an internal data set so that the two operations are actually handled by one physical unit.

Source: B. C. Telephone Company
excess capacity does exist. Public marketing of this excess is discouraged by the common carriers (some of their reasons would coincide with those expressed by the common carriers in the Microwave Inc. case discussed Appendix B). Yet, one user, Westcoast Transmission, is leasing usage of the lines to serve its communication needs in that region. Although the geographic limits of this type of system make them useful only in specific applications, their existence should be recognised. When a company has specific needs between remote geographical locations it could prove very beneficial to check with the Department of Transport (probably the Department of Communications as it develops, see Chapter 4) as to communication facilities available in that area.

DATA SETS EMPLOYED IN CANADIAN DATA COMMUNICATIONS

Data sets are designed to provide signal compatibility between data processing equipment and communications facilities. Computers generally develop information in the form of digital bits. These must be converted to tone signals which are acceptable for transmission over carrier channels. This process is called modulation. At the other end they must be again conditioned back to their original format to become meaningful to the receiving terminal. From this comes the term modem, modulator-demodulator.

The technological development of the data set is presently in a very dynamic state. Because of the rapidly expanding requirements for computer-telecommunications,
and the consequent demands for faster and more economical units, heavy research and development efforts in the field are making last week's data sets obsolete. Development costs are high and the risk of large inventories of relatively inefficient equipment is ever-apparent. The insistence of common carriers to control data set standards has smoothed the flow of progress only to a limited extent (see Appendix B). An example of the advances being made is the new data set groups available for voice grade systems. The old limits of 2400 bit transmission rates for voice-grade channels have doubled and quadrupled with new interface equipment developed by such companies as Milgo and Rixon. Although unit costs are much higher, in many cases this expense is outweighed by decreased line usage.

Figure 3-IX is developed to illustrate the most advantageous voice line data set combinations.

CN/CP data sets from Table 3-XV and accompanying Broadband line costs to transmit certain volumes of data are shown. These line costs are based on per minute charges between Vancouver-Toronto (50¢). The Milgo data and associated cost have been used to represent the 4800 bps units as its rental rate is more definite. If this monthly charge decreases it necessitates an adjustment of fixed monthly cost on the graphs. The slope would remain the same.
FIGURE 3-IX
ANALYSIS OF VOICE GRADE DATA SETS
FOR TRANSMISSION BETWEEN TORONTO
AND VANCOUVER
ON CN/CP BROADBAND

NOTE: Each channel requires two compatible data sets.
Figure 3-IX shows the cost relationship for exchange connections with a usage rate of $0.50 per minute. Although in a specific situation it would be worthwhile to develop a cross-over graph, the following formula will provide the change over points for different per minute rates:

\[
\frac{.50}{\text{pertinent per minute Broadband rate}} \times \text{changeover usage level}
\]

The Broadband rates are available in Table 3-VII. The changeover usage levels from Figure 3-IX are 20 hours of WE 202 usage (i.e. 172 million bits) to move from the 1800 bps to the 2400 bps unit and 32.67 hours of 26C usage (282 million bits) to move from the 2400 bps to the 4800 bps unit. Let us look at the Vancouver to Calgary rate and see at what usage level we should move from the 1800 bps unit to the 2400 bps unit.

The simple calculation \( \frac{.50}{.10} \times 20 \) says that the Lenkurt 26C (2400 bps) should be installed if usage will exceed 100 hours (1295 million bits).

Obviously, as the monthly rental rate of the 4800 bps unit decreases, demand will grow and a problem of obsolete inventories could develop. The risk implied by this possibility is diminished, however, due to the common carriers control of the market. New data sets are not revealed like new automobile models every fall. They are phased in and phased out under the control of the carriers.

The interface equipment in a computer-communications
system is owned, controlled and maintained by the common carrier. Procedure in Canada is for the user to either select a unit presently marketed by the carrier, or to request that a specific modem be purchased by the carrier to be leased to the user. The common carriers reasoning behind this requirement is that they must hold control of all equipment attached to public lines, and to control and maintain they must own.

Some arguments against this theory have developed, but discussion of these thoughts is limited to FCC inquiries, as described in Appendix B.

The range of data sets available through the common carriers is extensive and differs as to any given moment.

With this in mind, a summary of the data sets available in Canada is presented. The information presented is derived from lists which were supplied by the common carriers. The listings are very susceptible to change, and will need updating on a regular basis to be meaningful.¹

¹ The reader is warned of an inconsistency in the time relevance of Tables 3-XIII, 3-XIV, and 3-XV. The B. C. Tel data is from a formalized listing dated early 1968. CN/CP data sets described were in use in the Vancouver, B. C.,area in early 1969.
Data Sets Attached to the Trans-Canada Telephone System

Table 3-XIII indicates data set classification, mode, speed, practical media, costs and general remarks for the various data set series available to interface communication channels with digital data terminals. This is complemented by Table 3-XIV, a reproduction of the schedule of data sets, and their pertinent characteristics, available through the British Columbia Telephone Company. In addition to the data set series referred to in Table 3-XIII, data on series 600 data sets is also included. This series is designed to interface with fascimile terminals\(^1\) and other analog signal equipment.

These listings do not make reference to the newer data sets which have been introduced since May, 1968. For instance some of the new 4800 bps data sets now on the market (see discussion of CN/CP data sets) have been accepted by the various telephone companies across Canada.

CN/CP Data Sets Used with Broadband

Table 3-XV lists the four different data sets presently available to users of the Broadband system in British Columbia\(^2\). It serves to indicate some of the

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1. Fascimile terminals will scan the light and dark lines of the original document, and transmit generated pulses over communication channels to a receiving unit which recognizes the pulses to reproduce the document.

2. This is no doubt representative of other provinces although the author has not verified this point.
### TABLE 3-XIII
**BELL CANADA DATA SETS**
**APRIL, 1968**

<table>
<thead>
<tr>
<th>CLASSIFICATION</th>
<th>MODE</th>
<th>SPEED</th>
<th>MEDIUM</th>
<th>MONTHLY RATE</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>103A2</td>
<td>Serial</td>
<td>Up to 300 bps either or both directions - simultaneously if desired</td>
<td>Paper tape Keyboard</td>
<td>30.00</td>
<td>Monthly charge 25.00</td>
</tr>
<tr>
<td>103F2</td>
<td>Serial</td>
<td>Up to 300 bps</td>
<td>Punched Card on line</td>
<td>30.00</td>
<td>int'l. charge 25.00</td>
</tr>
<tr>
<td>201A</td>
<td>Serial</td>
<td>Fixed-2000 bps</td>
<td>Paper tape Magnetic tape Punched card on line</td>
<td>110.00</td>
<td>inst'l. charge 100.00</td>
</tr>
<tr>
<td>201B</td>
<td>Serial</td>
<td>Fixed-2400 bps</td>
<td>Paper tape Magnetic tape Punched card on line</td>
<td>115.00</td>
<td>inst'l. charge 100.00</td>
</tr>
<tr>
<td>CLASSIFICATION</td>
<td>MODE</td>
<td>SPEED</td>
<td>MEDIUM</td>
<td>MONTHLY RATE</td>
<td>REMARKS</td>
</tr>
<tr>
<td>----------------</td>
<td>------</td>
<td>-------</td>
<td>--------</td>
<td>--------------</td>
<td>---------</td>
</tr>
<tr>
<td>202C</td>
<td>Serial</td>
<td>Up to 1800 bps on private line Up to 1200 bps on dial up network</td>
<td>Paper tape Magnetic tape Punched card on line</td>
<td>202C5 - 42.50 202C6 - 50.00 inst'ln. charge 50.00</td>
<td>202C6 used when reverse channel feature required</td>
</tr>
<tr>
<td>202B</td>
<td>Serial</td>
<td>150 - 1800 bps</td>
<td>Paper tape Magnetic tape Punched card on line</td>
<td>40.00 inst'ln. charge 50.00</td>
<td>Private line service Requires 4B conditioning if 1800 bps speed used</td>
</tr>
<tr>
<td>301B</td>
<td>Serial</td>
<td>40.8 kilobits per second</td>
<td>Magnetic tape core-to-core</td>
<td>special assembly</td>
<td>Used with Telpak A facilities</td>
</tr>
<tr>
<td>303</td>
<td>Serial</td>
<td>19.2 kilobits to 230.4 kilobits per second</td>
<td>Magnetic tape core-to-core</td>
<td>special assembly</td>
<td>Used with Telpak A, B, C facilities</td>
</tr>
<tr>
<td>401</td>
<td>Parallel, 3/14</td>
<td>Up to 20 CPS</td>
<td>Keyboard</td>
<td>401E - 10.00 401F - 40.00 inst'ln. charge-10.00 inst'ln. charge-50.00</td>
<td>One way transmission</td>
</tr>
<tr>
<td>CLASSIFICATION</td>
<td>MODE</td>
<td>SPEED</td>
<td>MEDIUM</td>
<td>MONTHLY RATE</td>
<td>REMARKS</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------</td>
<td>-----------</td>
<td>-----------------------</td>
<td>---------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>402</td>
<td>Parallel</td>
<td>Up to 75 CPS</td>
<td>Punched Card</td>
<td>402C1 - 35.00</td>
<td>402C - transmit only</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Paper tape</td>
<td>402C2 - 45.00</td>
<td>402D - receive only</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>inst'ln. charge 5.00</td>
<td>C2 and D2 provide reverse channel</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>402D1 - 100.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>402D2 - 110.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>inst'ln. charge 100.00</td>
<td></td>
</tr>
<tr>
<td>403</td>
<td>Parallel, 2/8</td>
<td>Up to 10 CPS</td>
<td>Special Assembly</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Table 3-XIV**

**B.C. Telephone Leasable Data Set Rates**

The following rates do not include auxiliary key equipment which may be required for private line applications. (The cost of this optional switch is minimal.)

<table>
<thead>
<tr>
<th>Model</th>
<th>Mode of Operation</th>
<th>Half Duplex</th>
<th>Full Duplex</th>
<th>Private Line</th>
<th>Switched Network</th>
<th>Rate Per Month</th>
<th>Installation Service Charge (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>103A (2)</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>$30.00</td>
<td>$25.00</td>
</tr>
<tr>
<td>103F2 (2)</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>30.00</td>
<td>25.00</td>
</tr>
<tr>
<td>103B</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>35.00</td>
<td>35.00</td>
</tr>
<tr>
<td>201A</td>
<td></td>
<td>X</td>
<td>X (4)</td>
<td>X (4)</td>
<td>110.00</td>
<td>100.00</td>
<td></td>
</tr>
<tr>
<td>201B</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>125.00</td>
<td>100.00</td>
<td></td>
</tr>
<tr>
<td>202A (3)</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>40.00</td>
<td>50.00</td>
<td></td>
</tr>
<tr>
<td>202B (3)</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>40.00</td>
<td>50.00</td>
<td></td>
</tr>
<tr>
<td>202C1</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>42.50</td>
<td>50.00</td>
<td></td>
</tr>
<tr>
<td>202C2</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>50.00</td>
<td>50.00</td>
<td></td>
</tr>
<tr>
<td>202D</td>
<td></td>
<td>X</td>
<td>X (4)</td>
<td>X (4)</td>
<td>40.00</td>
<td>50.00</td>
<td></td>
</tr>
<tr>
<td>401E</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>10.00</td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td>401J</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>50.00</td>
<td>50.00</td>
<td></td>
</tr>
<tr>
<td>402C</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>35.00</td>
<td>50.00</td>
<td></td>
</tr>
<tr>
<td>402D</td>
<td></td>
<td>X</td>
<td>X (4)</td>
<td>X (4)</td>
<td>100.00</td>
<td>100.00</td>
<td></td>
</tr>
<tr>
<td>601A</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>10.00</td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td>601B</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>15.00</td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td>602NT</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>5.00</td>
<td>5.00</td>
<td></td>
</tr>
<tr>
<td>602NR</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>5.00</td>
<td>5.00</td>
<td></td>
</tr>
<tr>
<td>602NTR</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>7.50</td>
<td>5.00</td>
<td></td>
</tr>
<tr>
<td>603A</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>28.50</td>
<td>25.00</td>
<td></td>
</tr>
<tr>
<td>603B</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>35.00</td>
<td>25.00</td>
<td></td>
</tr>
</tbody>
</table>

Note (1) One-half the service charge applies for moves on the same premises. Full service charges are applied to off-premises moves, and for changes from one type of equipment to another.

Note (2) When used with teletype equipment operating with direct current pulses, a data set coupler is required at a monthly rate of $5.00.
continuation of Table 3-XIV

Note (3) No longer manufactured but provided when available.
Note (4) Rate includes 804A data auxiliary set when voice is required.

Source: B. C. Telephone Company Private Services Manual
### TABLE 3-XV

**DATA SETS PRESENTLY EMPLOYED IN BRITISH COLUMBIA WITH CN/CP BROADBAND**

<table>
<thead>
<tr>
<th>Manufacturer and Model</th>
<th>Line Supplier</th>
<th>Speed</th>
<th>Monthly Rental</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western Electric 202</td>
<td>CN/CP</td>
<td>1200-1800 bits/sec.</td>
<td>$40.00</td>
<td>with reverse channel for error checking costs $50.00</td>
</tr>
<tr>
<td>Lenkurt 26C</td>
<td>CN/CP</td>
<td>2400 bits/sec.</td>
<td>$115.00</td>
<td></td>
</tr>
<tr>
<td>Lenkurt 26D</td>
<td>CN/CP</td>
<td>4800 bits/sec.</td>
<td>$325.00</td>
<td>this service is to become available April 1, 1969 and listed cost is approximate</td>
</tr>
<tr>
<td>Milgo</td>
<td>CN/CP</td>
<td>4800 bits/sec.</td>
<td>$360.00</td>
<td></td>
</tr>
</tbody>
</table>

*Source: CN/CP Telecommunications*
technological advances made within the last year when compared to voice grade data sets listed in Table 3-XIII.

A telephone company source has estimated that the next step in data set development, a 9600 bps voice line data set will be available in Canada within about two years. Western Electric, Milgo Electronics and Automatic Electric are companies which are doing research and development work in this area. No cost estimates are available.

This concludes the survey of the communication facilities available to the Canadian data transmitter. An analysis of the economic aspects of the services described in this chapter will be developed in terms of a specific application in Section Three.

1. Milgo has announced a Model 5500/96 data set capable of transmitting at 9600 bps over voice grade lines. It will be available in December, 1969 for $11,500 per unit.
CHAPTER IV
GOVERNMENT INVOLVEMENT AND THE SOCIAL IMPLICATIONS OF DATA COMMUNICATION IN CANADA

The economic aspects of data communication discussed in Chapter 3 might be viewed as the short-term considerations relevant to the development of this industry. Long-term considerations involve not only economic implications but political and social problems as well. The present communication systems in Canada, centred around two major common carriers have been described. The purpose here is to discuss some of the prevailing attitudes with regard to the proper development of the data communications industry in North America.

The major area of interest is Canada, but the advanced position of computer telecommunications in the United States and the close ties between the two countries makes prevailing attitudes in that country a significant factor. Most government regulations in the U.S. are controlled by the Federal Communications Commission. The Justice Department and their interpretations of FCC regulations have also influenced the development of regulatory documents. Information with regard to U.S. government policy is given in Appendix A.

Following is a brief summary of the Canadian situation.
The Canadian Government and Data Communications

It is only within the last year that the Canadian Federal government has provided specific evidence to indicate a true awareness of the massive effect that communications can have on the development of the nation. In the early part of 1969, we find a new and much-needed Federal Department of Communications in the initial stages of development. The present position of the government, with regard to computer telecommunications was expressed by Dr. J.H. Chapman, Assistant Deputy Minister of the Department of Communications, as follows: "Very little has as yet been done by the government towards the regulation of computer oriented communication facilities".¹

Present legislation affecting Canadian communications can be found in the Transportation Act, the Radio Act and the Railway Act, but the majority of this legislation is not directed at the special problems posed by data communications.

To develop a complete understanding of legislation, it is necessary not only to become acquainted with these acts, but also be knowledgeable of the authorities' interpretations. It is impossible here to relate government reaction to any system which might require approval. It is recommended that any company proposal be related to

¹. This remark resulted from correspondence with Dr. Chapman in February, 1969, (32).
a Department of Communications office, or if confined to provincial borders, described to the suitable provincial department (i.e. British Columbia Public Utilities Commission). A request to clarify corporate obligations based on government regulation should yield satisfactory results.

Two general points should be made, however. A communication system for private use only, might be developed but application for line development must be approved by the Department of Transport (soon to be transferred to the Department of Communications). To sell any portion of a communication system's capacity to a public user would make one a common carrier and this requires a government license.

Mr. E. R. Bushfield, Chief of the National Policy Division, Telecommunications Bureau in the newly founded Department of Communications expresses concern for the present state of regulatory legislation. A statement by Mr. Bushfield further confirms the remarks of Dr. Chapman: "The attitudes for future regulatory activities of the Federal government involve policy positions and decisions which have not yet been taken".¹

This leads to a somewhat bizarre environment for telecommunication activities in North America. In general, U.S. corporations, whether they be data carriers,

¹ Mr. Bushfield made this remark in a reply to inquiries to the Department of Communication, (31).
edp-manufacturers, or data facility users are deeply affected by the powers of the FCC and other U.S. government regulatory bodies. Many of these American entities have either control, direct or indirect, or varying degrees of influence upon affiliated Canadian entities. Therefore, if an American corporate concept, when proposed, is vetoed by U.S. government regulatory agencies, and a similar environmental setting exists in Canada, the proposal might be suggested to a Canadian organization by its U.S. counterpart. This is not to say, by any means, that Canadian government attitudes should be directed by U.S. government decisions. The point is that the FCC, for example, as a commission of knowledgeable experts, would in many instances made a decision which would have more relevance in the Canadian situation than no decision whatsoever.

This opinion might be better justified by describing an actual case.

In the United States, Western Union has shown a very keen interest in many aspects of the data service bureau business. Two major series of negotiations concluded with different results in 1968. A planned merger between Western Union (WU) and Computer Sciences Corporation (CSC) was frowned upon by many parties. Not only were competing data service centres against the intentions of CSC, but AT&T went as far as to break off talks regarding the sale of TWX services to Western Union. The
Justice Department and Federal Communications Commission were also questioning this merger as they discouraged the idea of a common carrier actively engaged as an active and competitive data processor.

As a result of the surrounding negative attitudes, merger talks ceased. The negotiations of the purchase of the TWX system were resumed with AT&T. This second major development proved more successful. After 20 years of on-and-off negotiation, the TWX service will be purchased and gradually incorporated into the International Telex System.

The Canadian complications require further explanation. Canadian National/Canadian Pacific Telecommunications and Western Union are affiliated through internation standardization of telegraph and Telex services. It is not intended to speculate on the degree of cooperation between these organizations but simply to recognize that a definite bond of mutual interest does exist.

At the beginning of March, 1969, shortly after the aforementioned occurrences in the United States, CN/CP announced the purchase of 51% of controlling interest in Computer Sciences Canada from the parent, Computer Sciences Corporation. There is presently no government body in Canada equipped to study the implications of such a takeover. Possibly characteristics unique to the Canadian situation would justify no discouraging actions whatsoever, On the other hand, the apparent relationships to the U.S.
situation and the similarity of the two environments seems to enhance the possibility that the reasoning behind the restricting attitudes in the U.S. might have some pertinence in Canada.

The TWX purchase also affects Canadian communication systems. This sale by AT&T to Western Union was encouraged by the FCC in the U.S. The result in Canada is that within a five year transition period, TWX services, presently controlled by the Trans Canada Telephone System, will be integrated with CN/CP's Telex system.¹ This will eliminate what until now has been a competitive market. While there are no doubt some advantages to the singular massive system, there are disadvantages also. A decision as to whether a monopolistic or an oligopolistic market is most desirable in Canada should be internal.

These are only two cases where a Canadian government body should be authorized to influence and control the development of telecommunications in Canada.

The present regulatory framework to guide Canadian computer telecommunications has been described as follows by a Department of Communications official: Certain activities of the major common carriers (i.e. the Bell Telephone Company, The B.C. Telephone Company, Canadian National/Canadian Pacific Telecommunications) are regulated by the Federal government through the Canadian Transport Commission. Private wire services

¹. This fact resulted from an interview with representatives of the British Columbia Telephone Company.
supplied by the common carriers, systems established by companies for internal use, and landlines established for intra-provincial use by provincial companies are in no way controlled by a Federal agency.

This present regulatory framework will not suffice, and this is one of the main reasons why the Department of Communications has been formed. As has been mentioned, the actual policy development which must precede the formation of a controlling agency is now in process. It is not the desire, herewithin, to propose any Utopian framework around which this board might be structured but a brief indication of possible developments is offered.

Obviously an intensive study of the historical growth of the Federal Communications Commission in the United States would be a necessity. The experiences, of this body, good or bad, are of relevance.

One instance which seems to imply that the FCC state is not one of perfection is its handling of the Telpak tariff.\(^1\) All four Telpak services - A, B, C, and D - simply allow an AT&T client to purchase voice grade channels at a quantity discount. This bulk-usage discount is of benefit to only the larger organizations who employ many private lines between two given points. The

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pricing structure of such an offering is based on the same economies of scale which exist in the computer manufacturing process. For example the capabilities attained by leasing Telpak A for $15.00 per month would cost $24.00 per month if voice grade lines were leased individually. Since the initial proposal by AT&T, the Telpak tariff has been a controversial topic. The legal foundation on which Telpak rests is of interest.

Initially the Telpak tariff was filed but not approved by the FCC. However the legislation under which the FCC functions is such that the commission must prove the service undesirable after a tariff application. The tariff can go into effect ninety days after the announcement as was the case with Telpak. After a study of the service, the FCC and later the Court of Appeals in Washington disapproved the service on grounds that it was discriminatory against the smaller firms who require communication services in a competitive market. And here, the major problem is revealed. AT&T did not desire to appeal the decision. Some users of the Telpak service did appeal, however. In many cases, these companies had completed expensive feasibility studies and/or had integrated Telpak services into their computer-communications systems. The result of discontinuing the Telpak tariff could result in a very high-cost, low benefit venture for many of the initial users. It seems that this predicament is a fault of the system. In any situation where the tariff is found
to be unjustified somebody gets hurt.

Another area of concern that should be briefly discussed is the need for federal-provincial co-operation. A sample case to emphasize this need is the introduction of the Model 35 ACS communication terminal system on a nationwide basis in the United States.\(^1\) In different states, regulatory bodies had unique views upon the usage of prototype equipment with their state communications systems. The inclusion of this terminal type had to be scrapped in at least one nationwide system because one state would not permit the use of this non-standard offering.

Thus it seems that representative bodies from provincial governments in Canada should co-operate with the Federal regulatory agency in some form of national standardization and co-ordination committee.

Data Communications and the Canadian Society

Traditionally, any models which are used to justify a course of action for industrial growth are heavily influenced by economic factors. Political and social parameters are deemphasized and afterwards weighed in terms of effect on economics rather than for themselves. There is no intention to condemn or applaud this methodology, it is simply a stated, real-life fact.

Time and change are one, however, and in a society

\(^1\) W.E. Simonson, op. cit., p. 24.
bulging with social demands, the business world is becoming increasingly aware of the social implications of industrial development. Thus in many cases, statements of social theory as related to business growth are becoming more of a practical consideration and less of an academic exercise.

The socio-economic arguments can be divided into two major attitudes - maximum free enterprise versus total government control, independent subsystems versus the all-inclusive system.

In the area of computers and communications a strong representative of the first view is J. B. Dennis, of MIT, (9) who extols the virtues of a set of free enterprise subsystems, while Douglas F. Parkhill (25) lauds the theory of a large scale system or systems under national and eventually international government control.

Dennis claims that the development of large scale computer systems is an extension of the basic North American society and will best progress through the competitive atmosphere of a capitalistic environment. The availability of specialized systems will provide greater flexibility and should lead to lower costs for a user who would, otherwise, only be interested in segments of a 'total system'. R. L. Simms (29) foresees development trends along this line as highly populated clusters attract alternative systems.

Although Parkhill accepts the development of private special purpose systems he eyes the national and international development of government controlled communication networks to ease the complexities of public administration. The only
point to be made here is that it will not likely be economic policies that decide the degree of government involvement. Rather it will be the social policies regarding individual freedoms and rights that have the greatest effect on political decisions.

One specific problem which has attracted much attention is that of data-privacy. Although some might feel that the emphasis on privacy is out of perspective it is still a goal of our society to recognize the rights of the individual. Technically, data privacy can be guaranteed almost 100%. It would be no easier for an unauthorized person to gain access to computer core storage than to a combination safe. The problem becomes a trade-off between cost and desirable degree of privacy.

This completes comment on the political and social implications of data communications. Now the aim is to discuss one development in data communications of major consequence - an innovation of great significance economically, politically, and socially - the communications satellite.
CHAPTER V
DATA TRANSMISSION AND COMMERCIAL COMMUNICATION SATELLITES

The enormous potential effect that technological advances in satellite communication will have on data transmission warrants special consideration. The fact that nine U.S. computer centres were linked to a Paris computer system via satellite for test purposes and that reliable transmission at 50,000 words per minute was executed is an indication of the future. However, commercial communication satellites and the scope of their influence is in no way limited to data communications. Voice, telegraph, television and facsimile as well as data - all forms of communication have been greatly facilitated by satellites. Here, we emphasize those advantages which are most relevant to data communications. Before discussing the economic assets that the communication satellite brings to long distance data communication, a brief history of commercial satellite development is described.

Communication Satellites, 1962-1969

In mid 1962, an experimental satellite known as Telstar first demonstrated the potential of space communications. This stimulated the passing of the Communications

1. Joseph B. Charyk "Commercial Communications Satellites". This paper was presented to the United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, Austria, August 14-27, 1968. Dr. Charyk is the President of COMSAT.
Satellite Act of 1962 by the Congress of the United States. It called for the establishment of a private U.S. corporation "to establish a communications satellite system in conjunction and in co-operation with other countries of the world as quickly and expeditiously as practicable".¹

This resulted in the formation of the Communications Satellite Corporation. Plans for an international effort matured toward the formation of the International Telecommunications Satellite Consortium (INTELSAT) in August, 1964. The Canadian member of this group is the Canadian Overseas Telecommunications Corporation. Early Bird, the Intelsat I satellite launched April 6, 1965 has been joined in space by three Intelsat II satellites. Each of these instruments provides 240 high quality voice circuits, and the system will serve two-thirds of the world. The Intelsat III series, to be launched in 1969 and consisting of four 1200-circuit satellites will increase capacities over the Atlantic and Pacific routes, and the planned unit above the Indian Ocean will complete a global system of communication satellites.² Intelsat IV satellites, to be available by 1971, will be more flexible units with an average capacity of 5000 voice-grade circuits.

Of the major new dimensions added to communications by the satellite, one stands out. Let us regard the economics of the commercial satellite system.

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Economic Advantages of Data Communication Via Satellite

It has been stressed that an economically feasible data communications system is of major consequence to the business system. The fact that an entire chapter has been devoted to commercial communications satellite verifies this author's judgement that the effect of the satellite upon the economics of data communication has and will be spectacular.

The economics of satellite communication are only meaningful when compared to existing land lines assuming similar conditions. Prior to the Early Bird launching in 1965, a voice grade half-duplex channel from New York to Paris cost $10,000/month. The Early Bird charge was $4,200/month. In late 1968, these charges had been reduced to $6,500/month via cable and $3,800/month via satellite. Besides the large difference economically, it is interesting to note the effect of a competitive environment upon cable rates. Would the international carrier system of cable networks have dropped rates 35% in a monopolistic atmosphere? Across the Pacific, from San Francisco to Tokyo, a similar satellite channel costs $4,900/month. Since 1965, cable charges have dropped from $15,000 to $10,000/month.

The concept of intercontinental communication is of relevance to only a small portion of North American business in most cases. However, the economic usefulness of the commercial satellite is pertinent on a national basis.
A Comsat proposal for the pilot domestic satellite program is now being reviewed by the FCC. The purpose of the project is to establish the uses, costs and problems of satellite communication. This experimental five-year program would make available thirteen wideband television channels and be operational by 1971 at the earliest. One company, McCall Corp., has already applied for usage of a full channel for television, data and graphic transmission. McCall's economic reasons for this application are of interest.

The McCall system will involve data transmission between data centres in Ohio and California. Also the system will be geared to transmit coded copy to nine printing plants across the nation. In justifying his project plan, Mr. William Schubert, Senior Vice President at McCall's, provided comparative figures for costs over a 3,000 mile system matching Telpak D services against the proposed satellite communications system.

Telpak D private line rates are $45.00/mile/month. Expected usage of 600 hours per month gives a cost per minute over the 3,000 miles of $3.75. To transmit 150 pages at 33.66 megabits/page would take 90 minutes. This is based on a 960 KH bandwidth with transmission at 920,000 bits per second. The cost to transmit the 150 pages in 90 minutes is $337.50.

Because Comsat charges have not as yet been fixed, it was necessary to approximate. On the basis of a government pegged 12% return on investment for Comsat, the yearly revenue necessary from the 13-channel satellite is 20.8 million dollars. This means channel cost is $133,000/month or $3.70/minute, based on 600 hour usage, approximately the same as the Telpak D rate. The difference is in the line capacity. The 5 MH bandwidth of the TV channel make transmission speeds of 15.75 megabits/second possible. At this rate, the complete 150 pages would be transmitted in 5.32 minutes or at an amazingly low cost of $19.68.

Analysis that is based simply on this fact is incomplete. Microwave costs from the ground station to the final destination have not been included, and the proximity of ground stations will be another very influential factor. Also incompatibility between satellite and ground line capacities must be accounted for. In developing these cost calculations, Mr. Schubert has also made one assumption which might not be realistic. He assumed that Comsat would have full ownership and control of ground lines. This point is presently being vigorously contested by AT&T.. Another important consideration which was not brought into the analysis is that of fixed cost. Both Telpak ($135,000/month) and the Comsat channel ($133,000/month) are private line leased services. If these services were offered strictly on a full channel basis, alternative costs would be comparable.
Economic benefit would only be derived where usage exceeded the capacity of one Telpak D channel. Practical application of the satellite will have economic advantage as illustrated only when a channel can be 'tailored' to the users needs.

Technological advances have been dynamic, and there is no indication that progress will suddenly halt. It is not beyond reason that by 1975 an international dial-up communication service, via commercial satellite, will be as real as Broadband or Dataline services are at present. The rate at which the density of ground stations grows, or technological advance towards direct satellite transmission and sophistication of channel multiplexing will be major factors.

One recent announcement supports this view towards continual progress. A new service has been launched by Comsat in early 1969. A 4 KHz broadband service across the Pacific and Atlantic Oceans promises to reduce international telecommunications costs. Estimated expense reductions are about 23% when compared to rates for 12 4KHz channels.\(^1\)

Initially, the system will operate with a restricted market. Only when domestic line costs are reduced and the service can be made on a toll basis, with channel sharing, will this offering be available to the public. One suggestion to reduce ground data transmission rates is to have unlimited sharing of the Telpak D service. This issue is now before the FCC.

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Figures of the McCall's example show that per unit communication cost via satellite could be as low as 6% of Telpak D costs. This might be very optimistic, but a reduction to 20% of present costs in a commercial atmosphere does not seem beyond possibility. Time has shown that computer processing costs have greatly decreased with the development of technology. The communication satellite will do to data transmission costs what the electronic computer has done for data processing costs.

Without straying to the complex area of economics within the computer, one further point should be made. The success of any computer system is highly dependent upon the ability to match system needs with the optimal configuration. It is reasonable to assume that channel selection in a computer communications system will be dependent on total system capacity estimates. Therefore any error in an over or under capacity estimate should be common to the entire system. This interdependence is not necessarily bad as consistency seems a desirable systems trait. The implications of the relationship must, however, be realized. Any misjudgement of needs and the resulting costs in terms of dollars will, with regards to the computer, be magnified by the improper capacity communication channels.

Most reference has been to the U.S. scene, but this is obviously because of the advanced position of satellite technology in that economy. Canada is a very active participant in the international consortium and it
seems safe to say that any commercial services which become available in the United States will spread to Canada rapidly.

Any commercial organization which is projecting communication requirements and costs into the future can assume a definite decrease in data transmission costs.
SECTION 3

A

DATA COMMUNICATIONS

SYSTEM
CHAPTER 6
A DATA COMMUNICATIONS SYSTEM

One phenomenon which accompanies the evolution of any business process—especially the more glamorous ones,—is the mass of 'format recipes' which are developed to guide the businessman down the road to progress. The introduction of the electronic computer and the pursuing flux of literature armed at aiding adjustment to the resulting new environment are a prime example. The marriage of the computer with communications systems is no exception. Again, formalized guidelines to systems development are apparent in a variety of business periodicals, journals and magazines (3, 7, 28).

Rather than reorganizing and repeating the ideas of many authors, let us test one formalized plan against the development of a real-life situation. To serve this purpose, a published systems development guideline (7) by William P. Davenport, a consulting engineer with Comsul Ltd., San Francisco, California has been employed. Mr. Davenport's format for success has been presented to the manager of a communication system centred in Vancouver, B. C. The company is in the transportation business with terminals covering Vancouver Island, the lower B. C. mainland and stretching into the interior of the province. The system which has been in operation for three years has successfully fulfilled the original objectives and is termed a success by Management. Our systems manager has
FIGURE 6-1
A BRITISH COLUMBIA
DATA COMMUNICATIONS SYSTEM

Campbell River

Courtenay

Port Alberni

Nanaimo

Ladysmith

Vancouver

Victoria

PRIVATE VOICE GRADE LINE

PRIVATE VOICE GRADE LINE

PRIVATE VOICE GRADE LINE
reviewed his operation using the Davenport article as a guide to discussion. Possibly through extensive development of this case history, the generalized plan will have more meaning.

First, a description of the original system and the problems of that system are offered. This will be followed by a summary solution in accordance with the structure of Mr. Davenport's article.

The Original System

The hauling company has three major terminals, at Vancouver on the lower B. C. mainland, at Victoria and at Nanaimo on Vancouver Island. A series of smaller terminals, as illustrated in Figure 6-1 complete the network. Because shipments between the mainland and the island communities are dependent upon the ferry barge service, scheduling is somewhat restricted (i.e. if a truck misses the 9 P.M. ferry from the Vancouver dock to Victoria it must wait until the next day). The major problem of the original system was that the bills of lading which had to accompany goods on delivery were not fully prepared when the cargo had been loaded. The result was that clerical functions which should have been handled at the sending depot had to be completed at the receiving depot.

The suggested solution was to transmit documents over a TWX or Telex network. Copies would be developed at both locations and a paper tape would be produced for computer processing.
General Objectives

The general objective of the system was to speed up the shipping system and to eliminate restrictive clerical functions. It was also hoped to automate the billing process as part of an expanded computer operation.

Determining the Scope

Determination of scope was regarded within four main categories. Geographically the system was to coincide with existing depot locations. Restrictions imposed by administrative requirements, computer requirements and terminal needs were also considered. This is to say specific data was required at a specific location at a specific time. Time and manpower needs were looked upon conservatively. There was no need to rush into a new system. "Take all the time necessary to train our employees to handle the new system and introduce it only when it is felt to be fully operation". Time limits could be described, "as soon as it was ready".

A final consideration in determining scope was evaluating the reactions of people - the acceptance by employees to a major change and the attitude of management towards involvement in making a new system work. Although management was behind the project and there was no major concern as to employee reaction the project team was constantly aware of the necessity to 'sell the new system' when plans had been finalized.
It should be added here that, because of the size of the company, the planning team was higher in the organization than it would be in most larger corporations. This helped to eliminate the frequent problem of lack of top management involvement.

**Preliminary Planning**

It is at this point that development of the selected system diverged, to some extent, from Mr. Davenport's plan. Rather than projecting training requirements and designing procedures and new organization charts at this time, the team sought initial systems proposals from suppliers. This involved studies by four major data communication equipment and/or facility suppliers. The company 'decision makers' consisted of the general manager, comptroller and the field manager.

This team decided to open their doors to CN/CP, the B.C. Telephone Co., Fridon and IBM. After listening to the four proposals, and after extensive conferring and negotiating in a competitive environment, the hope was to gain insight into the data communications field. By incorporating what might be subjective evaluation with 'outside' views, a total picture of a desirable system might best be developed.

**Study of the Original System**

In contrast to Davenport's recommendations no formalized study of the original system was undertaken
at this time. It was described as an operational, well-documented system that simply becomes antiquated in an automated age. Data had to move faster. The intention to introduce a third-generation computer into the company made the availability of input data for billing and accounts receivable purposes very desirable. It was hoped to fulfil a secondary need for computerized lane analysis (to optimize shipment schedules). This necessitated developing specific computer input.

Analysis of Systems Requirements

The company team decided that the solution to their problem was to transmit data in digital form between terminals. A second function of this process would be to produce adequate input data for computer program requirements. The major factor was that this would relieve trucks from delays due to paperwork. While a shipment was physically moving between terminals the liens related to that shipment could be transmitted over a line facility and actually come off the output terminal before the shipment had arrived.

Total cost (processing charges, reduction in cost of trucking delays, etc.) had to be less than the old system. The new system would have to be capable of handling a growth in data transmission of ten per cent per year over five years.
The Approach to Solution

Mr. Davenport recommends doing a feasibility study. In this case no formal study was done. It was decided, intuitively, that the expense of a feasibility study was not justifiable. If the new system could avoid a one or two hour delay in shipping at a 'reasonable cost' it was judged worthwhile. The projected costs from at least one proposal made the 'new system' approach acceptable. By this time, the competitors had been eliminated and the B.C. Telephone Company was selected to supply the lines and terminals.

Considerations

The major attribute of the competitive proposal technique to develop a general systems design is that the evaluator is not analysing segmented parts of a system. Besides regarding the individual factors that compose a system the alternative proposals might propose different views of the dynamics, the interactions of the various parts of the system. The possibility of different concepts from external sources might prove more beneficial than the limited view of a single internal group.

As a result of the selected general proposal, one major corporate policy was necessary. To centralize billing and scheduling would require high speed data transmission. A decentralized system could employ low speed lines. Cost of alternatives dictated that a decentralized system was most suitable.
Other important considerations had to be made. A problem of internal politics arose as one terminal manager rejected participation in the system. The system stayed. The man finally had to be replaced. (The systems manager saw this as a very sensitive moment in the life of the system and emphasized the dependence upon people in any system's success).

Peak daily, weekly, monthly and seasonal volumes were considered and the system allowed for these. Allowance for volume fluctuations is of prime importance. The urgency of information at a certain point can be vital. Such was the case in this system where the liens had to be at the receiving terminal when the shipment arrived. The consequence of errors was also evaluated. Optional error-checking equipment was included to decrease the possibility of incorrect transmission. A study of cost associated with transmission error should be developed and error checking (and associated costs) would depend upon the desired level of confidence for data transmission.

Also of importance is the distribution pattern of data. Projected line loads will determine the necessary capacities between different terminals. In this case it was felt that the bulk of data would move between Victoria, Nanaimo and Vancouver. Other connections in the network had a smaller communication requirement.

Also to be considered was forms design. The con-
version to the use of TWX terminals necessitated a new lien form which conformed to machine requirements. This was designed internally, according to guidelines set down by B. C. Tel.

Another factor is to judge how this proposed new corporate subsystem might be most efficiently integrated into the total system. In this case both computerized billing and lane analysis were an afterthought to the initial purpose of avoiding trucking delays.

Practices & Pitfalls

The communications man at our trucking firm agrees with Mr. Davenport that users of the system should be involved in its development. In this case, two field trips were made by the systems design 'team' to get terminal managers opinions of system requirements. Not only might this eliminate adjustments that would have to be made in the future but it is natural for people to have more interest in a system that they helped build.

One major pitfall possibility in any corporate process is the problem of personal communication. In data communications development a clear concise statement of the problems to be solved is highly important. In this respect our system manager says "Verify what you have been told".

We have already mentioned that four alternative suppliers were considered. Even when the supplier had been selected, alternative services were available. Should the
system employ private or toll lines or a combination? As many alternatives as are available should be considered.

As Mr. Davenport points out, when relying upon supplier representatives for advice remember that it is a very rare circumstance when that supplier does not recommend his own equipment.

The system was designed by a team co-ordinated to develop an optimal level of expertise. Effect upon the total corporate system, input and output requirements, service availability and costs, field requirements and cost justification would be some of the reasons for calling upon the general manager, controller and field manager and the data communications representative.

Systems Design and Implementation

The actual description of this system will be left for a moment. The systems manager in our transportation-oriented operation has made comments in this area which serve to complement or supplement Mr. Davenport's remarks: Prove that the system works theoretically beyond a doubt and then sell it to the user. Pose oddball conditions and judge how the system would react. Although the system must be optimized according to normal conditions it must allow for the exception.

People should be trained in terminal operations on location before the lines are established. This not only saves time and expense but introduces change at a somewhat
slower rate. This is actually the beginning of implementation. In this case, since it was decided to 'switch-over' from the old system to the new as opposed to running parallel, preliminary testing and training were extremely important.

One warning accompanies design and implementations. People resist changes. The design engineer might be respected, but he will probably not be liked. This wariness in people can be reduced to some extent by complete written procedure manuals for the operating personnel.

The final major consideration upon which the systems manager expanded was error control. No matter how well planned, transmission errors will occur. This necessitates building into the system error identification and control processes. Technically such features as parity checking (discussed in Chapter 2) and longitudinal redundancy checks (actually a parity check operation for a series of characters) can be built into the system. Other controls such as hash totals for batch processing or self checking customer numbers might be employed.

One rule with regard to degree of error might be stated as follows: the higher the speed, the more serious the error (more data is transmitted during 'error time'). Therefore, it follows that in systems employing high speed transmission, adequate error control procedures are especially important.
Before turning to a description and brief analysis of the existing system, a few ad hoc comments might be offered. At sometime or other the unexpected, uncontrollable and undesirable will happen. In this case, a terminal unit was dropped during delivery to a depot causing a training delay. As mentioned, one depot manager had to be replaced as a result of a disagreement over the system. Problems arose in physically locating terminal equipment. Some terminal operators were not trained well initially and this resulted in transmission problems. The first day of transmission was marred by a 50% error rate due to line quality problems. Although problems were rapidly corrected, this one instance seems to indicate to the author that a short term parallel run might have been in order when initiating this system.

Figure 6-1 illustrates the present facilities of the system we have been discussing. Private voice grade lines between Victoria and Vancouver and between Vancouver and Nanaimo join the major company offices. All depots have TWX terminals which are tied into the Dataphone system on a toll usage basis. The Vancouver terminal also employs the international Telex network, but this is not used for internal communication. Rather it allows data flow with North American allied van companies who share a common area of interest.

The voice grade lines from Victoria to Vancouver (63 miles) and Vancouver to Nanaimo (46 miles) are used
during office hours (8:30 A.M. to 5:00 P.M.) strictly for voice transmission. Data transmission between these three locations is carried on after hours. To handle the data preparation, there are 5 35-ASR terminals in Vancouver, 2 each in Nanaimo and Victoria, and a single unit at each of the other terminals.

Line volumes average as follows: 210,000 bits/day between Vancouver and Victoria, 120,000 bits/day between Vancouver and Nanaimo, and 60,000 bits/day through different connections of the TWX toll usage system.

The needs of the inter-depot TWX system (for the moment we ignore the voice grade lines and their workloads) would be a single terminal at every depot (7) and line usage, based on 60,000 bits/day at 80 bps, of 12.5 minutes per day. The cost per month might be estimated on the following basis:

Line Usage: 25 days x 12.5 minutes x $0.10/minute = $31.25

Terminal Rentals: 7 x $110/month = $770/month

From this the cost of the system would approximate $800/month. Management (although no concrete results were provided) feels that this expense is well worth the return.

Let us look deeper into the practicality of the voice grade lines and their present costs. As far as the relationship between channel capacity and terminal speeds, there is a high degree of incompatibility. While the line could carry 2000 bps, the model 35-ASR can only send or receive 80 bps. One argument is that because the
facility is a private line with no time/cost restrictions, this is insignificant. However it might be worthwhile to look at the possibility of faster terminals or a Schedule 3 private line 12 hours per day rather than a 24 hour per day Schedule 4 line.

The present system calls for four terminals in Vancouver producing data tapes (paper tape) off-line and one terminal transmitting on-line. The terminals in other locations produce off-line and then all data is transmitted between depots according to a predetermined schedule.

The line between Vancouver and Victoria handles 210,000 bits/day. At optimal terminal speeds this would take 43.75 minutes/day. The private line charge for the 63 mile line is a monthly rate of \((63 \times 4.00) + (2 \times 35.00)\) = $316.00 (a $4.00/mile line charge plus conditioning costs from Table 3X1).

The line between Vancouver and Nanaimo carries 130,000 bits/day which would take about 27 minutes to transmit at 80 bps. The line charge for this channel is \((4.00 \times 46) + 35.00 = 219.00/month\).

It is interesting to note that in this case to use the Dataline I toll service for an hour per day thirty days per month between Victoria and Vancouver would cost $180/- month in tolls (comparable to line charges). Thirty minutes per day to Nanaimo would cost $90/month.

Another alternative would be to lease schedule 3A lines, which are more compatible with terminal equipment,
for $2.50/mile. The Victoria-Vancouver channel would cost $173.75/month and the Vancouver-Nanaimo channel $121.25/month (see Table 3-XI).

Of course both of these alternatives eliminate the use of the private line for voice communications during the day.

The limited data volumes rule out the other possibility of higher speed terminals on a voice grade line. Terminal rentals, even when using a toll cost for line usage would be very inefficient in comparison to other alternatives.

Figures 6-II and 6-III illustrate comparative costs at different volumes for three alternatives: (1) the present system private voice line transmission, (2) the Dataline I toll service, and (3) a Schedule 3A private line service.¹

It can be seen from Figure 6-II (Vancouver-Victoria) that based strictly on data transmission costs (terminal costs are omitted) the present system does not become economically feasible until we exceed capacity of the lower speed lines. Figure 6-III shows the same thing for the Vancouver-Nanaimo lines.

This means that the added benefits, to justify the present system, must be derived from voice communication rates during office hours. At the present volume of

¹. Schedule 31 lines at 75 bps might also represent this alternative.
FIGURE 6-II
THE ECONOMICS OF LINE ALTERNATIVES
BETWEEN VICTORIA AND VANCOUVER

NOTE: monthly volume is approximately six million bits
FIGURE 6-III
THE ECONOMICS OF LINE ALTERNATIVES
BETWEEN NANAIMO AND VANCOUVER

NOTE: monthly volume is approximately four million bits
210,000 bits/day (approximately 5 million/month) and considering an expected growth rate of 10%, yearly, we are presently in the portion of Figure 6-II where (a)-(b) results in a dollar value of economic benefits which must be derived from other sources (i.e. telephone conversation). This means approximately $140.00 in the case of the Victoria-Vancouver line or seven hours per month of conversation. The same relationships exist regarding the Nanaimo-Vancouver channel, and again the added costs of the voice line, are, no doubt, justified by voice communication requirements.

The above discussion serves a dual purpose. It is a non-complex example to give insight into the implications of data communications system design. Also, it indirectly illustrates the lack of service alternatives.

The described system might be thought of as relatively small, lacking in glamour, and having little meaning in larger systems. Certainly, the larger system is more complex but many of the decision factors are similar. All cases are restricted by the limited number of services available through the common carriers. The implications of line and terminal compatibility have been introduced. Also, the interdependence of corporate sub-systems and its effect on design decisions has been suggested by the relationship of data transmission and voice transmission costs.

The case history which has been discussed also
illustrates a need for a wider range of services. It appears that the transportation company has selected the best of alternative services for its needs. This alternative, however, is not compatible with these needs. If the lines were used for transmission fifteen hours/day instead of one and at speeds closer to capacity of 2000 bps as opposed to 80 bps, line costs would be the same! That is to say that while paying the same monthly line cost, a larger organization might transmit closer to 375 times as much data and still leave the line for voice communication during the day. Is not the small organization entitled to a more economic service?

In planning a data communications system, one should regard as many alternatives as possible. Of course, this evaluation should be confined by cost/benefit economics. It is not reasonable to spend five thousand dollars differentiating between systems with a possible savings of $100/- month over four years.

In large scale systems these investigations will involve depth studies of line facilities provided by the carriers. Evaluation of terminals would go beyond that of the transportation company we have studied. In most cases, terminal units marketed by the computer manufacturers would be considered along with those of specialized terminal marketers. An example of this group would be Mohawk Data Corporation who first introduced the concept of data transmission via magnetic tape terminals. Data set alternatives
will become increasingly important as more firms enter the market.

As the environment grows more competitive and as more specialized equipment is introduced, it will become more appropriate to seek out and develop one's own unique, individually-tailored system.

While attempting to emphasize the benefits of analysis of alternatives, let us not exaggerate, beyond practicality, its usefulness. The degree of initial analysis should vary directly as the expected costs of the communications system. Any analytical framework should be developed with this rule in mind.
SECTION 4

LOOKING TO THE FUTURE
CHAPTER VII
CONCLUSIONS

We have attempted to perceive the Canadian telecommunications industry as a systems state - an effort which requires analysis of physical attributes, internal dynamics and environmental intrarelationships (37). Both structural and dynamic aspects of the industry have brought us to a moment in time. It is a complex system. Any forecasts as to change in any of these three dimensions (physical, dynamic relationships, ecology) are subject to a relatively high probability of error because of this complexity. Both exogenous and endogenous factors will no doubt distort any projected growth patterns from reality.

In some areas further comment is justified. Let us then conclude with remarks based on the physical domain, systems dynamics and environmental relationships.

Technological advances are being made in telecommunications at a rapid pace. This is the result of demands for faster, higher capacity equipment - channels, data sets, terminals. The American data volumes which command this extensive research do not exist, as frequently, in Canada. While computer technology has advanced so rapidly that internal speeds have far surpassed capabilities of existing communication channels, few systems presently exist in Canada which are restricted by this state. On the other hand, in the U.S., where data volumes and informations
systems are waiting for the common carrier services to 'catch up' to the computer, there have been more cries of non-preparation. As a result there has been and will be, in Canada, a closer time correlation between demand for facilities from the users and supply (as new services drift in from the U.S.) from the common carriers.

For instance, Dataphone 50, a service introduced within the last year in the United States, will be available in Canada within two years. This offering is a common usage switched wideband data service capable of transmitting 50,000 bps. It is the first non-private wideband service marketed in North America. The initial network consisted of New York, Washington, Chicago and Los Angeles but will gradually include all major American cities. Costs will range from $0.50/minute under 50 miles to $3.25/minute over 2000 miles. The cross-over point to a private line, from New York to Chicago, would be about three hours usage per day. This will open wideband services to the lower volume clients, providing an attractive alternative to many.

1. This information resulted from an interview with Mr. J. Bleiler, recent Supervisor of Marketing, Data Communications, British Columbia Telephone.

Another development which should become available in Canada shortly is the touch-tone terminal. This would be a unit very similar to a touch-tone telephone, only having twelve keys rather than ten. The system would use regular telephone lines and have a monthly fixed charge similar to that of domestic telephone units. There would be no time/usage charge for local calls. The originator would use the keyboard to dial a receiving terminal (i.e. computer) and transmit data, digitally, with the twelve keys. This concept will truly bring the computer into the home. Obviously, such a terminal would only be feasible where an operation required very little input data.

Foresight in the development of marketable program packages on the part of commercial service bureaus accompanied by the physical introduction of these terminals could open up an entirely new market of data communication users within two or three years.

There will be a steady growth in the range of data sets available to the commercial user. The presently limited offerings above 5000 bps will, no doubt, fill in.

The growth of data communications with the development of the electronic computer has greatly affected the position of the common carriers. Until this occurrence, the carriers were regarded, with little objection, as suppliers of a total service. The Trans Canada Telephone System supplied and maintained telephone terminals and all line facilities. They had control of the total system.
This author feels, as do many others (see Appendix B) that what might be desirable for a nationwide voice communication system is not necessarily the optimal approach to a commercial or domestic digital communication system.

The carriers do have a right, and an obligation, to protect information being transmitted over public channels. This can be accomplished by a simple protective sensor at the customers connection to a public line.

Terminal and data set units should be available on a totally competitive basis and always situated upon the 'customer side' of this protective device.

Certainly the carriers might be allowed to market terminal and data set units and to supply maintenance services but in no way should they restrict attachments used for data input. The carriers seem to be, gradually, succumbing to this approach. The policy of British Columbia Telephone on acoustic couplers is presently being redefined (35). "Our future attitude will possibly be to consider the telephone itself as the interface for protection of our network when used in connection with acoustic couplers". Also, terminal devices 'beyond' the data set are in most cases accepted by the carriers to be attached to carrier supplied data sets.

The common carriers, on the other hand, appear to have a more convincing case for restricting other specialized public carriers in high volume areas. Certainly, if a common carrier is required, in his role, to serve
low volume areas and finance a sub optimal system in sparsely populated areas he should be protected from 'cream-skimmers' who wish to develop systems between the larger cities. On the other hand, the carriers should not be allowed to restrict the risk-seeker who will venture 'on to thinner ice'. These complications might justify a government committee which would evaluate individual proposals and react accordingly. Let us look at a hypothetical case where a private group wishes to develop a toll/usage microwave system between Montreal and Toronto. After the initial proposal to the government committee, the common carriers (Telephone System and/or CN/CP) would have an opportunity to study and respond to the suggested offering. They might maintain that they had themselves planned such a system in the near future or that they have no such plans for ten years. In the first case, the proposed system might be allocated to the Telephone System or a joint venture might be suggested. In the second case, the private system might be acceptable. The point to be made is that the situation is complicated to the point where a rigid set of regulations is undesirable. Flexibility is the answer, and the individuality of proposals should be recognized.

The dynamic relationships of data communications could be greatly altered with progress in the area of satellite communications. Opinions as to the economic effect of satellites upon data communications do vary, however. Some feel that costs will be greatly altered
(see Chapter 5). Different authors see the major breakthrough as coming when the ground stations can be eliminated and data transmitted directly from the satellite to an antenna on the receiving terminal.¹ A more conservative attitude has been presented by D.F. Bowie, President and General Manager of the Canadian Overseas Telecommunications Corporation (35), "There is at this point in time no reason to believe that satellite service will be cheaper than, say, conventional microwave systems". With such a wide range of authoritative opinions, it is almost impossible to predict at what distance between stations will satellite communications become desirable. It seems reasonable to say that although a direct relationship between transmission cost and distance separating terminals will remain the degree of cost variation should decrease. (i.e. the cost to transmit data via satellite from Toronto to Winnipeg should not be much different from costs between Toronto and Vancouver). Also, this author tends towards the consensus that per unit long range data transmission costs will decrease with commercial usage of communication satellites.

Until now we have to a large extent ignored specific comment upon the basic factor of data transmission. The North American community is in a massive transition

period from analogue to digital information transfer. Digital transmission is either replacing or supplementing analogue transmission. The reason, in one sentence, is that this will allow all forms of communication to occur over the same facilities with a high degree of efficiency. Although analogue forms (i.e. voice) will never disappear, it is quite possible that phone conversation will soon be altered to digital form for transmission over connecting channels and restored at the receiving terminal.¹

Advances in data communications might find the greatest change in effective environmental relationships. We have already mentioned that soon the touch tone terminal or some similar device may be a part of many homes. This could mean many things. Certainly a more extensive communication system will eliminate a great deal of today's physical movement. Employees might commute to the office once or twice per week and spend the other days at home deriving necessary data from a computer via a desk terminal or through phone conversation. The cashless society could be a reality and not the excuse for some awe-inspiring magazine article.

Unfortunately the necessary standardization which will be a part of this development will in many ways restrict individuality. This is one reason why this author tends towards a modular systems approach rather than the single universal system which some advocate. Modularity provides flexibility, and a single module might more easily

¹. H.J. McMains, op. cit., p. 29.
accommodate the inventiveness of an individual than would a universal system.

It is impossible to predict the future. We might simply try to understand the possibilities before us. The businessman is usually faced with a set of objectives. He must work with the information which is economically available. A high degree of risk is inherent in decisions related to a complex systems state. It is hoped that the information gathered here, in the field of data communications, might help to minimize risk, when applied to specific needs.
SELECTED BIBLIOGRAPHY
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CORRESPONDENCE TO AUTHOR

PUBLISHED

33. Chapman, J.H. Assistant Deputy Minister, Department of Communications, February 21, 1969.


35. Bowie, D.F. Canadian Overseas Telecommunications Corporation, President and General Manager, March 26, 1969.


UNPUBLISHED

37. Sutherland, J. "A Socio-Economic Decision Model: (mimeographed draft of proposed publication), Vancouver, B. C., 1969.

LEGISLATION


PERSONAL INTERVIEWS


41. Mr. M. Burns, IBM Canada, February, 1969.

42. Mr. R. McGuigan, British Columbia Telephone Company, February 6, 1969.

43. Mr. L. McNeil, CN/CP Telecommunications, January 30, 1969.
APPENDICES
APPENDIX A

GRAPHIC REPRESENTATION OF DATA TRANSMISSION
COST-VOLUME RELATIONSHIPS

At different points in this thesis, reference has been made to the use of graphic analysis in the planning of a data communications system. Also, it has been mentioned that the form that any graphic representations might take is dependent upon the geographic locations of the terminals being connected. Two examples of graphic analysis were illustrated in Chapter 3. Figure 3-VIII showed the possible advantages of multiplexing a voice grade channel (the Datapak service). Figure 3-IX illustrates the advantageous volumes at which different data sets should be employed with voice grade lines. The purpose here is to look at the lines themselves. In the examples, terminal locations are Vancouver, B. C. and Toronto, Ontario.

Figure A-I shows comparable subvoice line options. Figure A-II illustrates the voice grade options. All private line charges are based on 2078 air miles between the cities.

Because terminal units and costs are more standardized in the Telex and TWX systems, their costs have been included in Figure A-I. Due to a larger variety of terminals being employed with voice grade lines, no terminal costs are included. All calculations have been based upon the maximum throughput possible within the transmission rate restrictions of the various services.
Analysis of Sub-Voice Grade Line Services

Figure A-I looks at four alternatives for low speed data transmission between Toronto and Vancouver.

The Datatelex toll rate from Vancouver to Toronto is $0.90/minute (see Table 3-VI) and the terminal cost is $110.00/month. Transmission speed is limited to 110 bps by the terminal.

A private, full duplex telex channel capable of 80 bps transmission for a 40 hour week costs $1.65/mile. Terminal costs are also considered, (because the similar 75 bps Schedule 3 line with similar traits of Telephone System costs $1.72/mile it is not considered).

The TWX service costs $0.90/minute and terminal rentals are $90.00/month. Transmission speed is based on 80 bps.

The Telex line also costs $0.90/minute and terminal rental for the KSR unit is $40.00/month. Transmission is limited to 50 bps although it should be remembered that this is in a five-level code rather than eight-level as is TWX and Datatelex transmission.

Although other service combinations are available and intangible values have not been considered, this provides some indication of the service cost relationships.

Analysis of Voice-Grade Channel Services

Figure A-II illustrates the variations in voice-grade service costs at different volumes. Terminal and data set costs are not included.
FIGURE A-1
COST-VOLUME RELATIONSHIPS FOR
LOW SPEED SERVICES

NOTE: Terminal costs are included.
(A) Datatelex Toll Service
(B) Datatelex Private Line
(C) TWX Service    (D) Telex Service
Broadband toll rates from Toronto to Vancouver are $0.50/minute plus a monthly fixed cost of $100.00. The maximum transmission rate is 2400 bps.

The private line charges for a Broadband circuit over 2078 miles is $5,250.50 (100 x 4) + (400' x 32.5) + (1578 x 2.25). Capacity is similar to that of the toll service.

Dataline I services, both toll and private, have the same cost structure as the Broadband services. The main difference is that the maximum capacity of Dataline I is 2000 bps. Therefore, rather than plot these services on a graph, it will suffice to say that if both systems operate at maximum, the variable costs of the Dataline I toll service would be 20% higher than that of Broadband. Private line maximum through-put for a Dataline I channel would be 20% less than the CN/CP supplied private channel. In any instance where the system would be slowed, by the terminal or data set capacities, to 2000 bps or less, the costs of both Broadband and Dataline services would be equal.

It appears in this instance that the actual line costs of CN/CP services are more economical than the Telephone System on a cost per unit basis. In other circumstances it is possible that the opposite would be true. Even in this case, different analysts might feel that the difference in dollar cost might be more than offset by intangible benefits that they might perceive within the Telephone Company offering.
FIGURE A-II
COST-VOLUME RELATIONSHIPS FOR
VOICE GRADE CHANNELS

NOTE: No terminal or data set costs are considered.

(A) Broadband Toll Services
(B) Broadband Private Line Charges
In this appendix we simply show how a pictorial representation can aid to clarify the relationship between different line costs at different volumes.
APPENDIX B

THE FEDERAL COMMUNICATIONS COMMISSION AND THE REGULATORY AND POLICY PROBLEMS IMPLIED BY COMPUTER TELECOMMUNICATIONS

Interstate communications in the United States fall under the controlling influence of the Federal Communications Commission. This regulatory body is a by-product of the Communications Act of 1934, as amended, and the operating procedures of the FCC are outlined by this legislation.

The rulings and tariffs, as developed by the FCC, have increasingly important effects upon any organization which operates in a computer-communication environment.

The dynamic advances of the computer industry - both in terms of growth (roughly 20% per year) and in terms of technology, with increasing trends towards telecomputing - have resulted in what one author refers to as a boiling pot.¹

The complexities of this situation stimulated the issuance, on November 10, 1966, by the FCC, Notice of Inquiry on Docket No. 16979, of "Regulatory and Policy Problems Presented by the Interdependence of Computer and Communication Services and Facilities". The Notice specified the areas of study where the Commission requested voluntary information, views and recommendations from

all interested parties. The main items of inquiry are shown in Table B-I.

This effort by the FCC resulted in replies of various forms from thirty-nine organizations. The responses could be subdivided into four types (38):

1. those who confirmed the relevance and scope of the inquiry,

2. premature submissions which referred to the merits of the questions at hand,

3. those seeking interpretation and/or modifications of items introduced in the initial notice,

4. suggestions as to procedures for handling submissions.

These responses led to the adoption and release of a Supplemental Novice of Inquiry on March 2, 1967.

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In view of the foregoing, it is incumbent upon the Commission to obtain information, views and recommendations from interested members of the public in order to assist the Commission in resolving the regulatory and policy questions presented by this new technology. Accordingly, such information, views and recommendations are requested in response to the following items of inquiry:

A. Describe the uses that are being made currently and the uses that are anticipated in the next decade of computers and communication channels and facilities for:

1. Message or circuit switching (including the storage and forwarding of data);
2. Data processing;
3. General or special information services;
4. Any combination of the foregoing.

B. Describe the basis for and structure of charges to the customers for the services listed in A above.

C. The circumstances, if any, under which any of the aforementioned services should be deemed subject to regulation pursuant to the provisions of Title II of the Communications Act.

1. When involving the use of communication facilities and services;
2. When furnished by established communication common carriers;
3. When furnished by entities other than established communication common carriers.

D. Assuming that any of all of such services are subject to regulation under the Communications Act, whether the policies and objectives of the Communications Act will be served better by such regulation or by such services evolving in a free, competitive market, and if the latter, whether changes in existing provisions
E. Assuming that any and all of such services are not subject to regulations under the Communications Act, whether public policy dictates that legislation be enacted bringing such services under regulation by an appropriate governmental authority, and the nature of such legislation.

F. Whether existing rate-making, accounting and other regulatory procedures of the Commission are consistent with insuring fair and effective competition between communications common carriers and other entities (whether or not subject to regulation) in the sale of computer services involving the use of communications facilities; and, if not, what changes are required in those procedures.

G. Whether the rate structure, regulations and practices contained in the existing tariff schedules of communications common carriers are compatible with present and anticipated requirements of the computer industry and its customers. In this connection, specific reference may be made to those tariff provisions relating to:

1. Interconnection of customer-provided facilities (owned or leased) with common carrier facilities, including prohibitions against use of foreign attachement;

2. Time and distance as a basis for constructing charges for services;

3. Shared use of equipment and services offered by common carriers;

4. Restrictions on use of services offered, including prohibitions against resale thereof.

H. What new common carrier tariff offerings or services are or will be required to meet the present and anticipated needs of the computer industry and its customers.

I. The respect in which present-day transmission facilities of common carriers are inadequate to meet the requirements of computer technology, including those for accuracy and speed.

J. What measures are required by the computer industry and what carriers to protect the privacy and proprietary nature of data stored in computers and transmitted over communications facilities, including:
1. Descriptions of those measures which are now being taken and are under consideration; and

2. Recommendations as to legislative or other governmental action that should be taken.
Amidst reference to the initial respondents and clarification of the original intentions, this additional notice invited response to Items A through J of paragraph 25. This invitation expired on October 2, 1967.

By the first quarter of 1968, all relevant submissions had been received and the views of varying positions were established. The fifty-seven statements of position which were received came to the Commission from computer manufacturers, common carriers, data processors and related associations as well as from the Justice Department.

The common carriers' message was voiced most loudly by Western Union. They argued that message switching, message concentrations, and circuit interconnection are, by historical development, communications functions, not data processing functions. Therefore, under existing laws, not only do common carriers have the right to perform these functions, but any such functions which are performed by a data processing concern should be regulated by the FCC in its role of aegis of all interstate communications. Referring to various legal decision, Western Union insisted that whenever a data processing firm offered any of the aforementioned 'communication services' it would have to be classed as a common carrier.

The Business Equipment Manufacturer's Association (BEMA), in submitting three reports to the Commission,
emphasized the "multiuser sharing of communication facilities". This group supported elimination of all restrictions on circuit sharing and encouraged the sharing of communication channels between major cities.

BEMA clarified its position and exposed a less contrasting viewpoint than expected. First, there was no insistence that users control any shared 'communication' services. The necessary arrangements for pooling might be controlled by the common carriers. Secondly, it was recognized that the carriers might be entitled to sell data processing services. In this case, however, the FCC should establish a framework to ensure a competitive atmosphere.

It can be seen that, as a result of the responses, prevailing moods appeared. BEMA did not find data processing competition from the carriers unhealthy. The common carriers insisted that members of the data processing industry should not provide any communication services.

The major request of BEMA was for progressive development of communication channels, interface equipment and tariff schedules, which accommodated the uniqueness of data communications. The significant problem areas were found to be twofold. There is, presently, an inconsistent range of services available. Carrier objections to foreign attachments are presently limiting efficiency.
In the first case, there are inadequate services in the 3-24K bps range, and a maximum capacity of 250K bps.

A BEMA study, along with remarks from both users and data processing manufacturers, developed a strong position against carrier banishment of foreign equipment. While immediately available modems from independent suppliers might fulfil better the needs of the specific user, common carrier restrictions have prevented this. The solution might lie in the development of interconnection standards by the carriers rather than total banishment.

Carriers opinions were defensive. To develop new facilities, demand must stimulate supply. Western Union claimed another policy guideline, "users of current service offerings must not be penalized by these efforts".

Of prime consequence was the opinion of the Justice Department. Although history has shown that the recommendations of this body have had little direct effect upon past FCC decisions, referrals to these public recommendations could carry weight in any future legal battles. In this case, the Justice Department backed data processors. "The foreign attachment rule restricts competition by independent equipment suppliers...principle focus was on the modem."1 Also, the Justice Department voiced that "remote

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access data processing is not common carrier communications and hence is not subject to the Commission's jurisdiction".

For obvious reasons, the topic became a popular one for conferences, panels and discussion groups throughout North America. In the words of Dr. Manley Irwin, consultant to the FCC, "Communication policy and practices (are being exposed) to an unprecedented re-evaluation".1

The foreign attachment tariff, especially, has been under pressure for review. Not only in the case of computer terminal equipment now pending, but a committee studying the Carterfone case2, has made an unprecedented recommendation for approval of the Carterfone device and all other equipment previously banned by this tariff.3 This case and that of computer user demands for greater flexibility in ownership and control of terminal equipment merit the special attention of all data users. Both cost and the range of alternative equipment will be deeply affected by any Commission decisions.

Dr. Irwin describes another relevant conflict as the "facilities and service dispute".4 While the

2. An application to the FCC by Carter Electronics Corporation to market an acoustic coupler called the Carterfone. The policy of the Telephone Company has been to refuse to allow 'outside' terminals to be attached to their lines.
carriers have always maintained a policy of supplying total communication service, present day 'computer demands' urge simple line facility usage. They desire a 'pipe' line to use in data transmission. One example of possible benefits is the variations in overseas routes among possible suppliers. While the Trans-Pacific carriers bid $12,000 per circuit per month (based on a total service concept) on a Department of Defense contract, the comparable bid of Comsat was $4,000 (based on wholesale circuit concept).\textsuperscript{1} The FCC decision maintained that the Comsat-carrier-customer relationship must be preserved and ruled against the DOD's application for 'authorized user status'.\textsuperscript{2}

Other relevant dockets which commanded attention in 1968 concerned line sharing. The carriers frowned upon the subleasing of lines which they have committed to a private user. With few exceptions, line sharing was not permitted. The problem of regulated services versus non-regulated services appears again. On one hand, if utility tariff levels were restricted in the fact of competition, private competitors would undercut the tariff floors to attract a market. Letting the carriers lower tariffs on the other hand would, no doubt, discourage the development of new carriers.

\begin{enumerate}
\item Manley Irwin, op. cit., p. 38.
\item The Communications Satellite Act of 1962 allowed for "authorized users' to lease circuits directly from Comsat.
\end{enumerate}
Any future trends in this area will be influenced by the Microwave Communication Inc. issue. The intention of this company is to make available, to its customers, telecommunications facilities between St. Louis and Chicago to use at their discretion. Final decision on the MCI application will establish an important precedent for other firms hoping to attract common carrier submarkets.

The FCC is also faced with the question of satellite communication regulations. Dockets pending before the Commission will lead to policies regarding both publicly and privately owned satellites.

The aforementioned problems have more in common than controversy. A correct and consistent policy regarding both control and usage must be derived from the complex dynamics of a rapidly progressing technology.

The above provides a description of the FCC's position in the middle of 1968. The remainder of this appendix will summarize relevant events between June, 1968 and the final development of this thesis, and in conclusion, discuss any trends which might be apparent.

On June 26, 1968, the FCC found the total prohibition of foreign attachments to be illegal. It upheld the original ruling in the Carterphone case and expanded it to include all harmless customer-provided attachments. The

reasoning was that any customer who wished to adapt telephone company facilities for specific requirements without harming the public network should be allowed to do so.¹

The Telephone System protested the decision but to no avail. A new tariff, effective as of January 1, 1969, allowed the use of customer-supplied equipment heretofore prohibited. The new tariff contained three restrictions.² Total power output and energy distribution must be limited to avoid interference with public operations. A protective connection must join customer equipment to the telephone lines. Thirdly, network control signalling functions, such as dialing, must be performed by an AT&T unit.

Many users³ and the Department of Justice protested the revised tariff as only partially fulfilling the Carter-phone decision.⁴ Restrictions involving protective connections and control signalling cause particular concern. In the spring of 1969, the FCC was in the state of evaluating these user protests. What will occur remains to be

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seen, but there is a definite trend developing. The degree of common carrier control over its ecological environment is diminishing. The relaxation of the foreign attachments rule is significant. Desirable effects would be twofold:¹ data set costs would no doubt be reduced, and the competitive atmosphere would stimulate a more rapid development of special purpose interface equipment.

This author foresees the major effect of a final foreign equipment decision as dependent upon the 'network signalling control' restriction. It is in this realm that a competitive environment will link the computer to the home. Special purpose tone generation terminals with dual purpose dialing and data transmission capability require a non-monopolistic market place to ensure efficient development. Only when restrictions on signalling units are revised will these units develop at an optimal rate.

The FCC is proceeding at a somewhat slower speed in considering application for licenses as specialized common carriers. The main concern is the effect that these specialized carriers might have on the pricing policies of the common carriers. The Bell System and Western Union foresee these competitive services only in densely-populated high-profit routes, while they must support a national network which includes many low-profit routes. While this argument is valid, private interests, such as

¹ P.M. Walker, et. al., op. cit., p. 60, 67-72.
Microwave Communications Incorporated, contend that they are seeking to exploit markets which have been ignored by the carriers. What is the solution? Is a more competitive environment desirable? The growing list of applicants to provide specialized carrier services support the affirmative. Yet, the interests of the present carriers must be protected.

This author sees one possible road to solution. The common carriers should have an option on partial ownership of all proposed private systems. They could evaluate a proposed private system and elect to invest or not to invest in the system. The specialized carrier who makes the proposal could then proceed alone or as part of a joint venture, depending upon the common carrier's decision. Although no FCC decisions have, as yet been finalized in this area it is accepted that both sides have valid contentions. The final path will most likely be one of compromise and the suggested concept seems feasible.

This summary brings us to the spring of 1969. The effect of FCC decisions on Canadian common carriers will be significant. Trends in the attitudes toward foreign attachments provide an example. As a result of recent FCC decisions (which have been discussed), a representative of B. C. Telephone Company made the following remarks: "Our policy on acoustic couplers is at present being redefined. In the past, we enforced restrictions on the use of acoustic couplers, but now with (improvements and) developments in
the U.S. we have taken a permissive attitude...".  

Decisions of the Federal Communications Commission in the United States provide a good indicator of future data communication trends in Canada.

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1. This comment resulted from correspondence with Mr. G. Swan, a B.C. Tel representative with regards to present policies on foreign attachments.