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RELATIONSHIPS BETWEEN TELECOMMUNICATION  
CARRIERS, COMPUTER SERVICE  
COMPANIES AND THEIR INFORMATION  
AND DATA SYSTEMS

November 1969

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AND DATA SYSTEMS

A Report to the Department of Communications by

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1. INTRODUCTION

This report contains written responses to eight questions concerning the relationships between common carriers, computer service companies and their information and data systems. The questions were posed by the Federal Department of Communications.

Assistance in preparing these responses was provided by professors R. Dobell, B. Dunlop, T. Hull, G. Lang, K. Smith, L. Waverman and T. Wilson, all of the University of Toronto. Professor R. W. Judy of the University of Toronto and the Systems Research Group co-ordinated the study and wrote this final report.

2. DEFINE WHAT ARE TELECOMMUNICATION SERVICES AND DATA PROCESSING SERVICES

Definitions of these two terms are best given together with those of several related terms.

2.1 Definitions

Data:	A set of symbols, discrete or continuous.
Data Processing:	All operations performed on data except (distant) alteration of location.
Data Processing Services:	Providing facilities and/or related services for effecting data processing.
Data Processing Organization:	An organization that provides data processing services.

Computer: A machine that does data processing.

Analog Computer: A computer capable of processing only continuous data.

Digital Computer: A computer capable of processing only discrete data.

Computer Service Company: A data processing organization that offers data processing services to other organizations. Large scale, electronic, digital computers are normally used although analog devices may also be used.

Data Transmission: Alteration of the location of data.

Telecommunication: Data transmission by means of an electromagnetic signal representation between individuals or small groups.

Telecommunication Services: Providing facilities and/or related services for effecting telecommunication.

Telecommunication Carrier: An organization providing telecommunication services.

Telecommunication Common Carrier: A telecommunication carrier which offers for sale telecommunication to unrelated groups simultaneously while maintaining user privacy and offering means to the user for access to different group members.

Computer Utility: An organization that offers both data processing services and telecommunication services to other organizations.

## 2.2 Discussion of Data Processing Services

A variety of operations may be performed upon data.

Among the most prominent are the following:

- Arithmetic operations
- Logical Operations
- Storage operations
- Coding operations
- Editing operations
- Formating operations
- Recording operations

By our definition, these are all data processing operations. In greater or lesser degree, they are all concerned with transforming the data. They originate, improve, and otherwise alter the data and their information content. They do not alter the data's location in space.

A distinguishing feature of the data processing service business is the responsibility taken for the integrity of the operations applied to the data, and in general, to the function of making the result available to the user. Specifically to be included are: electronic supervisory actions (including monitoring and control), data base facilities ( e.g. in libraries, catalogues, inventories), maintenance of files (e.g. in banking, inventory) and intermachine data transfer. An example of a suitable data processing service would be provision of means for people to ascertain the time on a business basis.

As a counter-example, the mere transmission, as by facsimile, of pictorial information should not be interpreted as data processing even though numerous analog and digital electronic processes may have been carried out in the course of transmission, since there is no intent to perform any operation on the data other than alteration of location. Such other functions as they occur are mainly by incidental to the main intent which is to alter the location of the data.



### 2.3 Discussion of Telecommunication Services

The function of telecommunication services is to transmit (i.e. to alter the location of) data. In the process of transmitting data it may be expeditious or necessary also to perform other operations. A message switching centre, for example, may perform logical and arithmetic operations and temporarily store data and later forward them in order to use communications circuits more efficiently. But the intent of the transmission was to alter the location of the data; the calculations and storage were merely incidental to this intent.

### 2.4 Discussion of Telecommunication Common Carriers

Telecommunication common carriers provide ready and usual means for two-way communication between individual small groups of persons or equipments (from among a larger mass to whom such services are also available). They will provide means for selecting from time to time, on a ready basis, different group correspondences. Such means will have the property of being available to many unrelated groups simultaneously and in an isolated manner.

Telecommunication common carriers will generally have no concern for the meaning attached to the data transmitted through their facilities and do not in any way process, augment or reduce those data other than by default in the event that some degradation occurs. In general, telecommunica-

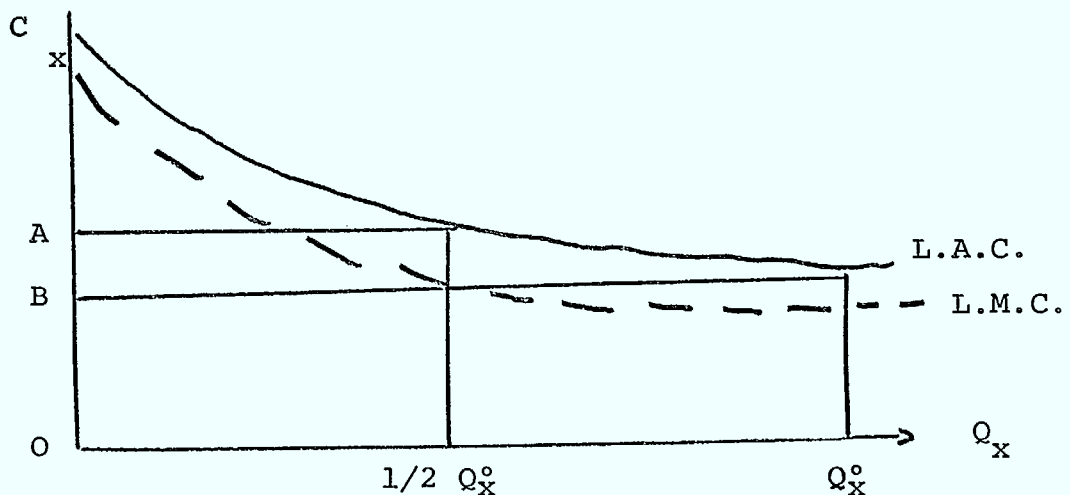
tion common carriers will take no responsibility for the retention of meaning of data transmitted by their facilities.

Specifically excluded by the definition are: a) the postal system, b) amateur radio communication, c) citizens band communication, d) commercial communication facilities within an organization, such as vehicle dispatching e) pneumatic message conveyance systems f) television, radio and other broadcast facilities g) coaxial cable distribution networks intended to provide largely unidirectional communication consisting mainly of entertainment and instruction.

Included in the definition are systems of electromagnetic paging and/or private communication facilities which are now available to allow personal vehicular communication as a public service.

3. DOES THE COMPUTER UTILITY AS AN INDUSTRY FIT THE "NATURAL MONOPOLY" FORMAT THAT ULTIMATELY CALLS FOR REGULATION?

A natural monopoly occurs when the range of output may be provided at lowest cost by one firm rather than two or more firms.



In the above diagram, the horizontal axis  $Q_x$  measures the quantity of good x produced. The vertical axis measures the long run average costs (L.A.C.) and long run marginal costs (L.M.C.) of this output  $Q_x$ .

Any specific industry output  $Q_x^0$  is produced at lowest cost by this one firm. If this output  $Q_x^0$  were divided among two identical firms, so that each produced  $1/2 Q_x^0$ , the L.A.C. for each firm would be OA. However, the one firm can produce the output  $1/2 Q_x^0 + 1/2 Q_x^0$  at OB, a lower per unit cost.

This situation is called 'natural' because the technological characteristics of the industry are such that if it began in a competitive state with n firms so that each firm produced  $\frac{1}{n} Q_x$ , natural evolution would occur until only one firm were left.

Given that the monopoly is not a result of anti-competitive pressures and artificial barriers, for efficiency of production, the government should not break up the monopoly. Instead, it must regulate it to ensure that excess profits are not being earned.

The provision of ordinary data processing services normally involves two elements: the use of machines or hardware and the production of programs or "software". The "computer utility" brings a third element, viz., data transmission by telecommunication. What signs do we find of present or incipient "natural monopoly"?

There are pronounced economies of scale in the use of hardware. These arise in two ways: (1) On any given computer, the average cost per processing operation performed in any given time period declines as the quantity of operations approaches the machine's capacity. (2) The average cost of a typical set of data processing operations is a declining function of the size of machine on which those operations are performed (assuming full capacity loading).

The economical scale of an ordinary computer service company is limited by the size of its market "catchement basin". Jobs must physically be brought to the computer for processing and the physical cost of this transportation rises as the user's remoteness increases. This rising cost counters the economies of scale in the use of the computer itself and thereby limits the size of the installation.

The computer utility, with its data transmission facility, permits remote access to the central computer. The geographical limits of the market are greatly reduced if not eliminated. The question now becomes: Are the economies of scale in computer usage so great that one firm could supply computer services remotely to a market the size of Canada or any significant part of it?

The answer to the question of the preceeding question must first be answered for the here and now. No existing computer is sufficiently large as to make its possessor a natural

monopolist. But what of the future? It is hazardous to speculate far ahead. Given the extremely rapid pace of technological progress in this industry, a decade may represent two or three generations of hardware technology with increases in computer speeds of many orders of magnitude. Nevertheless, the elasticity of demand for computer services appears to be so great that the growth of the market may outpace the growth of the technology.

There are no anti-competitive pressures or other artificial barriers barring entry into the field of providing computer hardware services. Recent performance of fledgling computer utilities in the financial markets suggests that investors are eager to provide capital. The other vital ingredient to successful entry is capable technical and business personnel. Here the market is very fluid. Bright and talented young specialists do not hesitate to leave the womb of IBM, Univac and other large concerns to launch their own entrepreneurial ventures.

Our conclusion is that the conditions of natural monopoly do not presently prevail in the area of machine usage within the computer utility industry in Canada. Nor does it seem likely that they will emerge within the next few (three to five) years. The situation bears careful watching because important breakthroughs in the hardware and timesharing software technologies could change the situation rapidly.



In the area of software production, the essentially competitive nature of the industry is even more pronounced. Low capital requirements for entry, the great mobility of skilled professionals, and the difficulty of maintaining proprietary software technology create great dynamism in this industry. Natural monopoly conditions are not now present nor are they likely to appear in the foreseeable future.

The question is more complex when we deal with certain data and software systems. In the case of a legal data bank, for example, it may be cheaper to set one up for the nation rather than two. However, the gains in resource savings from setting up the first legal data bank as a natural monopoly may be more than offset by the discentive this would place on the data bank owners to improve their service and on other possible competing data banks which might outperform the first. Until the technology of information retrieval systems has stabilized on a higher plane of perfection, there may be heavy costs of premature standardization. The "waste" when two firms would compete to offer the best legal data bank may well be offset by the competitive advantages.

Even granting that only one nation-wide legal data bank should be established is not to argue that the nation-wide medical or financial or scientific data banks need by offered by the same firm which offers the legal data bank. Nor need the data bank monopoly necessarily be owned by a computer utility or a communications common carrier. There seems to be

no natural monopoly for the provision of all data bank services by one company.

The question is the appropriate definition of the product. Whatever the field, the fact that there may be natural monopolies in small segments of that field is no reason to regulate the industry. Any field can be so subdivided geographically or functionally as to make some sector a natural monopoly. The provision of barber services on a street in a suburb of Acton Ontario is a natural monopoly - the excess capacity of the existing barber shop is such that any conceivable increase in local demand can be met by it. Yet, who would argue that such local barber shops be regulated as a natural monopoly?

The data processing and computer utility fields are now highly competitive. Regulation as a natural monopoly is unwarranted at the present time.

4. SHOULD ANY TELECOMMUNICATION COMMON CARRIER IN CANADA, WHETHER SUBJECT TO FEDERAL OR PROVINCIAL JURISDICTION, BE PERMITTED TO PROVIDE DATA PROCESSING SERVICES FOR USERS OUTSIDE OF THAT CARRIERS ORGANIZATION?

There are three broad policy alternatives. First, common carriers could be allowed to offer such services in an unregulated market. Secondly, they could offer processing services in a regulated market. Finally, the transmission utility could be prevented from offering any data processing services to firms outside its own organization.

The question of whether common carriers should be permitted to enter the data processing field must be answered by investigating the benefits and costs of such an entry to the public and to other non-integrated data processing firms.

We begin with the costs because these are the more simple and evident.

#### 4.1 Social Costs of a Permissive Policy

The main social cost the permissive first policy alternative is that desirable competition in the data processing field could be reduced or eliminated. This cost was featured as a prominent "danger" in The Brief recently filed by eleven data processing companies.<sup>1</sup> The dangers, according to The Brief because:

1. The computer services portion of the communications common carriers business may be subsidized from the proceeds of the regulated monopolist aspect of their business.
2. Whenever a regulated industry competes in one segment of its business and has a monopoly in another, the regulated industry has the opportunity to recoup any losses incurred in the competitive segment.
3. Predatory pricing and preference is possible.<sup>2</sup>

Anytime communications and computing are used together, the distinction between transmission and processing becomes operationally difficult. If these two services were offered by one firm, the distinction would become extremely difficult

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1. Brief on Public Policy and the Marriage of Communications Services with Computer Services, presented to the Government on Canada by AGT Data Systems Ltd. et al, July 23, 1969, herein after called "The Brief"

2. The Brief, p. 54

for an outside regulatory agency to assess because of the complexity of cost accounting procedures necessary to allocate correctly the costs between the two services. The possibility of price discrimination, therefore would exist. The common carrier would be offering data processing services at the same time as it would be selling transmission services to competing data processing firms. The incentive would exist for an integrated firm to allocate its costs so as to minimize its data processing costs and maximize its transmission costs. In so doing, the integrated firm would lower the price which competitive processing firms could charge while raising their costs.

Because of the inseparability of cost data the possibility would also exist for the common carrier to price its data processing services below a compensatory rate (below marginal cost) so as to drive all non integrated firms from the market. Carriers are presently regulated by setting a maximum rate which they can earn on their capitalization. The earnings in non-regulated sectors are not separated from earnings in the regulated sector. The carrier could therefore subsidize losses on its data processing sector by earnings from its regulated activities.

The power for common carriers to discriminate and price so as to foreclose the market is evident. The question is whether motivation for such use of this power would exist.

The use of this power is a rational policy. The elimination of computer service bureaus would prevent future competition from arising in the communications sector if and when data processing firms attempt to integrate forwards into transmission.

Such a pricing policy might also be rational for the carrier if it wished to maximize long run profits. Once all other firms were driven from the data processing industry, the carrier could raise its rates. Because of carrier control over the communications highways, artificial entry barriers could be established to prevent the re-entry of these firms in the future. The differentiation of the product which would exist between the service offered by an established large integrated communications and data processing firm and the service contemplated by a small unknown service bureau would make it difficult for effective competition to be raised against the carrier-cum-processor.

The telecommunications carriers may not be profit maximizers (since a maximal rate of return is now set for them) but, rather, sales maximizers. In this case, the manager of the carrier, in competing with managers of competitive firms for prestige, cannot be judged by his ability to increase the rate of profit. He may, however, compete with other managers in the size of his empire. If he is allowed to earn a maximum rate of return on his capitalization, the incentive exists to expand capitalization



(i.e. the empire) as long as the cost of capital is less than the possible and allowed rates of return. Regulated common carriers may be attempting to enter the data processing field simply because they would enter any field which their charter would allow them to.

Diminution of competition in the data processing industry could be expected, ceterus paribus, to bring social costs in the form of diminished incentive for rational innovation. If Canada is to realize the fruits of the "computer revolution", it is vital that that incentive be maximized.

We conclude that large, although difficult to measure, social costs would be associated with permitting common carriers into an unregulated data processing market.

#### 4.2 Social Benefits of Integrated Communications and Data Processing Operations

For there to be a benefit to data processing and information system users, the integrated common carrier - data processing firms must be able to provide services at lower costs than would a non-integrated firm. The possibilities for economies of integration lie in four areas:

1. The use of computer hardware.
2. The use of data and software systems.
3. The production of software.
4. The design and implementation of large information systems involving integrated use of communications and data processing services.

Each of these deserves examination.

4.2.1 From the use of computer hardware

It is common knowledge that economies of scale exist in computer hardware usage (see section 3, above). Since common carriers require large scale computer systems for their switching operations, does it follow that great economies would result from the use of these machines to provide data processing services to outside organizations?

Our feeling is that, at present, this question must be answered in the negative. Further research would be necessary to substantiate this negative response in detail. Future hardware developments will require continuing attention to this question.

It might be argued that economies of computer hardware usage could be reaped from fuller usage of switching computers during non-peak periods of communications usage. The merit of this argument is attenuated by the fact that data processing demands and communication demands tend to peak at the same periods of day and year.

For the present, then, we do not find generally convincing the arguments that large economies exist from the use of the same computer hardware for both data processing and communication purposes. The question merits further and continuing analysis.

#### 4.2.2 From the use of data and software systems

There may be economies of scale in this area since these systems are characterized by high initial but low marginal costs.

To say that economies of scale exist in the provision of data and software system services is not to say that there is a reason for these services to be provided by an integrated communications - data processing firms.

#### 4.2.3 From the production of software

There would appear to be no economies in the production of most kinds of software by an integrated communications - data processing firm.

#### 4.2.4 From the design and implementation of large information systems involving integrated use of communications and data processing services

A highly placed officer of one of Canada's largest communications common carriers has expressed his belief to us that there are important economies of integration in this area. The argument is that potential users of large complex, on line, dedicated information systems (e.g., airlines, railroads and other large far-flung industrial enterprises) require the services of large, experienced design groups with integrated expertise in computers and communications.

This argument is not to be dismissed lightly. However, the mere fact that a blend of communication and data processing inputs are required for a particular service does not warrant

the automatic conclusion that the service is most efficiently provided by an integrated telecommunications common carrier. An independent data processor may be able to lease the necessary communication services without loss of technical efficiency. Alternatively, an independent data processing firm may be able to supply the necessary communication links over a private system. (See Section 4, below).

However, just as efficiency demands that data processing firms should be allowed to penetrate communications where their cost is below the price charged by the telecommunications firms (See section 4 below), efficiency also demands that the telecommunications firms be allowed to provide those services where their cost is below the cost of the independents. Unlike the case of entry by data processing firms into the private communications field, the entry of telecommunications firms into any outside activity involving a blend of data processing and communications requires careful scrutiny by an appropriate regulatory body. To allow these firms to enter new fields of activity as they see fit would be to open wide the gates to discriminatory pricing and other practices designed to undermine the competitive position of the independents, and to the hazard, in the long run if not in the short, of the transfer of profits between the regulated and the unregulated portions of the conglomerate enterprise - or the unattractive alternative of imposing regulation in a field in which competition could have prevailed.

Consequently, we recommend that the entry of a telecommunications firm into any line of activity outside the communications field per se be permitted only after the firm has proved beyond a reasonable doubt that they can provide the service at lower cost than can their potential competitors. Since cost accounting in such a case is necessarily complex and uncertain, such a decision can only be wisely reached after both the careful scrutiny of relevant statistics by experts working for the regulatory authority and after the independent data processing firms and other interested parties have been given the opportunity to present rebuttal evidence in public hearings. In cases where a great deal of uncertainty exists even after the evidence has been assessed, the regulatory authority should only permit the service to be offered on a trial basis for a specified period for the purpose of obtaining additional evidence about costs and other matters.

If such service were allowed, the question would be raised whether it should then be subject to regulation. A definite answer can only be given to two aspects of this question. First, both the capital involved and the earnings on the capital should enter the relevant overall rate of return calculated by the regulatory authority. To do otherwise would be to encourage the telecommunications firms to establish subsidiaries in the field in order to place profits outside the scope of the regulatory authority. Second, the regulatory authority must satisfy itself that the telecommunications firms continue to supply adequate common carrier services to the independent data processing firms



and to private users who transmit data.

Whether a more stringent regulation of specific rates or prices is required cannot be determined in general in advance. For a new service, or for a service which is heterogeneous between customers, the filing of tariffs may be detrimental to the development of the industry and therefore to its customers in the long run. But if any service becomes established and standardized, the case for filing specific tariffs becomes very strong, particularly where the cost advantage of the telecommunications firms vis-a-vis their potential independent competitors is great and their monopoly position consequently secure.

Beyond incorporating the earnings of capital into its overall rate of return guideline, and insuring the adequate provision of common carrier services to independents, the regulatory authority should review periodically its policy with respect to the blended service offered. Premature detailed regulation of a new service may strangle its development; inadequate regulation of an established service could permit the exercise of private monopoly pricing power.<sup>2</sup>

Finally, we must address ourselves to the question of whether the proposed procedure is administratively feasible (by which we mean whether the potential benefits likely outweigh any potential costs. Regulation itself involves costs. These

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2. Obviously, the exercise of such power could not lead to excess profits in the aggregate, because of the rate of return constraints imposed by the regulatory authority. However, the pricing structure of the regulated firm could change to the detriment of the consumers of data processing services.

are of three types:

1. The direct costs of administering the regulations - including the costs incurred by the regulatory authority and the costs borne by the producers (and passed on to consumers).
2. Costs due to the delays inherent in regulations.
3. Indirect costs due to reduced incentives for efficiency and progress.

All of these costs rise with the degree to which the regulatory authority supervises or scrutinizes management decisions. Attempts to reduce costs of Type 2 will give rise to additional costs of Type 1 and Type 3. Hence a regulatory authority should not undertake new tasks unless the benefits - in terms of reduced monopoly pricing power - or increased efficiency in production are clear.

However, the procedures we recommend for the consideration of new blended services would not involve major additional costs. What we recommend is that the application of a telecommunications firm to enter a new field be subject to detailed scrutiny, but not necessarily the service itself be subject to detailed regulation after the firm is allowed to enter the field. Regulation beyond that involving constraints on the overall rate of return and requirements as to the availability of common carrier service would only be imposed when it became clear that the benefits of such regulation are great enough to warrant

incurring the costs involved.

Since the function described above - that of determining whether a telecommunications firm should be allowed to provide a specific blended service - is quite different from the function of regulating an established service, consideration should be given to allocating this function to an agency other than the Canadian Transport Commission. Perhaps the Department of Communications should be required to investigate such applications and to hold public hearings before recommending appropriate changes in the terms of reference of the regulatory authority.

#### 4.3 Summary

Our reasoning on this question may be summarized as follows:

1. There are large social costs to be expected from permitting any telecommunication common carrier to enter the data processing industry.
2. The benefits from integrated communications - data processing operations can generally be obtained without unifying them in the common carrier organization.

Our recommendations may be summarized as follows:

1. It should be general policy not to permit any telecommunication common carrier in Canada to provide data processing services for users outside of that carrier's organization.
2. Individual exceptions may be made to (1) above when carriers can provide to the regulatory commission that it can provide the service at lower cost than non-regulated firms.
  - 2.1 Carrier claims to lower costs should be publically scrutinized very carefully.

- 2.2 The burden of proof of lower cost should rest with the carrier.
- 2.3 Public hearings should ensure opportunity for full expression of all interested parties.
- 2.4 Deduction for tax purposes of legal and other costs incurred by carriers in unsuccessful litigation before the regulatory commission should not be allowed.

These recommendations have the merits (1) of preserving open options for future public policy as information and experience are gained, and (2) of permitting sufficient flexibility to respond to individual circumstances where carriers should be involved in data processing.

5. SHOULD A COMPUTER SERVICE SUBSIDIARY OF A CARRIER BE ALLOWED TO SELL ITS SERVICES TO THE CARRIER WHICH CONTROLS THE COMPUTER SUBSIDIARY?

5.1 The General Response

As has been demonstrated in section 4 (above), regulated communications carrier should only be allowed to enter the data processing field if there are demonstrable economies of integration. Were such economies important - and the available evidence suggests that they are not - presumably an integrated telecommunications computer service utility firm would be required to exploit them fully. A partially or wholly owned, but independently managed, computer service subsidiary of a communications firm would not be able to achieve technical or managerial economies of integration. It could exploit any economics of integration in information system development if a joint systems development operation were operated.

It seems untenable to argue that the economies of joint systems development are attainable only if the computer systems development group is owned by or a subsidiary of the communications carrier. Joint venture contracts negotiated at arm's length would appear to achieve equivalent or superior results.

The existence of a wholly or partially owned computer service subsidiary of a communications carrier would create almost as many problems as a fully integrated firm, particularly if the subsidiary were allowed to sell its services to the parent. The ability to transfer the funds from the regulated to non-regulated portions of the conglomerate would remain, as would the danger of the exercise of a hidden price squeeze or other techniques designed to hamper the growth of competitors.

There is therefore no case for allowing communications carriers establish computer subsidiaries, since:

1. Such subsidiaries would not be able to exploit fully any economies of integration, and
2. The problems inherent in the existence of a conglomerate which operates partly within and partly without the regulated sector would remain.

It might be argued that the communications carriers can supply needed capital directly to a growth industry via the existence of such subsidiaries. However, such capital can be readily obtained in the capital markets if investors believe that computer service utilities offer adequate rates of return. If computer service utilities do not offer adequate rates of



return, it would be a misallocation of scarce capital resources to pump funds directly from regulated firms to computer utility subsidiaries, rather than paying out the funds as dividends to shareholders who would choose to re-invest the funds elsewhere.

If the government feels that there are social benefits (not taken into account by private investors) to be reaped from the growth and development of the computer service utility industry, it can use tax incentives or provide direct capital assistance to the industry.

It follows that there is no case for allowing communications firms to establish subsidiaries, unless there is also a stronger case for allowing a fully integrated operation. If such subsidiaries were allowed to exist, no clearly satisfactory resolution of the policy problems created is apparent. To leave these subsidiaries unregulated would permit the communications firms to exploit the advantages of their regulated monopoly position in an unregulated field. To regulate only the subsidiaries of communications firms but no other computer service utilities would be impractical (and, if truly effective, would probably be equivalent to denying communications firms the right to establish such subsidiaries). To regulate the whole consumer service utility industry under these circumstances, would be to impose the costs of regulation - which are not trivial - where they are not necessary.

## 5.2 The Case of CNR-CPR and CSC

Having provided a general answer to this question, we cannot resist the temptation to deliver an obiter dictum concerning the acquisition by the Canadian National Railway and Canadian Pacific Railway of 25.5 per cent each of Computer Sciences Canada, Ltd.

According to a private communication from a top official of Canadian National Telecommunications, the main motives for this acquisition were two:

1. To diversify into a non-regulated field in the light of a highly probable extension of public regulation to virtually all other services offered by the utility.
2. To have a partner in the service bureau, software and system design business to help it provide the kind of systems design, programming and computing services that customers increasingly demand.

The first motive relates to a kind of penetration of a non-regulated field by a regulated carrier against which we have inveighed in this and the preceding sections. On this ground, the acquisition seems quite without public merit.

The second motivation is laudable to the extent that it springs from a concern to provide high quality service to information system users. The question arises; was it impossible to obtain the desired co-operation contractually from a Canadian firm?

The CNT official stated that no Canadian firm could be expected to be able to provide the depth of expertise or existing set of application software packages required by the carriers and its clients. Computer Sciences Corporation, Inc., with its large stable of human talent and large inventory of software seemed to CNT to be unrivaled by all except, possibly, University Computing Company of Dallas, Texas.

This pessimistic assessment of Canadian firms by CNT may be something of a self-fulfilling prophesy. CN-CP Telecommunications have forged corporate bonds with a subsidiary of an American company and apparently intend to walk hand-in-hand with CSC into every information systems job that comes their way. This should go far to discourage the development of domestic Canadian industry. Some will regard this as unfortunate in view of the fact that the computer service, software and systems development fields, because of their relatively small optimal firm size and low capital restrictions to entry, were (and, perhaps, still are) areas in which Canadian firms could aspire to succeed on national and international scales. It would be ironic in the extreme if a healthy Canadian infant industry were strangled in its cradle by government and crown corporation actions. The irony is only heightened in the light of a prolonged history of subsidy by tariff of moribund and superannuated "infants" in other industries.

### 5.3 Summary

Our response can be summarized as follows:

1. A computer service company should not be a subsidiary of a carrier.
  2. If it exists, a computer service subsidiary of a carrier should not be allowed to sell its services directly or indirectly to organizations other than the carrier which controls it.
  3. The acquisition by CNR and CPR of controlling interest in CSC was against the Canadian public interest. It is recognized that extrication from this fait accompli may occasion considerable embarrassment. To further acquiesce, however, may condemn a promising Canadian computer service, systems and software industry to a "branch plant" status.
6. SHOULD ANY NON-CARRIER DATA PROCESSING ORGANIZATION BE PERMITTED TO PROVIDE COMMUNICATION SERVICES FOR USERS?

At first glance, the logic developed in section 5 would appear to apply in reverse here. If no economies of integration exist, and if there are problems inherent in a conglomerate operating within and without the regulated sector, one could argue that to allow computer service companies to penetrate communications would be to create the same kind of problem.

The situation is not symmetrical, however, for the following reasons:

1. The direct person to person or station to station transmission of messages over a communications network can be reserved as the preserve of the communications common carriers.
2. Communications companies can prevent wasteful duplication of lines, micro-waves, channels, etc. by offering to sell their communications services to the computer service companies at a price below the full cost of the establishment of an independent system for the transmission of data. If the communication firms cannot offer a comparable service at a price below the full cost of an independent system, the optimal policy would be to permit the establishment of independent lines or systems.

In a natural monopoly situation, the long run marginal cost of an efficient monopolist must be below the full cost of the new entrant. And the monopolist should be willing to provide any new service which can be sold at a price at or above long run marginal cost. Hence the existence of the option of entry into "communications" by computer service companies serves three functions:

1. To draw the boundaries of the natural monopoly in telecommunications so as to exclude those services which can be provided more efficiently by the computer service utility firms.
2. By providing an alternative to dealing with the monopoly, thereby providing a stimulus for the monopoly to minimize its costs.
3. The potential or actual existence of alternatives provides a "market test" against which the performance of the communications monopoly can be judged when applications for rate adjustments are made.

It is, of course, obvious that a natural monopoly which sells all of its services at long run marginal cost will not be able to cover its total cost. While it is not at all clear that the optimal policy is to cover the overheads of the system by pricing some services above long run marginal cost, nevertheless this is the established practice in most natural monopolies on this continent. This practice gives rise to the argument that the natural monopolist requires protection against undercutting on those services which are priced above long run marginal cost, in order to make the whole system viable - this is the so-called argument against "cream skimming".

The "cream skimming" argument is of limited relevance when one considers the provision of new services. Here the cream skimming argument must be reversed - if the new service can be priced at long run marginal cost, it does not add to the overhead burden (which is presumably covered by pricing some other services above long run marginal cost). In fact, since the bulk of the new services can be priced above long run marginal cost without inducing computer service companies to construct independent facilities, they will reduce the amount of overhead cost which need to be covered by pricing established (e.g. telephone) services above long run marginal cost, thereby permitting reductions in selected (e.g. telephone) charges.

Even on established services, the "cream skimming" argument requires the most searching re-examination. For many reasons (e.g., variation in population density) the long run marginal cost of providing an identical communication service to different users can be expected to vary substantially. It is possible to marshal good reasons for differential pricing to reflect the differences in costs. But let us assume that it is public policy to furnish each communication service at uniform prices to all users irrespective of differential costs.

If the communications common carrier must cover total costs from its revenues, it must price some services above long run marginal costs in order to cover costs on those services or locations where long run marginal costs exceed the price of service. This transfer represents a tax on the

lower cost user and a subsidy on the lower cost user. There is no obvious principle of equity that is thereby served. Furthermore, the resulting allocation of resources is inefficient in that users in low cost areas are discouraged from using as much of the service as would be socially optimal; the reverse is true for the high cost user. Finally, the carrier must be protected from "cream skimming" in the low cost area if he is to remain solvent. This protection may deny society the fruits of healthy competition in those services and areas where the conditions of "natural monopoly" do not prevail.

The obvious alternative is to permit competition in those areas and services of communications where the market is large enough to invalidate the "natural monopoly" condition. The carrier's deficit incurred on higher cost services and areas could be covered by 1) higher prices or, if this is socially undesirable, by 2) direct public subsidies from general revenue sources.

In our eyes, the conditions of "natural monopoly" are not obviously present in many aspects of data communications. We believe that the net effects of greater competition in this area would be socially desirable. For this reason, we recommend that non-carrier data processing organization be permitted, under regulation, to provide communication services for users.

7. THE CIRCUMSTANCES, IF ANY, UNDER WHICH ANY OR ALL OF THE SERVICES INDICATED IN SECTIONS 4 and 6 (above) SHOULD BE DEEMED SUBJECT TO REGULATION BY AN APPROPRIATE GOVERNMENTAL AUTHORITY AND THE NATURE OF THE ENABLING LEGISLATION, OR, WHETHER THE POLICIES AND OBJECTIVES OF THE FEDERAL GOVERNMENT WOULD BE SERVED BETTER BY SUCH SERVICES EVOLVING IN A FREE, COMPETITIVE MARKET AND IF SO WHETHER CHANGES IN EXISTING PROVISION OR LAW OR REGULATIONS ARE NEEDED?



Our general conviction is that Canada's national welfare and therefore, presumably, the policies and objectives of the Federal Government would be served better by greater competition in the provision of data communications services and undiminished competition in the provision of data processing services.

The telecommunications industry as a natural monopoly, or set of natural monopolies, is very largely subject to regulation by the Canadian Transport Commission under the Railway Act, R.S.C. 1952, c. 234 as amended by the National Transportation Act, 1966-67 (Can.) c. 69. The data processing industry, on the other hand, appears not to be a natural monopoly requiring this kind of regulation of its rates and services. It would seem appropriate, however, to subject the data processing industry to anti-combines law from which it is presently exempt. This will, of course, come to pass if the recommendations of the Interim Report on Competition Policy of the Economic Council of Canada are implemented.

The danger of unfair competition and the absence of economic justification leads to the conclusion that telecommunications common carriers should be prevented from entering the data processing field. Their data processing operations should be limited to those which will facilitate more efficient and effective telecommunications.

The objective of keeping the telecommunications carriers out of the data processing field could be accomplished by amendments to the Railway Act. Section 380, which contains

"Provisions Governing Telegraphs and Telephone" (and which uses the word "company" to refer to telephone and telegraph companies) could be amended to add a sub-section something like the following:

The company shall not, directly or indirectly, on its own account or through a subsidiary or affiliate, offer data processing services either alone or in association with telecommunications services, but nothing in this sub-section shall prevent the company from engaging in data processing solely for the purposes of its undertaking.

We wish to achieve the desired advantages of greater competition in the provision of telecommunication services without jeopardizing the economic health of the telecommunication common carrier in the provision of those services where "natural monopoly" conditions prevail. Section 7 (above) outlines certain steps necessary to accomplish these twin objectives.

8. IN WHAT RESPECTS ARE PRESENT DAY TRANSMISSION FACILITIES OF COMMON CARRIERS INADEQUATE TO MEET THE REQUIREMENTS OF COMPUTER TECHNOLOGY, INCLUDING THOSE OF ACCURACY, SPEED AND BANDWIDTH?

Real and implied restraints on "foreign attachments" to carrier provided lines should be removed in order to facilitate multiple new uses of present facilities. The integrity of carrier facilities can be achieved by 1) the establishment and publication of government standards for interface equipment and other attachments 2) government testing and certification of those attachments.

Existing carrier rules and practices permit secrecy and obfuscation to obstruct choice of the most efficient communication facilities for new applications. Telecommunication common carriers should be required to publish and supply full technical and cost information on available facilities. In particular, the carriers should be required by statute to provide this information to the public agency responsible for establishing technical standards for the telecommunications industry.

Services provided by the carriers should be priced in relation to their costs. In general, a lower boundary would be long run marginal costs with long run average cost serving as an upper boundary.

Standard tests of data-carrying circuits should be devised by the public standards agency. It should then be required of carriers that they regularly perform these tests. Results of such tests should be furnished to carrier customers.

An order of magnitude increase is needed now in the capacity of central switching facilities for data transmission. The speed of switching should be increased by several orders of magnitude.

It must become possible for users to obtain circuits and pay for short bursts of data transmission (on the order of milliseconds) rather than being forced to pay minimum charges for periods (e.g. one minute) that are orders of magnitude in excess of their needs.

9. WHAT NEW CARRIER TARIFF OFFERINGS OR SERVICES ARE OR WILL BE REQUIRED TO MEET THE PRESENT AND ANTICIPATED NEEDS OF THE COMPUTER INDUSTRY AND ITS CUSTOMERS?

9.1 Potential Needs for New Processing Services

Evolution of new processing services is expected to proceed along two coupled paths - one emphasizing information storage and retrieval, the other concerned in general with remote (centralized) control of processes. Many distinct services are envisaged, each possibly constituting a different and distinct business.

Examples of large scale information storage and retrieval abound. As well as systems for banking, business and catalog ordering, special interest library facilities and data banks for law, medicine, engineering and theology may be expected. Existence of private files for individuals and business will encourage replacement of traditional postal procedures by simple transfers of part of a file to a named file of another system user.

Examples of centralized control of processes are perhaps less obvious. A strong case can be made for the need for systems of manufacturing process control which offer low enough capital cost to interest relatively small manufacturers. The entire area of remote monitoring, supervision and control of household activity is extremely broad, including all conventional metering activity. Traditional fire and police alarm systems should be unified and regularized by area-wide service organizations with suitable redundancy for critical applications. In

the realms of both home and business, centralized inventory control and ordering will be expected. Included in this category are mechanisms for education which go far beyond either the facility to access some selected data bank or the mass dissemination of standard program material.

Purveyance of programming packages suitable for use in design engineering, manufacturing, and production by centralized computing services will tend to inhibit private ownership of computing facilities and development of software. This is an obvious result of economic pressure. Such efficiency is desirable although it may tend to increase market concentration. This may eventually retard real innovation.

In the preceding survey we have not considered potential entertainment functions to be provided by cable companies and others since such services do not impact on the question of needs of the computer industry for telecommunication innovation.

## 9.2 Telecommunication Innovations

The majority of services suggested above could be adequately handled by existing telephone drops (wires) with relatively simple augmentations provided that problems of human engineered presentation are ignored. However, existing connection possibilities between users of the telephone network, including interoffice trunks, are inadequate and not designed for the simultaneous access implied by shared time usage in the home.

Psychologically acceptable operation will likely necessitate large increases in existing transmission capacity largely because of increased use to be made of visual presentation and optical surveillance.

Present day telecommunication facilities are largely of a design which has been optimized for the transmission of analogue voice signals. Considerable investment has gone into the optimization of the major transmission systems and comparative economies have been produced hinging on the fact that only voice signals will be employed.

It is well known that there are significant differences between the electrical composition of voice and general data signals. This is due to the physical construction of the human speech apparatus. To particularize, it is well known that transmission of direct current and certain low frequency signals is not required in speech reproduction but is of great significance to many data signals. Lack of low frequency transmission facilities in present telecommunication systems has resulted in expensive terminal apparatus paid for by the end user when other than speech signals are to be transmitted. This expense could be borne centrally in switched systems at a much lower total cost.

More detailed demand studies might substantiate the need for virtually new network for data transmission. It would be premature to conjecture to what extent the "natural monopoly" conditions would be met in that network. There would not seem

to be obvious reasons why the data transmission network should be restricted to the existing carriers. This would be particularly true if, as seems desirable, inter-connection of trunks were required.

It is suggested that all standards and methods for data transmission should be given a complete review with industry participation. Intent to this effect was expressed in the recent Canadian Government white paper on satellite communication. However, according to information obtained at a later Department of Communication briefing, this intent has been aborted in the interest of existing standards, compatibility and, of course, the pressure of time.

In concluding this section, we urge the Department of Communications to commission or undertake cost-benefit studies of (1) an increase of local channel and switching capacity by one or two orders of magnitude to meet the requirements of visual data transmission, (2) an increase of trunk capacity by at least three orders of magnitude during the 1970's, and (3) the order of magnitude increase in central switching capacity recommended above. We can conjecture that these needs will exist, but thorough demand studies should precede decisions to provide the facilities.



JUDY, RICHARD W.  
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