TELECOMMISSION

Study 8(b)(iii)

Problems Relating to the Interconnection of Terminal Devices with Common Carrier Provided Telecommunications

The Department of Communications

SECTION VIII

STUDY 8(b) iii

PROBLEMS RELATING TO THE INTERCONNECTION OF TERMINAL DEVICES WITH COMMON CARRIER PROVIDED TELECOMMUNICATIONS

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This Report was prepared for the Department of Communications by a project team made up of representatives from various organizations and does not necessarily represent the views of the Department or of the federal Government, and no commitment for future action should be inferred from the recommendations of the participants.

PROJECT TEAM

The Project Team consisted of the following representatives from departments of the federal government, from telecommunication carriers, and from associations and organizations of users. The appendix contains submissions received from these representatives.

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Although these members of the team contributed to the report and participated in its preparation, they do not necessarily agree to every statement made in it.

Since this study was one of three devoted to interconnection, the terms of the other studies were circulated through the three Project Teams; during the course of the studies appropriate information was shared as required, and discussions between Liaison Officers and members of the three Project Teams assisted in reducing any redundancy.

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CHAPTER 1

Introduction

Purpose of Study

The primary purpose of this study is to identify and examine the problem areas relating to the interconnection of user-owned or supplied communication terminal devices with services provided by the telecommunication carriers in Canada. The issues will be examined from three particular points of view:

1) that of the user
2) that of the manufacturer
3) that of the carrier

The subject of interconnection of telecommunication facilities of mixed ownership is one of several dealt with in Section 8 of the Telecommission studies.

In order to provide the appropriate focus on the issues involved in interconnection, the project was divided into three separate studies, of which this, relating to telecommunication terminals, was one. The other two sub-studies, 8(b) i and 8(b) ii, relate to interconnection of privately-owned telecommunication systems with those of the carriers, and the interconnection of carrier systems with each other, respectively.

Background of Study

The issues and problems arising from the interconnection of facilities owned by the carriers with terminal devices of mixed ownership are relatively new, and the majority concern interconnection with the switched network of the carriers rather than with their family of private-line services. Private-line services, in general, are not shared by users, and interconnection issues are negotiable. However, interconnection of terminals with the general switched networks can affect other users of the system as well as the integrity of the planning for the total system.

These issues seem to derive from two factors. The first is the rapid expansion of mechanized information handling systems employing computers and remote access terminals which has developed during the past ten years. The earlier development of communications in Canada was focused on the need for electronic voice communications and the expansion of the associated network to reach all parts of the country. As the growth in installations of data-processing equipment occurred, both in size and number, the electronic transmission of data became an

attractive method to transfer large quantities of information to and from computer centres.

The second factor that has raised issues of interconnection is the flood of new telecommunication terminals which have been developed by manufacturers utilizing various combinations of transmission speeds, machine languages or codes, media such as cards, tape, etc., and which have the capability of serving one or more information-handling functions.

Thus, when selecting a terminal the user has a very broad potential spectrum of choice, but his actual choice is limited to terminals that the carriers will allow to be interconnected with their facilities. Manufacturers feel that the carriers inhibit the development of the market for new communication terminals, for, in the absence of widely accepted technical and economic guidelines and standards, the carriers place limitations on the variety and extent to which users may employ communication terminals connected to their general telephone network. Though most of these practices are derived from or are incorporated into existing legislation and/or regulatory practices, the use and enforcement of these practices by the carriers tends to create the impression that they are the final arbiters in such interconnection. In actual fact, the majority of regulatory bodies have processes through which users may appeal any unfair or discriminatory application of interconnection practices.

All of these complications have created policy problems which involve the user, the manufacturer, and the carrier. All three agree that the user should be able to serve his need effectively, that the carrier must develop and maintain his network to provide the best possible service, and that the manufacturer should continue to develop new techniques and products, as well as to improve existing ones to serve the users' needs.

Scope and limitations of the Study

Any study of interconnection issues in telecommunications should preferably be preceded by a determination of the priority that interconnection policies have when referred to the total of national communication objectives. This question can be tested by determining whether interconnection issues would remain after objectives and policies had been established in such areas as the permitted amount of competition between carrier suppliers, the economics of developing and introducing products of Canadian research and manufacture versus those of foreign source, and the degree to which telecommunications capability is to be developed in Canada by other than the existing carriers.

There is general agreement by the participants in this study that if issues of this nature were resolved, there would be few residual interconnection problems. Thus, any attempt to deal

with interconnection issues cannot be seriously undertaken without making assumptions about the related and more important economic, commercial and technical issues involved. These related issues are being dealt with in other Telecommission studies.

The Project Team also recognized that a more rigorous examination of the detailed technical problems of interconnection than could be undertaken in this study should be the subject of further investigation.

Thus, the scope of this study has been carefully selected to examine the current specific issues relating to the interconnection of terminals with the facilities of the carriers, and has avoided any broad excursions into other areas. As terms of reference, the study set out to examine: -

1) the interconnection practices of the common carriers as they exist at present, and any possible future trends that can be anticipated;

2) the communications terminal field and its general classification, and any reference possible to the direction that technology in this field appears to be taking;

3) user requirements for terminals, including the variety of needs being served now and those that are foreseen in the immediate future;

4) manufacturers' objectives in the terminal market, and problems arising from interconnection practices that affect the development of this market;

5) special interconnection situations such as the use of multiplexors, interconnection of radio terminals and other special customer requirements;

6) any economic trends in the communications terminal field, particularly with their relationship to alternatives.

Re 2) above, during the course of the study, the Project Team concluded that a detailed examination of communication terminals would require much more time than was available and would not have any significant value.

Some of the submissions to this study undertook to define the various categories and functions that can be served by communication terminals, and since none of the problems arising required any further explanation or description, the Project TEAM AGREED TO FOREGO A MORE DETAILED EXAMINATION.

Definition

The term "telecommunications terminal" is one which covers a very broad area of technology, and which can be defined in a number of ways, depending upon the objective. From a technical angle, the term can refer to a single set of binding posts that terminate a communication channel, or it can refer to the very sophisticated complexion of the largest computer operating as a terminal on a carrier's network.

For purposes of this study, a terminal refers to a point in a telecommunication system where information may enter or leave the system, or where it may be stored until conditions permit the information to be moved to another terminal or terminals.

With respect to ownership of terminals, there are two classifications involved:-

1) user owned, and

2) user leased, from

a. terminal manufacturer or supplier
b. telecommunications carrier

Another means of classifying terminals used by the Project Team involved their function, and these seemed to fall into three main classes:-

1) terminals oriented to people -

to be used directly by humans, to hear, see, write or speak; this category includes telephones, typing machines, machines used to transmit writing or reproduction, etc.;

2) terminals oriented to other machines or systems -

such telecommunication terminals require input from machines and provide output only to machine, i.e. magnetic tape terminals, processors, accounting machines, all for on-line use, or terminals involving read-write in machine-oriented language. Neither the input nor output of such terminals can be interfaced directly with humans;

3) terminals that control, monitor and supervise communication facilities -

devices such as switchers, multiplexors, automatic dialers, voice operated

switches for radio terminals, etc.

Some terminals can serve more than one function, and the above classification was not intended to limit but rather to direct consideration to areas that are compatible with user needs.

CHAPTER 2
Interconnection Practices and Carrier Requirements

Historical Barkground

The recent emergence of problems resulting from interconnection practices of the telecommunication carriers might suggest that a new dimension is being added to telecommunications which must be dealt with quickly and effectively if further progress is to be realized. In actual fact, interconnection practices have existed almost as long as the communications industry itself and until recently have primarily affected only those carriers involved in the development and growth of the telecommunications network in North America.

In the early part of the century, there was a proliferation of telephone companies, each serving a community of interest and sometimes competitively, which were gradually interconnected to form the vast continental system now in existence. Due to the wide variety of technical standards among the independent companies, interconnection practices were established when any merger or integration occurred. In these circumstances the standards of the larger company usually prevailed.

As a result, interconnection practices have evolved over a long time and are still in the process of evolution. On an international basis, for instance, interconnection standards are continuously being derived to permit the development and expansion of an international network covering all occupied areas of the world.

This process of evolution, applied to interconnection practices in Canada, has now reached a point that affects the user of telecommunications individually, as well as the manufacturer of telecommunications equipment. It has created problems that interfere with the accomplishment of the users' objectives and requires that he use new, and sometimes unfamiliar, skills to deal with them.

Thus, from an historical point of view, interconnection practices have evolved with the growth and development of the telecommunications network that relies on universally adopted technical standards for successful performance, as well as the introduction of new technology and the retirement of obsolescent techniques and methods. Interconnection practices are a means of defining these standards and ensuring that they are maintained.

Problems Created by Interconnection Practices

From a cursory observation, one could deduce that interconnection practices are a barrier established by the carriers to defend their vested interests against and technical or economic erosion by the users and manufacturers, who, in turn,

regard the practices as obstacles to the realization of their objectives, the development of their markets and the improvement of their products. Such, however, is not the case.

Most of the problems being experienced today result from rapid growth in the mechanized transfer of information required by the growing proliferation of high-speed data-processing installations. A second contribution to the interconnection problem results from the rapid advance in the technology of information handling, which has motivated the development of increasing varieties of equipment. A third factor in this problem is the development of telecommunications capability in Canada by other than existing carriers; this illuminates an area of competition that was previously unidentified.

Thus, the problem, simply stated, reduces to a description of three points of view. The user is faced with a burgeoning complexity of equipment and services from which he must, at his peril, extract the best combination to achieve the most effective result. When he has made a selection of suitable equipment, he may discover that it connot be connected either to the communication facilities of his choice, or to those he has already established in his organization, without some form of compromise. Moreover, when he has had installed a suitable combination of equipment and communications, he may discover subsequently that he is unable to take advantage of improvements to the terminals or communications, which were unforeseen in the application of interconnection practices.

The manufacturer, from his point of view, undertakes the responsibility for developing new techniques and new hardware or modifying and adapting existing equipment to satisfy the expressed demands of users. He is frustrated if the benefits of such developments are economically neutralized or reduced by the costs of interconnection of communication facilities.

The carriers see the telecommunications network as a vast dynamic organism with inherent economic and technical inertia which must be considered when any changes are planned. For instance, the planning of switching systems for a large municipality involves continuous change to accomodate growth in population and calling habits. Additional capacity to handle growth alone must be planned many years ahead, and requires a minimum of two years, for installation before it is required for use. If the proposed changes are particularly complex, such as the general implementation of Touch-Tone calling, or the conversion from manual switching to dial switching, the time frame can be at least 10-20 years. However, it is quite possible for a user to change his method of transmitting information in a much shorter time and, by doing so, to add a critical load to the local communication system and interfere with other users.

Inevitably, the solution to a problem for any one of these three groups must involve the other two. If these problems are to be resolved through further evolution of interconnection practices, then the resulting practices should appropriately represent the diversity of objectives and needs of all three parties. However, the need to meet individual requirements of users has not in the past been a factor in the evolution of interconnection practices.

Existing Interconnection Practices and Common Carrier Needs

Carrier guidelines relating to the connection of their facilities with terminal devices owned by others differentiate between terminals to be connected to their family of private-line services and terminals to be connected to the general switched network.

For private-line systems, the carriers, including CN/CP, have established technical criteria as the basis of definition of terminal connection requirements. Generally, these standards are the only ones imposed on customers requesting interconnection, though protective interfaces may be required, as determined by these technical standards. This statement does not necessarily apply, however, when and if the private-line service has access to public telephone services. No serious problems were identified that resulted from users being required to meet the carriers' established requirements for the interconnection of customer-owner or leased terminals with carrier-supplied private-line facilities.

The most difficult area in which to establish precise guidelines from the carriers' point of view, is that involving the interconnection of customer-provided terminals with the general telephone network. There are a number of reasons for this, all of which do not act in concert in the solution of any particular problem.

First, all the Canadian carriers undertake the responsibility of providing and maintaining a satisfactory level of service to all their users. They have advanced control of the network, including its terminals, if they are to maintian a desired quality of service to all users. Through this control, the carriers must be able to guard against technical pollution of their network from other signal sources; to prevent the use of systems or procedures by one user that could interfere with others and degrade the service; to ensure the safety of employees; and to design their networks consistently with the provision of effective maintenance. These arguments are included in appendices 1,2 and 3 of this study. For instance, one problem complicated by the use of terminals and facilities of mixed ownership, with terminals and facilities of mixed ownership, which tends to be ignored, is the requirement for more extensive administrative procedures to identify and correct sources of trouble. Due to the probabilistic nature of the traffic on the switched network, a terminal connected without suitable

safeguards could continually interfere with other users on a random basis and go undetected for a considerable period of time. Another area of concern arises from the manner in which a terminal addresses the network to activate the switching process. Terminal outputs which deviate from network requirements cannot only degrade the service to the owner of the terminal, but can also interfere with the service to other users.

Though these technical arguments leave little room for doubt as to the need for the carrier to be in complete control of the technical performance of the total network, it does not necessarily follow that the only effective means of maintaining control is through ownership. Yet, from a review of the interconnection practices of the Canadian carriers, it is observed that the responsibility for providing and maintaining the service is conditional on their ownership of all terminals directly connected to the network and the interface through which any others may be connected. Though based on technical reasons, this requirement for ownership immediately raises economic issues which affect both the user and the manufacturer of terminals.

For instance, each telephone company in the Trans-Canada Telephone System provides telephone sets that it has selected as a standard for use in its own operating area. Thus, the market for telephone sets is preserved for the supplier of that particular telephone company. Any other telephone sets, regardless of manufacture, that a subscriber may wish to use must be inspected by the telephone company's representative, for a fee, and, where necessary, parts or components must be replaced at the users' expense to meet the network standards. Another example involves the provision of communication terminals not manufactured by the carrier. When sufficient need arises, the telephone company may supply, as part of its service, terminals purchased from a particular manufacturer. This terminal device is usually manufactured to specifications of the carrier and any interface will be included in the price of the service, rather than as a separate charge. However, should this set be purchased directly from that manufacturer, the user would be required to interconnect it to the telephone network through a separate interface supplied by the carrier, at an appropriate rate. Thus, terminals such as radio set for mobile communications, switchboards, multiplexors, etc., must be interfaced with the network according to interconnection practices when purchased by the user, even though they are identical to those provided by the carrier.

The carriers support this approach for maintenance reasons. When they provide the terminal as a part of the service, they are responsible for maintaining its operating characteristics to meet the network standards continually. This includes making any necessary modifications and chages that are introduced by the supplier from time to time to extend the life of the terminal, to reduce the number of repair visits per year, or to improve parts that time-testing may show to have been originally inferior. Experience has persuaded the carriers that

the user cannot be relied upon to make such modifications, or even to maintain the equipment in its original state, particularly if there is no apparent improvement that justifies the cost.

Another economic issue arising from the technically based interconnection practices involves the derivation of carrier rate-structures. For instance, the uniform charge or "flat-rate" applied to local telephone service is derived from a number of cost factors associated with the provision and maintenance of the local service. Included in these factors is the cost of the local switching equipment. Even though subscribers can make unlimited use of the local switching equipment, their calling habits are predictable, and the resulting traffic forecasts are reliable when applied to voice traffic. However, when non-voice communication terminals are connected to the network, the resulting traffic load is unpredictable beyond the fact that it can exceed the average calling rate by factors as high as ten. At the present time rates have not been derived by carriers to cover the increased costs generated by these terminals, and though it may appear obvious that some form of message rate will be required, the additional cost of installing such equipment in the local switching complex is substantial in itself, and would certainly work against the use of such terminals to satisfy individual needs of subscribers. A similar problem appears when these terminals are used on the long-distance telephone services.

Thus, if the individual user needs are to be satisfied, some consideration must be given to new methods of deriving rates that would permit the carrier to recover the associated cost increases without denying the user the economic advantages of using terminals of his choice, or restricting the manufacturer in developing new and improved terminal devices. Historically, message rates have been based on time and distance factors, which are inappropriate for new varieties of communication terminals becoming available. It is possible that the carriers will need to consider information flow in terms of quantity and speed as the basis for terminal rates, with little emphasis, if any, on the distance that information travels.

The carriers do not consciously intend to limit the development and use of new terminal equipment, but in the absence of reliable means to anticipate the results of broader interconnection policies, and in the light of events that have occurred in large metropolitan cities such as New York, Chicago, and Los Angeles, there is sincere reluctance to increase the risk of degradation of service to existing and future users of the network by changing these policies until the more cirtical issues associated with them are resolved. Some changes have been made, however, to accept the interconnection of acoustically and inductively coupled terminals, but some of the techniques involved in this interconnection may be made obsolete by proposed changes to the telephone set which are being considered.

Summary of Carrier Needs

The carriers must be accountable and responsible for the design and complete control of the common user network if it is to be improved and expanded to meet future needs. Interconnection practices are a means of ensuring that these objectives are met. However, in the opinion of the carriers, the risks involved in broadening these practices to better serve the individual needs of users and manufacturers appear uneconomic unless they can be shared through the judicial establishment and maintenance of standards and objectives accepted by all parties involved. Such standards would reflect technical and economic objectives and deal with such subjects as competition, developement of technology, grade of service, and revenue to carriers. Since these issues are the subject of other "Telecommission" studies, further discussion is not attempted here. It is recognized, however, that additional studies to consider the impact of these issues on interconnection will be required before any significant change to interconnection practices can be undertaken.

Future Interconnection Practices

A number of factors could affect or change the interconnection practices presently established by Canadian carriers. Policy decisions, for instance, in fields such as regulation, the degree that competition is permitted in the marketing of telecommunication services, the requirement to develop a strong Canadian communication equipment-supply industry, even changes in the corporate organization of communication carriers (particularly as it affects ownership and/or market to be served), the development of Telesat service and the manner in which it could provide communication services - all of these would be expected to have an impact on the evolution of interconnection practices. Since many of these topics are under study in the Telecommission and are being participated in by representatives of the carriers, any projection of future trends affecting terminals is limited to the existing guidelines. Thus, the carriers plan tc continue to control the maintenance, administration, and long-term system design of their networks, and expect that, through the development of suitable interfaces and improved service offerings, a reasonable balance will be provided between the market needs and the protection of the common user network.

CHAPTER 3

User Requirements for Interconnection

Users have growing requirements to serve their individual needs through the general telephone network by the interconnection of terminals leased or purchased directly from equipement suppliers rather than from the carriers. Separate consideration is given, first, to general industrial requirements, sourcing from product manufacturing and marketing oriented industries; secondly, there are special applications for information systems used by organizations such as policeforces, utilities - gas and electrical, etc. and the broadcasting industry.

Industrial User' Needs

The users' problems of interconnection stem primarily from increased pressure to move more information faster and cheaper without loss in quality. Rising administrative costs can often be attractively offset by the mechanization of information systems when it results in the transfer and use of information by more people in a shorter time. Effective inventory control, sales order completion and delivery, production processes, market research and analysis, etc., are only a few of the many industrial applications presently utilizing communication terminal devices, and, because of the variety and scope of these system objectives, there are requirements for terminal devices of parallel dimensions.

These information systems can be broadly classed as follows:-

1) Data Collection or Distribution Applications -

Data are collected and transferred to a central processing point and distributed from there according to need. The increase in the number of these systems results from the efforts of system designers who are striving to reduce the number of times data must be manually converted, thus reducing clerical costs and error rate.

2) Enquiry Processing Applications -

Central data files are established which, when accessed at random from local or remote terminal locations, can

provide fast responses to the enquiries. These systems are particularly effective in marketing applications, and are being developed and used by large catalogue suppliers, among others.

3) Network Control Applications -

When a central processor is required to handle a large number of information systems, it may require fast access to a broad spectrum of communication services to accomplish its objectives. Because of the size of these computer installations, there is a trend towards the development of special purpose communication control computers to act as the communications manager for the larger processor.

In all these data-transmission applications, the terminals must be selected to utilize the medium involved (magnetic tape, punched cards, paper tape, etc.), to operate at the appropriate transmission speed, and sometimes to perform multiple functions as determined by their programming capability. To be effective, however, these terminals must have a connection to compatible communication services, which the user would like to utilize as efficiently as possible. Thus, if he has a large data file which is to be accessed by a number of remote low-speed terminals grouped in large centres, the use of multiplexors to derive channels from available telecommunication services can result in increased efficiency and economy in the utilization of his communications. However, interconnection practices presently permit only limited use of customer-owned or leased multiplexor equipment.

User Problems

Terminal technology has proceeded as rapidly as computer technology, but because of the seemingly infinite variety and combinations of functions that can be included in a terminal, together with the ranges of quality, the user cannot reliably or easily select the best available combination of terminals and communications for his particular needs. Assistance may be obtained from manufacturers who provide some advisory and consulting service, from independent cataloguing organizations such as Auerbach, or from systems consulting firms etc., who attempt to catalogue and publish lists of equipment with associated manufacturers' specifications. However, there is no central coordination of such assistance or even agreement among those supplying it when specific recommendations are required, and the user, without the necessary skills to evaluate equipment on his own, has no reliable standards for reference.

Even with the best of skills available, many limitations may not be discovered until after the terminals have been in operation. Problems affecting the grade of service can result from an unexpected demand for a variety of terminals, which

neither the carrier, the manufacturer, nor the user could anticipate or control without interconnection practices to buffer the impact. For instance, the use of automatic reporting devices (alarms), to advise utilities or police departments of circumstances requiring investigation, can seriously degrade both the local communication system and the investigative operations unless appropriate controls are applied to the connection and maintenance of such devices and the objectives they are to serve. Similarly, when a manufacturer introduces a new terminal, his research may have uncovered only a few of its potential uses. The effect of its use under these circumstances may favour its interconnection to the general telephone network. Later, when users find additional needs that the terminal can serve and that can be handled by the local switching network, it is then very difficult for the carrier, the user, or the manufacturer to coordinate the growth in use effectively.

Users have felt that there is a serious need to establish accurate classification standards for telecommunication terminals with respect to performance, interfacing requirements, information transfer capability, etc. in such a way that terminals meeting these standards could be connected to the carrier facilities at the users' discretion.

This need could be served by an agency, supported by government authority, and established to develop standards, coordinate their use and also act as a certification authority. This agency would need to review continually both existing and new terminals and, of course, would have to deal with the problems of decertification when appropriate.

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

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

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

Summary of General Industrial Users' Needs

The general industrial user primarily requires the flexibility to select the best combination of communication terminals and facilities to serve his individual needs. To assist him in the selection of suitable terminals and to anticipate their performance, reliable standards and procedures must be established so that accurate comparisons can be made during the selection process. These standards should be applicable throughout the life of the terminal to ensure that it continues to satisfy the system objectives and the technical specifications established for its interconnection with the network.

In order to deal with obsolescence of the terminal, or the communications, or the system, there is a requirement for authoritative procedures that will coordinate changes with the parties involved. Any broadening of interconnection practices must define the extent of the users' responsibility for maintaining his terminals to meet network standards, including modifications that may be required from time to time. These procedures would recognize the flexibility required, the freedom of choice of the user, and the objectives of the manufacturer to improve his product continually.

Any one of a number of administrative techniques could be employed for these purposes, and their consideration should ve the subject of a continuing study that would include users, carriers, and manufacturers.

Special User Applications

The terminal requirements for police organizations, gas and electrical utilities, and the broadcasting industry are peculiar to these different organizations. For example, the control and operation of pipeline transmission systems require special remote monitoring, metering, and control of terminals that must operate under standards of reliability different from those used by electrical utilities. Similarly, all these organizations, inlcluding police departments, use mobile radio terminals for despatching personnel and obtaining reports from remote locations. However, the reliability required by these different users has not yet been defined in terms of standards accepted by the users themselves.

Electric utilities and pipeline companies can each establish their own standards of reliabiliby and maintenance of service for their own operations with the resources available. Thus, for a private mobile radio system provided by the user to handle his despatching function, it is often desirable to re-

arrange one or two terminals in the system for interconnection with the public network in such a way that the other terminals on the system can call those stations and be transferred. With the exception of police forces and emergency services, interconnection practices at the present time do not usually permit such interconnection unless the total mobile system has been provided by the carrier.

Until standards of reliability and security, where required, are more precisely defined and universally adopted, the carriers are reluctant to relax interconnection practices in these cases. From their point of view, each situation is different, and there is very little opportunity to provide higher standards on a broader base compatibly with economies of scale. As a result, the user continues to insist on ownership and control of communication terminals and facilities required to serve his needs.

The broadcaster has a unique interconnection problem in that he must produce a "beep" tone whenever his broadcast facilities are connected directly to the switching network. The production of this tone at the interface was a practice that some of the telephone companies originally insisted on to protect the privacy of their users. The cost of this interface is, of course, borne by the broadcaster. The resulting inconvenience to listeners, particularly in long interviews, resulted in additional interfacing equipment being developed that would erase the "beep" tone going out on the air but would retain it on the line to the telephone user. This "debeeper" produced a more satisfactory result at additional expense. Recently, the introduction of acoustic couplers has reduced, if not eliminated, the need for an interface. The carrier still feels obligated to protect his user, but finds increasing difficulty in maintaining this position.

Another broadcasting requirement involving interconnection is in the collection of news. When reporters phone in directly over the switched network to report news items, there is a marked degradation of transmission caused by the standard telephone transmitter. In some frequently used locations, the carriers have installed interfaces which permit special microphones and coupling amplifiers to be interconnected whenever calls for broadcast are made. However, no technical solution has been devised that will allow any pay station or telephone sets to be used in this way.

Summary of Special Users' Needs

Standards of reliability and security required by users who provide essential and emergency services should be developed competently defining the users' objectives and needs. Terminal suppliers and carriers could then compete in this market and develop techniques and equipment to realize any economies of scale. From these standards, technical interconnection practices

could be established to satisfy the objectives of the carrier, the user, and the manufacturer.

In broadcasting, consideration should be given to procedures that will permit the user to maintain a high standard of transmission quality while affording whatever protection telephone users may require from unexpected calls that are going directly out on the air.

CHAPTER 4

Manufacturer Requirements

From the manufacturer's point of view, interconnection practices established by the carriers appear to add more economic hurdle to the successful marketing of their products. The relatively small Canadian market for telecommunication terminals is served not only by Canadian suppliers but also by foreign manufacturers in the United States, Europe, and Japan. These foreign products are particularly attractive to the user, due to the variety of the available product-lines, and, unfortunately, without a larger home market for a base, Canadian products are not similarly attractive to foreign users. Thus, the Canadian manufacturer needs as much assistance as possible. To some degree, interconnection practices can work in this direction. In the application of present interconnection policies, the carriers can and often have shown a preference for Canadian products.

However, as applied to radio terminals, interconnection practices appear to inhibit competition with the terminals the carriers provide with their service. For instance, carriers do not permit the electrical interconnection of customer-owned radio paging devices with their network, even though it could increase the scope and importance of the terminal to the user. When a similar paging service is provided by the carrier, it can be accessed directly from the public network.

A communications expertise has been developing within the manufacturing industry which is capable of competent system design and the recognition and developement of effective standards. This expertise has developed communication systems such as the radio systems used by the restricted common carriers, extensive intercom systems in large buildings, as well as systems employing microwave and switching techniques. If suitable interconnection standards were established and published by the communication carriers, this design expertise would have greater freedom and opportunity to grow, which in turn would require manufacturers to develop terminal devices for direct connection to the network under conditions that satisfy the needs of the user and the carrier. As mentioned in the previous chapter, the relaxation of interconnection practices to serve these objectives would require a definition of the responsibility that must be undertaken by the user and the manufacturer.

Although manufacturers believe that the relaxation of interconnection policies would accelerate and improve the market for their products and encourage the developement and improvement of Canadian products, some questions about the longer-range situation arise.

For instance, it must be assumed that foreign compeitors would soon employ similar standards for terminals sold in Canada, and one must ask whether such a move would result in even more difficult problems for the Canadian industry. It was pointed out that markets for this type of equipment in Europe and Asia are presently unavailable to north American sources.

Thus, a unilateral move in the direction of changing interconnection practices of this nature by Canada should be undertaken only after a thorough study has been made of the probable consequences, both short-term and long-term, to the user, the manufacturer, and the carrier.

CHAPTER 5

Summary and Conclusions

The requirement for interconnection of customer-owned terminals with the carrier-owned public network has been initiated by the user, or by the user together with the manufacturer of terminal equipment. Until the requirements for transmission of machine data emerged in substantial quantity, the pressure from users and manufacturers on the carriers to interconnect terminal devices was not considered significant. During the past few years, a very broad spectrum of telecommunication terminals, particularly oriented to the transmission of machine information, has been developed and produced to serve both the growing quantity and variety of users' needs. The carriers have recognized the changing needs of users, and have developed certain facilities and services to handle these new requirements. The pace and rhythm of this recognition nevertheliss do not seem to have eleminated the problems.

The carriers' interconnection practices became a serious problem for the user when he discovered that he could not combine the optimum choice of communications terminal and carrier facility. Wtihout this opportunity, his system objectives must be compromised. The carrier has always undertaken the responsibility of providing a suitable standard of service and maintenance to all customers, and generally insists that this can be most effectively provided if the terminals are owned by the carrier.

The manufacturer of communication terminals has particular difficulties, for he may have to sell his product to both the carrier and the user, and under different circumstances. If he is able to sell his product consistently to the carrier, interconnection practices can act as a proctection for his product. If the user is his only market, then present interconnection practices appear to be a barrier, particularly if his product is not compatible with existing practices.

Thus, the carrier practices relating to the interconnection of customer-owned terminals have in a sense generated a triangular set of forces between the carrier, the user, and the manufacturer, which cannot stay in equilibrium without continuous attention and negotiations on the part of all three.

The factors whcih probably upset this equilibrium are distributed among the three parties. Pressure comes from the user because of his requirement for flexibility in the selection of terminals and communications. The carrier's pressure can come

from his regulated rate structure which may interfere with the utilization of certain services. The manufacturer introduces the pressures of innovation. Since the manufacturer of terminals has considerably less inertia than that entailed in the maintenance of a vast communications network, more advancing communications technology is being introduced in the manufacture of new and unique terminals than could be possible in the communications network.

These pressures have now reached the point where they can be maintained in equilibrium only by negotiation, since there is essentially nobody with authority to act as a referee. Thus, there is a tendency and an opportunity for the largest users to negotiate preferential interconnection arrangements and, because they are large, they can undertake the necessary responsibility for terminal ownership and maintenance to the satisfaction of the carriers. Similarly, the large user can negotiate successfully with manufacturers to receive the benefits of modifications and improved maintenance procedures. This is not to suggest that problems do not exist for the large user in this triangle, but rather that tolerance for compromise on all sides is predictable, and thus stabilizing.

Problems resulting from interconnection practices are usually most serious to the small user of telecommunications equipment, since he is unable to obtain quantity discounts from the manufacturer or undertake the responsibility of maintaining the technical standards required for network connection by the carriers. However, his requirements for flexibility in the selection of terminal equipment and communication facilities may be even more critical and important than those of the large user.

From this study, there is substantial support for broadening interconnection practices for terminals. Changes must be undertaken, however, with the participation of users, carriers, and manufacturers, and could not be made until a number of issues related to interconnection have first been dealt with. Some of these issues are: -

1) more precise definition of the carriers' responsibilities to the users and the manufacturers with respect to the services they provide, and the associated maintenance standards;

2) the degree of competition that should exist between telecommunications carriers;

3) the responsibility of the manufacturer to the users and the carriers, and to what degree the market for all telecommunication terminals should be competitive;

4) the responsibilities of the user, with particular regard to interconnection;

5) the influence of approved rates, since some interconnection practices are related to regulated rates which are difficult to change.

In addition to the above issues, there are some of a technical nature which must be considered before deciding on any machanism or organization to control or influence interconnection practices.

At this point, it should be noted that the conclusions reached in a study of the technical aspects of interconnection by the national Academy of Sciences in the United States for the F.C.C. were supported by the Project Team; a copy of the report is appended. The principal conclusions are as follows: -

a) uncontrolled interconnection can cause harm to personnel, network performance, and property;

b) the signal criteria (described in the tariffs) relating to signal amplitude, way form, and spectrum are technically based and valid and, if exceeded, can cause harm by interfering with service to other user;

c) present tariff criteria, together with carrier provided connecting arrangements, are an acceptable basis for ensuring protection;

d) present tariff criteria, together with properly authorized and endorsed program of standards development, equipment certification and control installation and control installation and maintenance are an acceptable basis for achieving direct user interconnection;

e) innovation by carriers need not be significantly impeded by a certification program. Opportunities for innovation by users would be increased;

There can be no doubt about the growing importance of serving the users' needs. There is also no doubt that these needs are going to become more and more specialized and will require more specialized responses by the communication and equipment suppliers. If needs demand innovation and change at a faster pace than is economically viable for the carrier and/or the manufacturer, some influence must be applied so that the user may be directed towards objectives that are feasible for the carriers and manufacturers.

Users see a need for a federal agency with the necessary technical and regulatory authority to deal with interconnection issues on a continuing basis. This solution is easier to conceive than to implement due to the larger number of relationships involved, including those of federal/provincial jurisdiction. Although the ultimate mechanism is difficult to

visualize until some key issues have been dealt with, the next step is clear. The user and the manufacturer must be able to participate directly with the carrier in the formulation of any new or changed interconnection practices, and it would appear that this step be effectively taken through legislative action.