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KVA Communications and Electronics Co.

Communications System Specialists

THE IMPACT OF BYPASS

ON

THE FUTURE DEVELOPMENT

OF

LOCAL TELECOMMUNICATION NETWORKS

FINAL REPORT

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Client: Department of Communications

Project: 84-1246

Prepared by: Sheila Flynn, P. Eng.

Date: March 29, 1985

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DD 5405689

Commissioned by the Telecommunications Policy Branch, Department of Communications, Ottawa under DSS Contract OST84-00115. This report presents the views of KVA Communications Ltd. Its publication does not constitute approval of the report's findings, conclusions and recommendations by the Department of Communications.

SPECIAL ACKNOWLEDGEMENT

As the Study Director, I would like to express my special thanks to CableSystems Engineering, in particular Mr. S. Ting, for their contributions, to Mr. Charles Dalfen for his comments and suggestions, and to D.O.C. Scientific Authority, Mr. John Young for his guidance and support.

Mr. Mike Kedar
March, 1985

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Executive Summary

Introduction

This report on "The Impact of Bypass on the Future Development of Local Telecommunications Systems" shows that, as yet, there is no evidence to support any substantial impact of local bypass on either the development of local telecommunication networks nor on local subcribers telephone rates. Local bypass within the context of the Canadian telecommunication environment is expected to be minimal. We must stress that these conclusions are based on the limited information that was available during the course of the study, as we were not privy to any confidential data that has been presented to the CRTC.

The study further shows that the technology exists today and in many cases could be economically employed to effect local bypass. However, the ability to employ these technologies will depend on other factors such as, radio spectrum availabilty and licensing and right of way restrictions.

This study was confined to a review of local bypass within Bell Canada territory and generalized to include all of Canada. Further, this study was conducted at a time of great regulatory uncertainty, particularly in light the current CRTC hearing in which toll competition and rate rebalancing are being reviewed. Consideration has been given to four possible outcomes of this hearing and the impact of bypass was assessed within this framework. The actual outcome of the hearing could impact the results of this study.

Purpose and Objectives

This study was necessitated as a result of two major happenings. The first is the review of toll competition and rate rebalancing that is currently before the CRTC. The second is that the US, as a result of their policy allowing toll competition, have major concerns regarding the impact of local bypass as a direct result of toll competition. The US for some time have been conducting their own studies on the impact of local bypass. In Canada, the potential advent of toll competition and the possibility that toll competition might be a driving force behind local bypass, have resulted in the

commissioning of this study.

The objectives of the study were to:
Assess current and future technologies and their applicability to local bypass
Review local network bypass in the US and its relevance to Canada
Assess the potential impact of bypass on local subscriber rates

Methodology

The study approach consisted of a literature search, which was fairly extensive as evidenced by the bibliography. The literature search provided the data necessary to assess bypass technologies and to review the bypass issue in the US. In assessing the impact of bypass on local subscriber rates we relied heavily on information provided by Bell in their response to CRTC interrogatories and conducted interviews with the largest carriers including Cantel and CNCP. All information relevant to the cable carriers was provided by our subcontractor, Cablesystems Engineering.

In assessing the impact of local bypass, we chose to review this impact in light of four possible outcomes of the CRTC cost inquiry. These consisted of:
1) Maintain the status quo
2) Toll competition with toll subsidy
3) Toll competition and rate rebalancing (flat rate local service)
4) Toll competition and rate rebalancing (local measured service)

Problem Areas

Much of the data requested from Bell Canada was unavailable due to its confidential nature. This data was primarily concerned with revenue distributions amongst business and residential subscribers and the concentration or clustering of large users within Bell territory. This data would have proven very beneficial in assessing the potential impact of bypass based on the four scenarios.

There is no doubt that toll competition will have an impact on local bypass. Although, we have concluded that this impact will be minimal given the study assumptions, unlike the US, toll competition has yet to occur in Canada. We therefore had no direct experience upon which to base our analysis and assessment of local bypass in light of toll competition.

Results and Conclusions

Technical Considerations

Several technologies applicable to local network bypass were reviewed. We concluded that the technology was available and could be economically implemented. The most likely technologies to be implemented consist of:

microwave
coaxial cable
fibre optics.

These technologies can be implemented on an end to end basis or on a network basis. Some of the more widely used applications of these technologies are in local area networks (involving the transfer of data among nodes within a network), teleports (a receiving and transmitting point for local or long distance communication) and digital termination systems (local packetized microwave radio system). In addition, there are two carriers who have or will have established fairly substantive local networks that could be adapted to provide services that would bypass the local telephone network. These are the cable and cellular carriers.

Specific case studies were presented that demonstrated the economic viability of local bypass (See Appendix 2 for detailed cost analysis). These cases served to illustrate, that the technology is currently available to bypass and that this technology can, in many cases, be implemented at cost savings over comparable facilities that might be provided by Bell Canada.

Regulatory Considerations

Telephone companies across Canada are regulated on either a federal, provincial or municipal level. This makes it very difficult to establish a policy that will be uniformally accepted and implemented across Canada. Without this uniformity, companies operating in more than one province find themselves having to adhere to different sets of rules.

End User Considerations

There are many disadvantages and advantages associated with local bypass from an end user perspective. Local bypass would allow subscribers a choice in their selection of facilities. This allows subscribers to select facilities that meet their specific requirements and their decision will usually be based on the cost of facilities, their reliability, implementation time, value added services, and restoral time in case of failure. Also, when subscribers have a choice, manufacturers generally respond by creating new services and products. Businesses by selecting cost effective facilities that meet their requirements can improve efficiency and productivity. This leads to growth with its many spinoff benefits such as job creation, investment and export. Further, on an international basis, companies have a better chance to compete if their communication cost are more in line with those of their international competitors.

These advantages must be weighed against the disadvantages associated with local bypass. Since the local network has evolved in a monopoly environment, end users have come to expect reliable service at a reasonable cost. That is, the local network developed with the objective of achieving universal service. When local bypass occurs, some subscriber revenues are lost. However, the costs associated with providing and maintaining the local network do not change in the same proportion. The resulting shortfall in revenue must be acquired through other means, most likely higher subscriber charges. Increased charges threaten universal service.

Telco Perspective

From Bell's perspective, local bypass is closely related to the issues of toll competition and rate rebalancing. Bell argues that local costs are subsidized through toll revenues, therefore, toll prices are much higher than required based on an acceptable rate of return. In Bell's view, this invites toll competition and depending on the local interconnection arrangements and costs, could also result in local bypass by the toll competitors. Therfore, Bell has proposed that rates be rebalanced such that local subscribers bear what Bell views the full cost of service to be. However, if rates are rebalanced in an across the board fashion, then certain local area users could end up subsidizing other local area users and this could also invite local bypass.

Bell feels that with rates closely associated to costs, investors and consumers would more likely behave in a manner which would promote new services and technologies. It is for these reasons that we considered local bypass in light of toll competition and rate rebalancing.

Bell's allocation of costs to local and toll service has received considerable criticism from the CRTC (Decision 79-11 and the Report of the Inquiry Offices with Respect to the Inquiry into Telecommunications Carriers Costing and Accounting Procedures, Costing of Existing Services - 30 April/84), as well as other hearing participants including CNCP. The major criticism regards Bell's allocation of all access costs to the local network. This approach results in local costs exceeding revenues. The amount of toll revenue subsidization is entirely dependent on the allocation of these access costs.

Impact of Local Bypass in Bell Territory

In assessing the impact of bypass in Bell territory, four separate scenarios were considered in order to take into account the uncertainty that exists in the telecommunication environment, particularly in light of pending regulatory decisions on interexchange competition and rate rebalancing. The four scenarios are as follows:

1) Toll competition with toll subsidy
2) Toll competition and rate rebalancing (flat rate local service)
3) Toll competition and rate rebalancing (local measured service)
4) Maintain the status quo

Scenario 1 concluded that if toll competitors were required to subsidize the local network to the same extent that Bell claims it does today, they would have the greatest incentive to bypass the local network, but the extent of this local bypass would be very much limited. Given this, the potential impact on local subscribers was estimated based on the loss of toll subsidy that would result if toll competitors avoided this subsidy by providing private facilities between their toll network and a customer location. With lost toll revenues in the order of 1 to 15% and with 50% of the available subsidy lost due to local bypass, the impact to subscriber rates would vary from $0.08 to $1.14, respectively. We feel that lost toll revenues at the lower end of this scale i.e. a few percentage, is the most likely. Therefore, based on this scenario, bypass is minimal with little impact on local subscriber rates.

Scenario 2 concluded that the potential for local bypass would most likely occur as a result of local facility sharing or the use of dedicated local facilities, but the extent of this local bypass is expected to be minimal. Therefore, the impact on the local network or on subscriber rates is not expected to be substantial. The impact on subscriber rates would vary from a low of $0.23 to a high of $3.28, depending on the rate group, for local bypass ranging from 1 to 10%, respectively.

The impact on subscriber rates, in both Scenario 1 and 2, was based on Bell Canada data which, noted earlier, allocates all access costs to local network costs. This approach should be considered a worst case analysis. The impact on subscriber rates would be even less that that noted above if even some of these access costs were allocated to the toll network costs. The greater the allocation to toll costs, the less the impact is on local subscriber rates as a result of local network bypass.

Scenario 3 concluded that rate rebalancing implemented on a local measured service basis would result in minimal local bypass.

Scenario 4 concluded that there would be little incentive to bypass the local network if the status quo were maintained since local facilities including dedicated leased facilities are in many cases, according to Bell, subsidized through toll revenues.

In conclusion, we have no reason, **as of yet,** to believe that local bypass will be significant in Canada.

Recommendations

While it is our opinion that local bypass is minimal within the confines of this study, a more in-depth study should be made, taking into account specific information on subscriber costs and revenues which was unavailable for reasons of confidentiality. In addition, this in-depth study would have the benefit of knowing the outcome of the CRTC decision on rate rebalancing and interexchange competition and could therefore focus on the impact of local bypass given that market environment.

1.0 INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

BACKGROUND

This study was commissioned to address technological and market forces related to local network bypass of Canadian telephone companies. The timing of this study is particulary appropriate in light of two critical developments which will profoundly impact the course of Canadian telecommunications in the near and distant future. One is the CRTC proceeding dealing with Interexchange Competition and Related Issues (Telecom Public Notice 1984-6), and the other is the DOC Public Notice of January 14, 1984, concerning Telecommunications Policy Review, to be conducted by the department. These developments will have a far reaching effect, particularly with regard to such issues as consumer choice, technological development and rates. It is expected that the results obtained in this study, will provide a useful input to the overall Telecommunications Policy Review.

This study was conducted at a time of great uncertainty particularly concerning issues such as regulatory decisions, market forces and interconnection arrangements. Because of this, the study reviews local network bypass in consideration of several possible regulatory proceeding outcomes.

OBJECTIVES

The objectives of "The Impact of Bypass on the Future Development of Local Telecommunication Networks" study are to:

1) Describe existing and future technologies that could be used for local network bypass, including their relative advantages and disadvantages in relation to such items as:

- cost
- ease of installation
- transmission performance
- traffic capacity
- radio spectrum availability

2) Assess the potential impact of bypass on current monopoly providers revenues and consequently on subscriber rates for plain ordinary telephone service (POTS).

3) Review local network bypass in the U.S. including a review of the responses received to the FCC's request for comments on local network bypass. Assess U.S. development in this area and its impact on Canada.

1.2 DEFINITIONS AND ASSUMPTIONS

DEFINITIONS

Local Telephone Exchange Network - consists of local telephone switching centres (exchange central offices), the transmission facilities (trunks) that connect local switching centres to each other, and the transmission facilities (subscriber lines) that connect local switching centres to the user's premise.

Local Private Network - consists of dedicated facilities from a customer premise to a second premise, or from a customer premise to a metropolitan private network, through which calls may be originated or terminated without being switched through a local telephone switching centre. The distance between endpoints in a typical local private network would not exceed the farthest distance between endpoints in a Metropolitan Private Network.

Metropolitan Private Network - consists of switching and transmission equipment that is separate from the local telephone exchange network. A metropolitan private network serves to interconnect several local private networks, is located within the same city, and typically, does not exceed a diameter of 100 Km.

Switched Services - encompass all voice and voice-grade data services that can be provided through either the PSTN or a metropolitan private network. The dedicated facility connecting the customer premise to the metropolitan private network constitutes a local private network. See Diagram 1.2.1 - Bypass Network Configuration.

Non Switched Services - encompass all voice and voice-grade data services that are provided over dedicated facilities from a customer premise to a second premise. The dedicated facility constitutes a local private network. See Diagram 1.2.1 - Bypass Network Configuration.

Traffic - any voice, video or data traffic that can be carried in the transmission facilities used by the telephone company for both local telephone exchange networks and local private networks. Voice and voice-grade data are the major components of this traffic.

Bypass - Bypass arose in the US context of interexchange competition, in which the US long distance carriers must pay an access charge based on traffic usage in order to connect to the local telephone exchange network. A cost incentive was therefore created for the interexchange carriers to bypass the local exchange network by routing traffic directly to the user's premise, so that large users would not have to pay a traffic-based access charge. This form of bypass occurs whether the user's local private network is provided by the telephone company, an interexchange carrier, or a third party since traffic is diverted from the local telephone exchange in all cases.

Telephone companies have traditionally provided local private networks as well as local telephone exchange networks in the same cable plant. A loss of private services could therefore affect economies of scale and the cost of providing local telephone service. Thus, a second form of bypass occurs when the user is motivated by the price, quality and availability of local private network facilities to obtain these facilities from sources other than the telephone company.

Bypass refers to services which substitute in quality and kind for the local public and private services offered by the telephone company, and may therefore affect the development of local telecommunication networks. The two types of bypass mentioned earlier may be defined as:

1) the diversion of traffic from the local telephone exchange network to a local private network or a metropolitan private network that is provided by either the telephone company or others ('Public' to 'Private' bypass);

2) the diversion of traffic from local private networks or metropolitan private networks supplied by the telephone company to local private networks or metropolitan private networks supplied by others ('Private' to 'Private' bypass).

ASSUMPTIONS

The study is based on the following main assumption:

1) The potential impact on subscriber rates, as a result of local bypass, is based solely on Bell Canada data. It is assumed that the impact on Bell Canada would be similar for all other telephone companies operating in Canada.

1.3 METHODOLOGY

The methodology was designed to answer the following questions:

1. Does the technology exist to allow bypass at reasonable cost and quality?

2. Is there an incentive for subscribers to bypass the local telephone exchange network?

3. If an incentive exists to bypass, what segment of the subscriber market will benefit?

4. What would be the impact on the continuing availability of telephone service (POTS) at a reasonable price, given a potential loss of revenue to the telephone companies?

The study was subdivided into four major tasks descibed below. Tasks and study objectives are related as follows:

OBJECTIVE	TASK
1	1
2	2,3
3	3

TASK 1 - DESCRIPTION

Describe existing and future technologies that could be used for local network bypass. There are two issues dealt with in describing bypass technologies. They are:

1) bypass through a local private network. A few illustrative case studies were chosen and the cost of implementing a private local network was compared to leasing Telco facilities. Leased costs were based on Bell Canada tariffs.

2) bypass through a metropolitan area network. Such a network could be used to interconnect several local private networks. The large capital investment, and potential by-law and regulatory restrictions, will probably result in the establishment of very few of these systems. It would have been a monumental task to attempt any type of financial comparison between provision of a metropolitan private network and a PSTN, primarily because the local private network components of the PSTN are not unbundled for cost comparison. As such, a review of future trends including technology, services offered and target market was undertaken with the major participants, excluding financial comparisons.

TASK 1 - METHODOLOGY

Local Private Network Bypass - local private network bypass could consist of dedicated voice or voice-grade data facilities between a customer premise and a second premise, or between a customer premise and a metropolitan private network. The study was purposely limited to exclude wideband data applications although the trend is towards an end to end nationwide digital network allowing simultaneous use of the network for both switched voice and switched digital data applications. In developing this digital network, that includes the local loop, the objective is to use existing plant and to add new features and capabilities to achieve an Integrated Services Digital Network (ISDN). Since these developments are in their infancy and it is expected that their full impact will not be realized until well into the 1990's, this study focuses on the potential for voice and voice-grade data local bypass.

The following existing or future technologies could be used in local network bypass:

- fibre optics
- microwave radio system
- RF system
- cable TV
- laser
- cellular
- any other state-of-the-art system

On a case study basis, bypass using some of these technologies was reviewed to verify if economic bypass could be achieved.

The technologies that were included were reviewed based on the following criteria:

- cost of a typical system
- integration with other technologies
- performance
- capacity
- installation constraints
- spectrum availability
- policy, regulatory constraints
- availability
- any other relevant criteria

Based on the above factors, the use of a technology was compared to leasing facilities from Bell Canada.

Metropolitan Private Network - The creation of such a network to provide voice or voice-grade data services would require substantial duplication of the existing local telephone exchange network, and a large capital investment, since both switching and transmission facilities are required. Examples of such a network would include conversion of existing CATV facilities to provide telephone service or provision of a dedicated voice network, such as a cellular mobile telephone network.

At present, the cable TV operators may be in the best position to duplicate local exchange facilities. As such, the prime focus was to review the current technological trends in establishing CATV networks to compete with Telco networks. The bulk of this input was provided in consultation with a major cable TV operation. This review also included the types of services to be offered and the target market for which the services are intended.

In addition, the position of other major carriers who, have the resources to undertake development of such a network were reviewed. This included the cellular operator, CANTEL; and CNCP. None of these carriers have established a metropolitan private network to any degree, but certainly have some incentive to do so. As with the CATV review, data collected from representatives was assessed based on trends in network development, service offerings and target markets.

TASK 2 - DESCRIPTION

Assess the market need for bypass facilities and the impact on existing monopolistic networks.

TASK 2 - METHODOLOGY

Task 2 was based on the impact of local bypass on Bell Canada and its local networks. It was our initial intention through either Telecom Canada or CRTC, to obtain the percentage of total revenue that each major user group contributed, as well as the portion of revenue attributed to local dedicated facility leasing, within each user group. Given this information, we could assess the impact on existing monopolistic networks by determining what amount of revenue would be diverted to bypass networks and thus, the impact on POT service pricing policies. Much of this assessment would have been based on Comments on Bypass to the FCC, comments on CRTC Telecom 1984-6, and discussions with major users (i.e. banks, hospitals) and major U.S. carriers (i.e. MCI, AT&T).

A questionnaire was prepared that would provide much of the data necessary to make the assessment (see Attachment 1). A meeting was held with Bell Canada representatives to review the type of data required by the study. The needed data proved to be either unavailable (at least in the format or detail required) or had been provided to CRTC on a confidential basis and was thus inaccessible. We took whatever information could be provided by Bell Canada and revised the methodology as follows, so as to estimate the impact of bypass in Bell territory.

The impact of local bypass was analyzed under four separate scenarios. Although, each analysis differed depending on the scenario, the same base data was used in the analysis of each scenario. The following Bell Canada data as published in June 1984, in the "Report on the 5-Way Split Study of 1983", was used:

1983 Bell Canada

(i) local service costs $1.89/$1.00 of revenue

(ii) toll service costs $0.31/$1.00 of revenue

(iii) toll subsidy to local service - $1.2 billion

as well as Bell (CRCT) 22May84-303 IC Supplemental Attachment

(iv) Bell's approach to rate rablancing

It should be noted that different cost allocations to local and toll service may result from the CRTC cost inquiry. Further, Bell's allocation of costs to local and toll service in its 5-way split study, has received considerable criticism from the CRTC (Decision 79-11 and the Report of the Inquiry Offices with Respect to the Inquiry into Telecommunications Carriers Costing and Accounting Procedures, Costing of Existing Services - 30 April/84), as well as other hearing participants including CNCP. The major criticism regards Bells allocation of all access costs to the local network. This approach results in local costs exceeding revenues. The amount of toll revenue subsidization is entirely dependent on the allocation of these access costs.

The four scenarios considered are:

1) Toll competition with toll subsidy - the assumption is that toll competitors will pay the equivalent existing local subsidy as suggested by Bell. Under this scenario, the toll competitors have the greatest incentive to bypass the local netowrk and provide end to end service to their customers. This, of course, will only be feasible where the subsidy costs are more than the cost of establishing local facilities, i.e. areas where customers who generate substantial revenues are concentrated in major clusters. The following procedure provides a starting point in determining the possible impact on local subscriber rates and is based on data from Bell's 5-way split study as mentioned earlier:

Bell's noncompetitive toll revenue	1.99 billion
Bell's noncompetitive local revenue	1.39 billion
Bell's noncompetitive local costs (includes all network access costs)	2.63 billion

The impact on subscriber rates was assessed, for a number of different revenue losses by Bell to competition.

For example: Assume Bell loses 10% of its toll revenue to competition.

10% x 1.99 billion = 0.2 billion

In terms of local subsidy in Bell's view, this is equivalent to:

62% x .2 billion = 124 million

However, the competition will still pay $0.62/$1.00 of toll revenue or 124 million to subsidize local costs unless the competitor bypasses the Bell local network, thereby avoiding the subsidy payments.

Assume 10% of the toll traffic lost to competition uses local bypass facilities. Then in Bell's view, they lose:

10% x 124 million = 12.4 million

in subsidy and will have to charge subscribers higher local rates to cover the lost subsidy.

Once we had established a range which quantified the potential impacts on subscriber rates, we investigated the likelihood of each outcome and drew conclusions which classified the impact as slight, significant or destructive.

(2) Toll competition and rate rebalancing - (flat rate local service) - with this assumption, toll rates drop substantially and fixed line charges increase substantially. The most likely candidates for bypass are those with a large number of local lines. These local lines could be used to access a toll competitors network, or the telco local/toll network or could be local private leased lines.

Since we knew Bell's approach to rate rebalancing and their proposed local rates, we determined various percentages of local revenue that could be lost as a result of bypass. For this study , the 5th year local rates were used. We determined the various impacts on local rates by assuming a range of lost revenues to local bypass, and chose three illustrative rate groups to assess the impact.

(3) Toll competition and rate rebalancing - (local measured service is implemented) - it would be difficult to determine quantitative data for this scenario, without having some idea of the way LMS would be implemented. As such, we provided a qualitative analysis that compares scenarios (2) and (3) and presents the major differences in outcome that could result from implementation of LMS.

4) Maintain the status quo - this assumes no toll competition, and no rate rebalancing. Bypass under this scenario will largely be as a result of end to end private or shared systems. Those who could economically bypass, would likely have a large total toll demand between any two points, or a large local demand between two points, as opposed to a large overall demand between a number of points.

Besides the major bypass users as considered under each scenario, other potential bypass applications were reviewed as appropriate, such as, "smart buildings", local private lines provided by either the carrier or privately constructed and residential CATV systems.

TASK 3 - DESCRIPTION

Assess factors in the U.S. which have created a demand for local network bypass and which may affect a similar demand in Canada. Task 3 was conducted in conjunction with Task 2.

TASK 3 - METHODOLOGY

Recent trends in U.S. telecommunications relevant to the local bypass issue, are described. The effect of U.S. decisions on Canadian policy and the issue of inter-exchange competition within the U.S. are reviewed and discussed. This data was based on:

- comments to the FCC on bypass
- comments on CRTC Telecom 1984-6
- major U.S. carriers.
- trade publications

2.0 BYPASS TECHNOLOGIES

The technologies that have the greatest potential for use in a bypass system fall into one of two classifications: cable systems and radio systems. Cable system technologies include coaxial cable, primarily a cable TV medium and fibre optics. Radio system technologies include satellite systems, and microwave, which has been used for a considerable time by telephone companies to provide long distance service. The important characteristics of each technology is described below, as well as certain applications in bypass systems.

2.1 Review of Available Technologies

Microwave

Much of the research conducted for this study indicated that microwave is the most predominant bypass technology in use in the U.S. today and could become a primary bypass technology in Canada. The Canadian Department of Communications has recently issued microwave spectrum allocation policies in the bands 1-10 GHz and has submitted for public comments policy directions in the 10-30 GHz bands. Certain bands such as 10.6, 18 and 23 GHz are relatively unused and the department is reviewing possible allocations for the development of local public commercial microwave service.

Microwave systems can be used for both short and long haul transmission. Various system capacities allow transmission of voice circuits, video and wide band data. Further, higher frequency microwave systems make possible the use of smaller and cheaper dish antennas.

In the short haul local market digital point-to-point microwave sytems can provide a high capacity digital medium with typical capacities ranging from 2 lines of 1.544 Mbs or 48 voice channels to 56 lines of 1.544 Mbs or 1,344 voice channels. The predominant application of point-to-multipoint microwave systems is in the form of digital termination systems. DTS is a packetized microwave radio sytem that can support speeds up to 1.544 Mbs over a range of 5 to 15 miles, depending on the terrain and atmospheric conditions. In a DTS system, digital signals are broadcast from a central antenna to multiple users each

with a directional antenna to the central node. Each user has an associated address that is encoded as part of the digital bit stream and transmitted from the central node. When a users terminal equipment receives the correct address, the signal is taken and stored. Messages are sent to the central node as a digital bit stream over the directional antenna.

Advantages

- wideband/high speed
- no right of way requirement
- analog or digital operation
- quick deployment

Disadvantages

- spectrum availability and coordination
- line of sight considerations including terrain, building profiles, weather
- reliability, security and privacy more expensive than solid media transmission systems

Applications

- wideband transmission
- voice trunking
- video distribution

Satellite

Satellite is primarily used for long distance communication and in the context of this study, satellite is only considered in relation to the local bypass that occurs as a result of this end to end long distance communication.

Satellites have been described simply as repeaters in the sky. Radio signals are transmitted from an earth station to the satellite, amplified and retransmitted back to an earth station. If the earth stations are customer owned and located on a customer's property, bypass of the local network takes place with each message sent. However, for local communication, interconnection to the local network must still take place. The reduction in earth station antenna size to 1 metre diameter has made it possible to locate earth stations on a customer's premise.

Satellite employs only one repeater as opposed to a microwave system which would have many repeaters. Thus the cost of satellite transmission is largely independent of distance, unlike microwave where costs tend to increase with distance. The cost of satellite is largely dependent on the type of earth station, transmission technique and type of encoding. Depending on the system, large users could realize a cost advantage by routing long distance traffic via satellite and an even further advantage with privately owned and operated earth stations. In both instances, some bypass of the local network results.

Because of the long path lengths involved in satellite transmission, echo is a problem and the use of echo supressors or cancellors is required.

Advantages

- ownership of earth stations by business users is permitted
- declining costs associated with terminal and transmission equipment
- line of sight restrictions do not apply
- no right of way requirements

Disadvantages

- voice transmission echo problems
- delay effects on data transmission protocols
- difficulties in finding suitable earth station locations in a downtown office environment
- privacy and security limitations

Applications

- data transmission
- video transmission
- long distance voice trunking

Coaxial Cable

Coaxial cable is discussed fully in Section 2.3. Cable television has the potential of being established as a metropolitan network that could compete with the local telephone network in coverage.

Cable television has a high penetration rate in urban areas and would not face the right of way problems experienced by other technologies. However, cable television was not established with a switched system architecture and has been primarily established as a one way service. Network conversion to compete with local telephone companies would be a capital intensive undertaking.

Advantages
- wideband/high speed capability
- substantial network development
- mature technology

Disavantages
- primarily established as a one-way system
- a non-switched network
- short distance amplification required
- limited security
- limited reliability and capability due to architecture

Applications
- two-way interactive data transmission (low to medium speed)
- high speed data transmission
- video conferencing
- long distance telephone access

Fibre Optics

Two of the major benefits of fibre optics is its small size and wide bandwidth. Fibre optic cables consist of very thin strands of glass which are capable of transmitting high bit rates of information in an optical rather than electrical form. Fibre optic is ideal in a congested environment, such as is often experienced in metropolitan telephone duct systems, since the cable strands can easily be threaded through the underground duct system. Conventional copper cable placement, in contrast, would probably have required the streets to be torn up.

Fibre is expected to be a key technology in the provision of Integrated Services Digital Network (ISDN), "which will allow the simultaneous use of the network for both switched-voice and switched-digital applications."(1) Local loops will have to be converted to an alternate voice/data transmissiom media through the use of special terminating equipment. ISDN will also allow access to packetized switching networks. Conversion of the local telephone network to ISDN could restrict the extent of bypass, particularly if the primary reason for bypass is to obtain services not readily available from the telephone companies. However, ISDN development is in its infancy and is not expected to have any significant impact for several or more years.

Advantages
- wideband/high speed
- systems security and privacy
- low susceptibilty to electronic interference
- ease of placement

Disadvantages
- high cost
- fast obsolescence

Applications
- wide band data transmission
- digitized video
- device monitor and control
- large capacity multiplexing of voice grade channels

Other Bypass Technologies

The most predominant bypass technologies have been described above. One other technology that is much less developed is:

Optical Systems

Optical systems are based on either infrared or laser technology and like microwave, line of sight requirements apply. The use of these technologies is not widespread, one reason being their limited range of less than one mile. According to Touche Ross, costs are comparable to a microwave system.(2) Since optical systems are not subject to the present Radio Act, they may be implemented quickly without licencing delays.

Other Bypass Sytems

The bypass systems described below could be implemented using one or more of the technologies already described. Teleports are considered a direct bypass system while cellular and local area networks are considered to be specialized systems and are not seen as a direct threat to the local telephone company at this time.

Cellular Mobile Telephone System

A cellular system divides a service area into subsections, or cells. The available radio channels, in the 800 MHz band, are allocated among the cell sites. Channels assigned to one cell site can be reused if the sites are far enough apart to prevent interference.

Each cell site is served by low power transmitters, separate receivers and control systems. Cell sites are linked to a switching office which is equipped with an electronic switching system. This switch directs the mobile unit to one of the cell sites available voice channels and passes the call on to the telephone network beyond the cellular system to be processed as a conventional call.

Two licencees will provide cellular mobile telephone service in Canada; Cantel Inc. and the telephone companies. Service is to begin July 1, 1985. Licences will be granted for the 23 Metropolitan Areas in Canada, however, it will be several years before service is offered in all of these areas. A cellular system could potentially bypass the local telephone company, particularly on long distance calls, once the system is established in a number of MA's.

Advantages
- low power transmission
- frequency re-use

Disadvantages
- licencing restrictions
- high initial capital investment

Applications
- mobile voice and data transmission
- rural telephone service

Local Area Network

A local area network as written by Strole of IBM, is, "a basic transport mechanism for data transfer among nodes within a network."(3) LAN's have emerged primarily from a need to link computers to shared resources such as printers, disk drives and large data bases, and the tendency of many companies to consolidate functions such as, payroll and accounting.

Four parameters characterize local area networks: technology, topology, access method and transmission medium.(4) Local area networks can be based on one of several technologies, including baseband, broadband and PBX/CBX (private branch exchange/computerized private branch exchange). The broadband version is fully compatible with CATV cable technology while baseband is similar to that used in most data communication applications ie. RS-232. Topologies commonly used are the ring, bus and star. Access methods most commonly used are carrier sense multiple access with collision detection (CSMA/CD) and token passing and the most common transmission media are coaxial cable and fibre optics.

Advantages
- lower network costs
- resource sharing

Disadvantages
- 3270 and voice networks are separate to LAN
- incompatible with bisynchronous or System Network Architecture/Synchronous Data Link Control (SNA/SDLC) 3270 protocols

Applications
- periphereal linking
- large data base access

Teleports

Teleports provide economies of scale through the shared use of facilities which result in overall lower telecommunication costs. A teleport is receiving and transmitting point of long distance or local communication. Received signals are usually transmitted to customers over fibre optics, microwave radio or even copper cable, thereby bypassing the local telephone system.

Some analysts, "doubt that teleports will survive in markets that don't have a lot of firms that currently pay $50,000 to $100,000 a month for telephone service."(5) The most publicized teleport and the one closest to completion, is the teleport on Staten Island N.Y., which will connect the lower Manhatten business district with domestic and foreign locations via satellite. A fibre optic trunk of 96 fibres, capable of carrying 200 Mbs on each fiber, will connect the Manhatten customer to a number of private and public earth stations located on Staten Island.(6)

Advantages
- lower cost through shared use

Disadvantages
- High development and construction costs

Applications (all applications are on a shared basis)
- PBX
- Local Area Network
- teleconferencing
- electronic mail
- word processing

2.2 Local Network Bypass

2.2.1 Comparison of Bypass Alternatives

Each technology described above, whether a cable or radio technology, can support a wide variety of services. In addition, each technology offers alternatives in terms of costs, capacity, availability and provisioning trade-offs. Further, depending on the system requirements, it is often the case that a combination of technologies will provide the most economical solution, as well as, the most desirable system characteristics.

Cost comparisons are only meaningful when related to specific system characteristics, such as distance and capacity required. A recent study by Future Systems Inc titled, "Transmission Cost Comparison for Satellite, Fibre Optics and Microwave Radio Communications," indicated that each of these technologies, depending on the application, could be the most economical. They concluded that, "Viewing these three modes in light of distance and channel capacity, satellite circuits appear best for relativley long, lightly loaded links; optical-fibre systems appear best suited for shorter and/or heavier links; and microwave radio's best application appears to fall somewhere between those of the other two modes."(7) While generalizations are useful to a point, in the end, each system design must be evaluated individually. Since many other factors can influence total system cost besides the hardware required, such as, installation and construction costs, it is not unlikely that two systems covering approximately the same distance and requiring the same capacity, could be constructed for economic reasons using different technologies.

As stated, capacity considerations are important in system design decisions. The following excerpt, extracted from the testimony of J.B. Carpenter,before the FCC, shows the equivalent voice circuit capability of each of the major bypass technologies.

Summary of Bypass Technology Capabilities

	Cable Systems				Radio Systems				
	Twisted Pairs	Carrier on Cable	Coax (CATV)	Fibre Optics	Pt-Pt Microwave	DTS	Satellite	Sample service	Voice Circuit Equiv
Analog 4 KHz Voice	X	-	-	-	-	-	-	Voice Trunk	1
		-	-	-	-	-	-		
		-	-	-	-	-	-		
Digital to 56 Kbs		-	-	-	-	X	-	Computer Work Station	1
		-	-	-	-		-		
		-	-	-	-		-		
		-	-	-	-		-		
Digital 1.5 Mbs		X	-	-	X	-	-	Digital PBX Trunks	24
			-	-		-	-		
				-			-		
				-			-		
Digital 44 Mbs				X	X		X	Very High Speed Data	672
Analog 6 MHz Video			X		-		X	Cable TV Channel	240
					-				
					-				

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Besides cost and capacity, many other criteria are relevant in the choice of suitable transmission facilities. These criteria, which include installation constraints, compatibility with other technologies, availability and policy/regulatory constraints have been included in the discussion of each technology - Section 2.1

2.2.2 Case Studies

The following examples, serve only to show that bypass of local telephone company facilities using alternative technologies can be accomplished economically. Appendix 2 includes the detailed cost analysis of each case. Only the results and a discussion of their significance are presented below.

Case 1 - Comparison of DS1 Cable vs Microwave

This case compares the cost of establishing a 2800 metre dedicated facility, equivalent to 24 voice channels, using T1 carrier leased from a telephone company to the a cost of a private microwave system. The costs of the leased facility are based on Bell Canada tariff 5020 for meagaroute service.

No. of channels	24
Total Annual Costs of T1 leased facility	$75,000
Total Annual Cost of Private Microwave System	$31,000

The results indicate that a telecommunication user could realize a substantial saving (in the order of $45,000 annually) by establishing a private microwave system as opposed to leasing facilities from the telephone company. Although the result is only valid for the assumptions on which it is based (see appendix 2), it does show that economic alternatives to local telephone facilities exist today. A private microwave system offers other economic advantages in relation to expansion costs. While doubling the capacity would result in an almost doubling of the annual charges related to T1 leasing, increasing the capacity of the microwave system can be accomplished much more cheaply. This is because many of the costs associated with establishing the private microwave system are nonrecurring or do not recurr fully ie. site preparation. Other aspects associated with establishing a private microwave system, such as, radio licensing and spectrum availability have not been addressed.

Case 2 - Long Distance Resale

If as Bell claims, toll revenues subsidize local network costs, including the cost of both private and switched local facilities, the door is open for long distance competition. The effect of long distance competition may be to lower the subsidy realized, which could result in increased charges for local service and an incentive to bypass the local network. Bypass by large telecommunication users has been a concern in the U.S., where long distance competition is allowed and is also a concern in Canada where a decision on long distance competition is pending. This case study, is designed to illustrate how an incentive already exists for small business subscribers to bypass the toll network, which may increase pressure from these users for local bypass.

A service opportunity exists to provide small business users the opportunity to share the costs of dedicated channels between two cities at prices below Bell's long distance and WATS services and in circumstances where the user's traffic volume cannot justify FX service between the two cities.

Alternative long distance toll, FX or Wats service can be provided between any two pairs of cities. Telephone calls will route through the local public telephone network to special switches in each city served. The switches will be connected by leased or privately owned channels.

Profitability Analysis

Table 1 provides Total Revenues, Total Costs and Profit (Loss) for each volume level. Revenues are based on discounting Bell Canada's present day-time tarriff for toll calls between Toronto and Ottawa by 1/3. Costs include fixed costs (general administrative expenses and capital costs for switches) and variable costs (facilities, maintenance, billing/collecting, sales/promotion). This table suggests that a breakeven point is in the order of 60,000 to 70,000 minutes per month, which corresponds to 300 users on the system - 200 in City 1 and 100 in City 2.

Table 1 - Monthly Profitability Analysis

MINS/MO	TOTAL REVENUES		TOTAL COSTS		PROFIT (LOSS)
25,000	9,405	-	14,005	=	(4,600)
50,000	18,810	-	21,357	=	(2,547)
100,000	37,610	-	30,968	=	6,642
150,000	56,420	-	39,988	=	16,432
200,000	75,225	-	47,478	=	27,747
250,000	94,030	-	57,031	=	36,999
300,000	112,840	-	64,498	=	48,342

As noted earlier these results are based on a 1/3 discount and would be even more profitable if a 20% discount were offered. Both the reseller and the small business user benefit as a result of the discount and resale of services. The results indicate that even a small business user may be encouraged to use competitive toll services if it means the realization of sufficient savings in overall monthly telecommunication costs.

Case 3 - Multi-Tenant Buildings with Shared Facilities

The potential exists for residential apartment buildings to share local access facilities to a serving telephone company switch. Through resale, the advantages of a PBX can be realized by the residential user. Although resale is not total bypass of the local telephone network, it does deprive the local telephone company of some local revenues and will therefore impact both the network and local rates.

	Shared Facility Costs	Costs Without Shared Facilities
Bell Present Day Tariff* Apartment Complex 450 Units	$54,397	$54,000
Bell Fifth Year Rate Based on Rebalancing* Apartment Complex 100 Units	$33,017	$31,896

Note * - Based on average charge for all rate groups

Based on the assumptions used, the results indicate that currently residential complexes are not primary candidates for local network bypass. As indicated, cost savings can only be achieved if the size of the complex exceeds 450 units, and there are insufficient numbers of these complexes existing to have much impact. However, if Bell Canada does rebalance rates as proposed, the incentive for residential customers to bypass the local network increases substantially. With rates fully rebalanced, an apartment complex of only 100 units could benefit from shared facilities.

2.2.3 Conclusions

So far, it has been demonstrated that local network bypass is a very real possibility in the Canadian telecommunication environment. No determination has yet been made on the possible extent of this bypass, nor on the potential impact to local telephone networks or the possible impact on charges currently levied for use of this network.

Bypass as a result of competition and technological development could prove beneficial and result in the lowering of charges for many telephone subscribers, particularly large volume business subscribers. At the other extreme, bypass could result in increased charges of such a magnitude that universal access to the public network might be threatened.

The issue is further complicated by the current regulatory proceedings underway in Canada which, depending on their outcome could affect local network bypass in several different ways. Subsequent sections will deal with the issue of impact and extent, in consideration of the possible regulatory proceeding outcomes.

2.3 Metropolitan Private Network Bypass

2.3.1 Cable Television Network

2.3.1.1 Feasibility of Bypass

Cable television plant now passes 80% of all the homes in Canada with an average connection percentage of 75%. In most urban centres, connection percentages of over 85% have been achieved. These urban cable systems also pass major business districts where communication needs and expenses are highest amongst all users, thus providing the greatest opportunity for bypass via cable.

By upgrading a portion of the existing residential cable plant to two-way, a wide range of interactive data and business communications services can be provided to business users. Because the cable plant is already in place and in most cases, already fully depreciated, the total capital costs consist of plant upgrade (likely a small portion of total plant) to two-way active; headend hardware and the necessary terminal hardware at users' locations. These costs represent a relatively small fraction of a new fully two-way active dedicated network but nevertheless still represent a substantial outlay for the cable operator.

Because of this lower entry cost, cable operators can therefore provide data and business communication services to business and corporate clients at a more competitive rate. In most cases, cable service rates are based on time and bandwidth usage only and are insensitive to the distance from a user's location to the central office exchange.

If the existing residential cable networks were made entirely two-way active, a broader range of services could be provided not only to potential business or corporate clients, but to residential, government and institutional users as well. To offset the costs of upgrading the entire plant to two-way active, additional revenue would need to be generated, i.e. impulse pay-per-view, teleshopping etc.

A two-way upgrade essentially assumes a limited forward and return bandwidth requirement, typically 15 - 30 MHz. Should a larger bandwidth be required, construction of a new dedicated cable network with considerably more channel capacity would likely be necessary. The construction cost of such a dedicated network would be much higher, and therefore these large scale plant expansions would likely be very limited.

For this report, it is assumed that existing plant will be upgraded on an as needed basis to provide the necessary area coverage and channel capacity for the applications under consideration. Assuming a maximum bandwidth possibility of 30 MHz in both forward and return directions, this is equivalent to 5 video channels or about 20 T1 circuits or any combination thereof.

Existing Network Structure and Implications

The Canadian Cable industry has achieved a relatively high penetration rate and is still maintaining a steady rate of growth, as compared to systems in the U.S. who are currently enjoying a rapid growth period. Most Canadian systems were built or rebuilt over ten years ago when the state-of-the-art technology was 300 MHz and two-way technology was still in its infancy. Little provision was made to include any two-way considerations in system design at that time.

As the U.S. cable industry experienced an explosive growth in the mid seventies, new and innovative ideas, especially in the area of interactive cable technology, were implemented. Many new U.S. systems are now providing interactive services to residential and institutional customers through single or even multiple cable two-way networks. Although it is very unlikely that multiple cable technology would be needed or implemented in Canada due to its higher construction costs, two-way upgrades on the single basic residential network would be the most economical and thus the most likely approach used in Canada for many of the existing networks to meet bypass requirements.

To upgrade these systems to two-way, the following would need to be considered:

a) Forward Channel Requirement and Availability

To implement two-way upgrades, additional spectrum is required for the forward channel. Possible vacant slots available in the forward direction are 72 - 76 MHz, channels A-1, A-2, J if superband is offset. The 72-76 MHz is an unused slot of spectrum that exists between channels 4 and 5. Channels A-1 and A-2 are restricted channels due to their close proximity to the aeronautical band. However, for low level data with its lower power requirements, it may be permissable to use this spectrum. Superband is anything above channel 13 (J, K, L, channel etc.) and to minimize local oscillator interference, superband is often offset by 1 MHz. The J channel cannot be offset by 1 MHz because it would interfere with channel 13. By offsetting the K channel, the bandwidth of the J channel is reduced by 1 MHz from 6 MHz to 5 MHz. Since cable television requires 6 MHz of bandwidth, the J channel is therefore unused and vacant.

Other spectrum may be made available for the forward channel by dropping lower priority channels such as character generator channels (ie. broadcast news, weather reports), in favour of other new services. If more channel capacity is needed, rebuilding to a higher bandwidth (to 330 MHz, 400 MHz, 450 MHz, etc.) would likely be the only option. Again, it should be noted that only that portion of plant required for a new service would need upgrading or bandwidth expansion. It is also likely that new replacement amplifiers would have superior performance specifications than the existing units permitting drop-in replacement without costly respacing. In some marginal cases, this new technology may prove to be an economical choice for system upgrade. In addition to upgrading active equipment to expand bandwidth, sections of cable and certain passive equipment may also need replacement in affected service areas. Newer amplifiers sometimes require more power than existing units. Therefore, larger power suppliers or additional units may also be necessary.

b) Return Transmission Scheme

The most popular transmission schemes used for upstream (return) data transmission are contention and polling. A contention scheme is best suited for systems with a low terminal data rate and infrequent data transmission by each terminal. With this scheme, a very large number of terminals (100,000 plus) can be accomodated. During operation, each terminal is programmed to transmit only when it has data to send, and only when the return channel becomes idle. After each transmission, it listens to the echo of its own transmission on the forward channel. If it detects any data corruption due either to interference or channel collision, it immediately aborts its transmission and attempts to resume transmission after a random shut down period.

Polling on the other hand is more suited to a smaller group (typically less than 10,000) of more busy terminals, although with multiple priority levels, a larger number of terminals can be accomodated. With this transmission scheme, each terminal is polled sequentially regardless of its need for a transmission path (i.e. with or without data to send). A significant portion of time is spent polling idle terminals, although it has an inherent terminal status monitoring feature.

Both of these transmission schemes require a "clean" upstream channel on a continuous (unswitched) basis for highest reliability and low error rate. Extra effort is required to ensure minimum "ingress" problems.

c) "Ingress"

A common but severe problem associated with a two-way plant upgrade is the problem of "ingress". Ingress is the pick up of unwanted signals in the cable network due to improper isolation between the cable and the external electromagnetic environment. Major causes of ingress problems are: loose connectors at plant and subscriber locations; cracked cable or poorly shielded cable.

These same problems could have a far more severe impact on the return signals. The 5 - 35 MHz return spectrum is congested with many channels of over the air voice communications or broadcast carriers, for which the field intensities vary along different plant locations. An interfering voice carrier could cause an annoying intermittent carrier collision that makes tracking and problem correction a time consuming process. Generally speaking, additional operating staff and expenditures are expected to increase relative to one-way operation.

d) Other System Enhancements

While upgrading to two-way, it may also be desirable to add enhancements to cable plant at the same time to improve system reliability (uptime) and repair time in case of a system outage.

For example:

- station bypass: a feature that ensures signal continuity, though with a slightly degraded quality, in case of an amplifier module or station failure.
- station redundancy: duplicate module with automatic switch over circuitries to provide "hot standby".
- status monitoring: strategic plant locations are monitored for signal continuity, signal level variations, DC level variations, etc. to reduce troubleshooting and repair time during system failure.
- battery power back-up: batteries and invertor circuitries are used to provide back up power to amplifier stations in case of commercial power failures.

Two-way Upgrading Costs

- Two-way upgrading costs can be affected by many variables, such as plant age, original design and spacing, bandwidth and the shielding effectiveness of existing equipment and whether it has been built two-way capable. Also, costs are dictated by the bandwidth desired, return transmission scheme planned and enhancement features contemplated.

a) Plant Costs

To generalize the cost of plant upgrade, it is felt best to present a range of cost per unit distance (km) with the upper and lower bounds defined as follows:

Upper bound: it is assumed that the plant is not two-way compatible, but the existing cable, passive hardware including splices, connectors and taps (no pressure taps) are salvageable. Along the affected trunk and distribution plants, amplifiers and associated connectors are to be replaced, as well as the power supplies with battery backup units. Trunk stations are to be equipped with station bypass and status monitoring features.

- trunk station	$5,600
- power supply	$ 225
- design, installation and align	$ 500
Cost per km of trunk	$6,325

- Distribution amplifiers	$ 875
- power supply	$ 225
- design, installation and align	$ 500
Cost per km of distribution	$1,600

Lower bound: The plant is already designed to two-way and the equipment is two-way compatible. No enhancement feature is added.

- trunk modules	$ 600
- installation and align	$ 250
Cost per km of trunk	$ 850
- distribution amplifier	$ 250
- installation and align	$ 250
Cost per km of distribution	$ 500

Lower and upper bound costs are based on the unit cost assumptions as presented in Table 2.3.1.1 at the end of this section.

As noted earlier, most Canadian systems were built or rebuilt over ten years ago, when two-way technology was in its infancy. As such, these systems were not designed to include two-way considerations. Therefore, in most cases, plant costs in the upper bound would apply.

b) Headend Costs

Headend costs associated with two-way consist of a network controller unit which may be merely a frequency translator converting incoming (return) signals to different outgoing frequencies. The cost of a translator ranges from $3,000 (stand alone unit) to $10,000 (redundancy and automatic switch over).

Some systems require an intelligent unit at the headend to control the flow of information throughout the network. Such a network controller costs $10,000 - $25,000 depending on its make and features.

In addition to the network controller, additional duplex hardware and a signal combining network would be necessary to make the headend two-way capable.

Example Case:

Two hospitals require a two-way video link for training purposes. One hospital requires 5 km of trunk and 1/2 km distribution from the headend while the second one requires 10 km of trunk and 1/2 km distribution on the other side of town:

	Lower bound	Upper bound
Plant upgrade to hospital one		
Trunk (5km)	$ 4,250	$ 31,625
Distribution (1/2 km) upgrade	$ 250	$ 800
Plant upgrade to hospital two		
Trunk (10km)	$ 8,500	$ 63,250
Distribution (1/2km)	$ 250	$ 800
Headend processor (2)	$ 4,000	$ 4,000
Modulators at hospitals (2)	$ 3,000	$ 3,000
TV receivers, user provided		
Total Costs	$20,250	$103,475

It should be noted that two-way upgrade cost to any portion of the plant is a one time charge. Once upgraded, any point along the upgraded plant may be used to provide interactive services to potential users with very little incremental costs or cost per user.

All costs shown above are indicative figures only to present the order of magnitude of the costs involved. Actual costs may vary widely depending on plant conditions, equipment in use and planned etc.

In Canada because of the fact that most cable systems were not designed with two-way considerations, the upper bound costs would apply in most cases.

TABLE 2.3.1.1
UNIT COST ASSUMPTIONS

	Upgrade Activity	average quantity per km	estimated unit cost	cost per km	running total of cost per km
A)	**Plant cost (trunk)**				
1)	Trunk upgrade to two-way by drop in return amplifiers and system balance	2/km of tr.	$ 300	$ 600	$ 600
2)	Trunk upgrade to two-way compatible	2	$1800	$3600	$4200
3)	Add station bypass capability	2	$ 200	$ 400	$4600
4)	Add status monitoring	2	$ 500	$1000	$5600
B)	**Plant Cost (Distribution)**				
5)	Add return amplifier to two-way ready line extenders	2.5/km of dist.	$ 100	$ 250	$ 250
6)	Replace line extender to two-way compatible	2.5	$ 250	$ 625	$ 875
C)	**Plant Cost (power supply)**				
7)	Replace with battery standby units	0.15/km of tr/dist.	$1500	$ 225	$ 225
D)	**Plant Cost**				
8)	Replace tap if necessary including labour			$17 - $30 each	
9)	Replace Cable if necessary, cable only			$1000 - $2000 per km	

2.3.1.2 Bypass Trends

Trend in the U.S.

Due to stiff franchise competitions, more and more new and innovative cable services have been promised and developed. These services include two-way data communications through either an integrated or separate institutional network. Equipment manufacturers have also developed a wide range of hardware catering to various transmission schemes, operating frequency bands, bandwidth requirements, and data rates from 1,200 b/s to high speed T1 circuits at 1.544 Mb/s. Also, depending on return transmission schemes, service can be half-duplex, full-duplex, asynchronous or synchronous. In short, all the essential ingredients necessary to establish a large scale metropolitan access network (MAN) are readily available. However, hardware costs are still relatively high for any large scale bypass operation.

Even so, many institutional networks are fully operational at various major cities offering low cost data services to business and institutional clients. Table 2.3.2.2 list several examples of cable bypass activities in the US. Services in use largely fall into the following categories:

- Point to point low/medium/high speed data communications (i.e. T1 circuits).
- Point to multiple point high speed data communications (Reuters IDR service).
- Teleconferencing between centres within a cable system or intercity via satellite.
- Traffic signal control and monitoring.
- Connection to packet switching networks such as Tymnet.

Typical customers include major banks, corporations, hospitals, data processing centres and government agencies, who are all incurring large communications costs to move and transfer data. Most clients find cable data service very price attractive due to its "distance insensitive" rate

structure offered by most cable operators. Those who have a large amount of data and frequent need for transmission also find cable offers a reliable and error free (lower error rate) transmission service. Most important to many clients is the availability of new circuits; fast installation time and fast repair time in case of system failure.

In addition, many large corporations who have unusually large communications needs between divisions, plants and central offices where the geographical separations are small, have these sites interconnected by a dedicated private network. Interconnection of these large capacity local area networks (LAN) is possible through either the existing cable network or a separate dedicated cable.

In summary, bypass via cable is growing steadily and is expected to continue this trend as an increasingly profitable business venture. However, most of the service applications are for high speed data or video as indicated in Table 2.3.2.2. Although there are a few examples of cable providing local circuits for toll interconnect, specifically to MCI, the primary applications for cable do not involve providing the local telephone exchange services of voice and voice-grade data.

Table 2.3.2.2
US Local Bypass Cable Activities

Multiple System Operator (MSO)	Location	Potential Homes	Active Date	System Type	Services	Distance (miles)	Users	Revenue Annual (000's)
Warner AMEX	Dallas Texas	82,000	Nov 84	440 MHz midsplit	INET data, video, Reuters 1.54 Mbs, private construction for corporate LAN	110	10	-
	Houston Texas	180,000	Mid 84	440 MHz midsplit	INET data, video, Reuters 1.54 Mbs, private construction for corporate LAN	230	-	-
	Cincinatti	126,000	Spring 1984	400 MHz midsplit	data	-	-	-
American Television Corp	Manhattan	188,000	1976	330 MHz midsplit	low/high speed data, Reuters	35	Wall street	1,200
	Austin Texas	99,000	Sept 84	420 MHz midsplit	data, video conferencing	150	10	-
	Kansas City Mo.	59,000	Early 1983	400 MHz midsplit	data, video	-	18 hospitals	-
Storer	Browerd County Florida	69,000	Early 1984	400 MHz midsplit	MCI interconnect and data	15	10	48
	Anaheim California	-	Early 1984	330 MHz midsplit	MCI interconnect	10	5 motels	24
	Washington County Oregon	32,000	Mid 84	400 MHz midsplit	data	110	10 govt agencies	-
Colony Cable Vision	Lowell Mass.	N/A	Late 1983	420 MHz midsplit	dedicated plant T1 service	26	Wang Lab	120 - 180
	White Plains NY	N/A	Early 1984	420 MHz midsplit	dedicated T1 plant	-	IBM	-
Cox Cable	Omaha Nebraska	-	Late 1982	400 MHz midsplit	data, voice, video MCI Interconnect	200	40	500
Rogers	Portland Oregon	180,000	1982	400 MHz midsplit	data, teleconference, T1 service	1600	20	100

Note - although, the revenues quoted give no indication as to the profitability fo these bypass ventures, it is generally true that dedicated plant facilities are quite profitable. Also, bypass applications over 100 miles were most likely constructed because of franchise commitments and therefore most of the costs are sunk costs. Excluding these plant costs, revenues are in excess of the incremental costs.

Impact of U.S. Bypass on Canada

Traditionally, technological development and its implementation between Canada and U.S. have been closely tied together, especially in the communications field where standard compatibility is of upmost importance to ensure efficiency and cost effectiveness.

Although, a breakup similar to AT&T and its operating systems is not expected in Canada, the possibility of bypass and the opportunities that can be derived to impact the economy cannot be ignored nor overlooked.

The advantage of making more efficient and cost effective communications means available to business and major communication users through bypass will be closely monitored by potential clients and operators. To remain competitive with U.S. counterparts, Canadian companies would likely lobby for a similarly expanded use of bypass technologies in Canada.

Given the favourable regulatory climate, cable could become one of the major proponents in the provision of wider use of bypass technologies.

Canadian Example of Bypass

In comparison to the U.S., cable bypass development in Canada is much less active. The main reason is because of the older cable plants in Canada, which for the most part are over 10 years old when two-way bypass technology hardly existed. The cost to upgrade these plants to two-way will be very high unless special funding is available.

An example of one kind of bypass in Canada is a traffic light control project in London, Ontario, which could be economically undertaken because London, has one of the most modern cable systems in Canada, having only been upgraded to two-way compatible in the past two years. Since a large portion of the 1,100 km plant was already two-way upgraded affecting some 80 trunk and 136 bridger locations, the total cost of this project was approximately $300,000 of which the city paid all the terminal installation costs while the cable company absorbed the $67,000 plant upgrade cost.

Cable was favoured over the other bidding competitors (including the telephone company) because of the significantly lower operating cost to the city.

In many other Canadian locations, cable would have proved much less favourable because of the high costs associated with two-way upgrading. Despite the CRTC's Public Announcement of 1978 in which they give assurance of prompt and favourable application to "non-programming" categories, cable companies have not aggressively pursued bypass activites in Canada. This situation is not expected to change until two-way upgrade costs in Canada are less prohibitive.

Other examples of Cable bypass in Canada are included in Attachment 3.

Canadian Trend Projection

Cable Television in Canada is traditionally viewed as an entertainment service provider. From a marketing standpoint, data service via cable is rather unconventional and will likely be viewed with skepticism. To overcome this image problem, cable operators must demonstrate their commitment to service support and performance reliability. It must be shown to the potential customers that there exists distinct economical advantages for the use of cable. Based on current technology and service history in the U.S. thus far, cable can and is providing reliable and economical data transmission services. Generally speaking, without the burden of two-way upgrade costs, the amount of revenue derived can provide an attractive payback period to cover the initial investment in headend and terminal equipment. However, in Canada the cost of two-upgrade is still prohibitively expensive in most cases and will therefore limit the extent of bypass until a means to reduce these costs has been achieved.

2.3.1.3 Advantage of CATV Bypass

Cable is within reach of 80% of the households in Canada. Once these networks are two-way upgraded, a broad range of non-entertainment communications services can be made available to a large majority of the Canadian population. Cable bypass is expected to be very real and feasible in the longer term and would offer many advantages. For example:

Coverage Area: Because of the high saturation, cable services are virtually available to all residential areas except some distant rural communities where costs of cable construction are still prohibitively high. With few exceptions, cable bypass can be made available to all potential users.

Service Availability: Because of the large bandwidth available in co-axial cable and the relative ease of expanding its channel capacity once it's two-way capable, cable can offer services to potential users with short lead times. In many cases, the lead time is dependent on modem delivery and installation approval, which in a case of an office building installation may require owners consent; architect's approval and a city permit for construction.

High System Performance: Given a properly maintained cable system, cable can offer superior system performance in terms of speed/error and rate/reliability. Automatic monitoring systems also mean more dependable service. With state-of-the-art technology, the entire cable plant can be monitored continuously, with an early warning system, in such a way that a potential equipment failure can be detected thus averting a catastrophical failure. Even during a major system failure, the fault location(s) and its condition can be quickly pin-pointed for minimum repair time. With these approaches, reliability (uptime) of over 99.9% can be achieved with virtually error free transmission.

Competitive Rate Structure: Because of the sunk cost of existing cable plant, service extension to new customers usually requires modems, drop installation, and moderate plant upgrade (except for those in plant extremities or initial customers). Since two-way upgrade costs are a one time charge, once upgraded, any point along the upgraded plant may be used to provide interactive services with very little incremental cost. Thus, service provision, following two-way upgrade is in most cases, insensitive to users location in relation to the headend. Service rates, can therefore be structured independant of distance but related to number of terminals, data speed (bandwidth) and time of usage. In Canada, where two-way upgrade costs are still prohibitively high, a competitive rate structure would be difficult to achieve at this time.

As cable is less active in data communications service provision in Canada, the cable industry is likely to be perceived as a new and inexperienced data communications service provider. To overcome this potential image barrier, the cable operators must demonstrate their ability to; a) understand user's needs and growth requirements; b) provide a reliable and dependable transmission medium for the users; c) provide service support capability satisfactory to the potential users, and most importantly; d) create an image as a performer and a money saver for the potential users.

2.3.1.4 Estimated Extent of Bypass

The high plant saturation in Canada provides cable operators a solid market base for new and innovative services especially in the interactive data communications area. Although plant two-way upgrade costs would be a barrier to introducing these new interactive services, the trend is towards declining upgrade costs with improved technology. The newer generation amplifiers are not only two-way ready, they also provide far superior distortion performance with extended forward bandwidth for additional growth capability. Also, various enhancement features such as station bypass, redundancy, status monitoring, etc., all add valuable improvements in system reliability and time required to troubleshoot system faults. In this sense, the marginal costs for two-way upgrade would be considerably less and therefore would provide a better economic incentive to introduce interactive services.

In addition, the price of terminal hardware is also declining, partly due to more developed technologies and competition among suppliers. Until such time as the modem costs drop to the consumer level ($200 - $300) allowing consumer ownership, the near term cable bypass is expected within the business and institutional applications.

Target Areas

As shown in Section 2.3.2.1, two-way upgrading costs are quite considerable at this time ranging from $800 - $6000 per km. Assuming a three year payback, without accounting for the cost of money, monthly revenue per km required to offset plant costs would be $22 to $167. Modem and headend costs would add another $30 - $100 depending on the data rate. It is quite evident that such a high monthly rate could only be supported by business clients, whose monthly communication costs are in the same order of magnitude or higher.

Furthermore, by targeting to business clients, plant upgrade costs would likely be more controllable as a much smaller plant area would need to be upgraded, thus further reducing up front capital costs. Once the plant upgrade costs have been absorbed, it becomes more economically feasible to extend these services to other potential users including residential.

The potential market would likely be intracity point-to-point, point-to-multiple interconnections for various speeds of data communications. Through packet switching networks (dataroute, Infoswitch) that are already in place, interconnection between cities in Canada and U.S. can readily be implemented.

Target Customers

The profile of initial customers for cable bypass are major companies who handle or process a huge number of transaction (i.e. banks) or who have a daily requirement of moving or assembling a large number of records or files (i.e. daily news papers). Financial centres in major cities (Vancouver, Toronto, Montreal) offer the greatest potential for the start up of an aggressive cable bypass network as the volume of data communications and their associated budgets are among the highest.

Hospitals who have a need for interconnection to share resources, databanks, and training facilities, are also potential users of such a new technology.

Finally, other special group users including data processing centres, stock brokers, and database providers, all fit the profile described.

The technology for cable bypass is proven and ready. The market place is also ready and is anxious to have a more economical means available for efficient data transmission. As noted earlier, the costs associated with two-way upgrade are already on the decline. Therefore, in Canada, cable bypass, although not expected to have any significant impact in the short term could prove a viable alternative to the local exchange network in the longer term.

2.3.2 Cellular Networks

Cellular systems will establish a local telecommunication infrastructure similar to that already provided by the local telephone company. As discussed earlier, in a cellular system, mobile telephone users communicate via UHF radio to a cell site. Each cell site is connected to the cellular operators switch. There are a number of ways to interconnect cell sites to cellular switches. The two most likely alternatives are to use microwave or to lease lines from the telephone company. As demonstrated earlier, microwave can be much more economical than leasing lines.

We do not consider the use of cellular for mobile applications as local bypass. Nor do we consider the use of portable cellular radios to be important in the context of local bypass, particularly, when one considers the costs of these units and services. However, the potential development of a cellular network into a competitive fixed network could have some impact on the local exchange network and is considered below.

The fixed investment in a cellular network is very high, however, once the network is in place, expanding this network to handle fixed applications can be done relatively cheaply. It could be economically advantageous for a cellular operator to adapt the cellular network to fixed applications. In the following examples, we suggest some of the ways that a cellular network may be used for fixed applications, which could be considered local bypass. Constraining factors such as regulations are not considered at this time.

In this first example, a business has a large volume of traffic with its subsidiary in a distant city. The fixed portion of the cellular network could provide the end to end facilities needed to bypass the local and toll network. Bypass could be accomplished by connecting the business subscriber to the cell site through the use of wireline facilities (these facilities could be rented from the telephone company, another carrier or a third party) or connection could be provided by extending the cellular microwave system. Although equipment at the cellsite is currently designed to receive UHF radio, it could be modified to receive other forms of transmission. If the cellsite were located in the same building as the business, then interconnection to the cellsite is that much simpler and would require no

leased facilities. Once the business is interconnected to the cellsite, bypass is accomplished by routing the call from the cellsite to the cellular switch, ie over microwave links, from this cellular switch to the distant cellular switch and then to the distant cellsite and to the end user. This concept could be extended to include all businesses from a particular location or building.

The second example is a modification of the first in which residential customers are offered an alternative to local distribution. Should rates be rebalanced, residential customers will likely face the largest rate increases ever and would therefore have a strong incentive to bypass the local network. Traffic from new subdivisions or new apartment complexes in particular, could be routed over the cellular network to the local telephone network. Costs savings are achieved by concentrating the traffic of these apartment complexes or subdivisions prior to interconnection to the telephone network. Thus, customers are individually connected via wireline to the cellsite. The cellsite is interconnected to the cellular switch, via wireline or microwave links and the cellular switch is then interconnected to a central office of the local telephone company.

A cellular network could also be used to provide local dedicated facilities or an alternative to telco private leased facilities, as this next example demonstrates. As before, the subscriber could be connected either by wireline or by microwave to the closest cellsite. The terminating end is also connected in a similar manner to the cellsite closest to it. A dedicated channel or facility is provided to the subscriber between the originating and terminating end over the cellular network. This facility would be two way and of comparable quality to that provided by the telephone company.

We have suggested that once the cellular network is in place, there is no technical reason why it could not be readily adapted to fixed applications that bypass the local telephone network, at least in part.

2.3.3 Other Major Carriers

CNCP Telecommunications

CNCP has been a major provider of telecommunications services in Canada, particularly in the competitive private line voice and data communication services. There can be no doubt that this competition has had a positive effect through new and more rapid implementation of service offerings, reduced prices and an improved response to user needs.

CNCP has been restricted from offering local or long distance voice communication, which has traditionally been provided exclusively by the telephone companies, with the exception of private line voice. At present, CNCP has an application before the CRTC, for the interchange of traffic with the public switched telephone networks. This application is primarily designed to allow CNCP to offer long distance public telephone service to both residential and business users who have access to Bell Canada's or BC Tel's local public telephone networks.

It is clear from CNCP's application, that the offering of long distance voice services is their initial prime interest. As noted in their application, CNCP recognizes the subsidy of long distance revenues to local networks and under the guidelines of the CRTC, are willing to ensure a proportionately similar subsidy through payments to the telephone companies. According to CNCP, their involvement in the provisioning of long distance public telephone service, will in no way impact the local networks, particularly in regard to subscriber rates. They further state in their application, that:

> "While technology such as cellular radio technology is making alternative local distribution systems possible, it is likely that any broadly based local distribution systems will for some time to come remain the traditional, switched, copper wire pair systems (no doubt vastly improved) that are operated by the telephone companies. As noted by the Commission at page 199 of Telecom Decision CRTC 79-11, such systems are a monopoly of the telephone companies:

`At the same time, as indicated in Part VI the evidence has demonstrated to the Commission's satisfaction that the local exchange facilities of the public switched telephone network can be considered a "natural" or "logical" monopoly for a number of legal, economic, and environmental reasons.'

In view of the existence of a monopoly on broadly based local distribution systems, competition in long distance public telephone service is dependent upon the interchange of traffic between such local systems and competing long distance systems."

It may seem that CNCP's application has little bearing on this study of local telecommunication networks, and bypass. However, it is our opinion, that the outcome of the CNCP application, could have a considerable impact on existing local distribution systems.

Assuming application approval, implementation of the traffic interchange decision, will require careful and diligent consideration. In other sections, we will attempt to quantify the impact of local network bypass as a result of long distance competition approval. For now, we will simply describe its potential impacts.

CNCP have stated their willingness to pay for local facilities and to reimburse the telephone companies for possible subsidy losses as a result of lost long distance revenues. However, it is possible that these payments may provide sufficient incentive to CNCP to find alternative interconnect arrangements and avoid such subsidies. This would be analogous to the US, where long distance competitors, particularly AT&T, have threatened to bypass the local network in order to avoid toll subsidy payments. CNCP in their CRTC application have stated that direct circuits would be provided from a customer location to a CNCP switch where applicable. This suggests that further local bypass could result from toll competition.

3.0 LOCAL NETWORK BYPASS IN THE U.S.

3.1 Background

3.1.1 Historical Update

Over 15 years ago, when Carter Electronics challenged the anti-competitive tarriffs of AT&T with an antitrust lawsuit and won the right to interconnect customer-provided equipment, the stage was set for continuing challenges to the monopoly rights of telephone companies. The "Carter Decision" is significant for two major reasons; it was the first real step towards competition, ultimately leading to the whole issue of bypass and it "made possible a number of new technologies and long distance services."(8) Considerable developments have taken place in the U.S. telecommunication industry since this time but the issues of bypass, competition, new technology and service development and the universality of telephone service have never been more seriously questioned than they are today, particulary by the FCC and in light of their access charge decision and its far reaching consequences.

In December 1982, the FCC announced its decision to develop a system of access charges that would replace the existing method of recovering a share of local fixed charges from long distance revenues. Because of the response to its initial decision and subsequent modifications, the latest decision by the FCC, issued on January 19, 1984 was to postpone until June 1985, access charges for residential and single line business customers. Further, as of December 1984, the FCC adopted the access charge recommendations of the federal/state joint board which allow implementing a $1.00 per month subscriber line charge for residential and single line business customers effective June 1985, and increasing this to $2.00 per month in June 1986, where it will be frozen. Access charges for multi-line business customers would begin in April 1984, with most paying $6.00 per line per month. Long distance carriers would pay a charge of several cents per minute on long distance calls. In addition, a $25 charge would be levied on private facilities which do not now make any contribution towards local fixed costs. The rationale being that the switched network provides backup to private networks in overflow conditions.

Ultimately, subscribers would pay access charges in the form of fixed monthly fees to cover the bulk of fixed local costs, while long distance carriers would pay access charges based on the volume of interstate traffic originated or terminated through the local company to compensate mainly for traffic sensitive costs.

The access charge proposed by the FCC is only one source for local telephone rate increases. Other reasons for increased rates include revised depreciation practices, current expensing of some of the costs that were previously capitalized (such as installation costs), and increased rates of return. Further, the access charge decision has occurred at a time when the telephone industry is undergoing considerable change due to:

- deregulation of customer premise equipment and inside wiring
- toll competition
- new technology development and related economic benefits to large telecommunication users
- divestiture of the Bell Operating Companies (BOC) from AT&T following the "Modified Final Judgement" of the US federal district court

The major concern is that access charges, together with other telephone rate increases, will affect the universality of telephone service. On the other hand, the purpose behind the new access charges was to reduce the incentive for large telecommunications users to bypass the networks of the local telephone companies. It was believed that the existing system of toll support would lead to sufficient bypass by large users resulting in lost revenue that would increase rates for the remaining subscribers to the point where the universality of telephone service would be affected. As noted by Johnson, "Historically the industry was viewed as a natural monopoly. It was upon this monopoly foundation that the goal of universal service was established. To support the concept, pricing policies were based on the value of service, rather than the cost."(9)

Thus, the issues of bypass and access charges are closely related. The issue has become even more complicated with the divestiture of AT&T operating companies. Since AT&T currently provides about 95% of the toll service in the U.S., the toll support paid by AT&T may be incentive enough for them to bypass the local telephone companies in favour of direct connection to the customer premise. Bypass by either the toll carrier or large telecommunication users is a major concern to local telephone companies.

Currently, about 26 percent (national average), of fixed subscriber plant costs are recovered from interstate toll call revenue. A significant portion is also recovered through intrastate toll schedules on MTS and WATS services. While 26% is a national average, there are some small telephone companies that recover a considerably larger proportion of their fixed costs. By 1990, all local telephone companies will recover most of their fixed costs from their local subscribers rather than from revenues derived from long distance calls. With the current decision of fixing access charges for residential and single line business customers at $2.00 monthly, some telephone companies may have to further increase local rates to make up for lost toll subsidies.

To understand the issues underlying toll subsidy of local rates, it is necessary to understand the development of toll contributions. When local telephone companies began interconnecting to provide long distance service, it became necessary for two or more companies to share the revenues derived from long distance services. A system evolved to handle the sharing of revenue and has come to be known as "separations and settlements". Costs are separated into interstate and intrastate. Interstate toll costs, including a return on investment, are recovered from a nationwide "pool" administered by AT&T. The percentage of subscriber plant costs assigned to interstate service is based on a procedure that weighs relative usage called the interstate "subscriber plant factor (SPF)". Based on this cost allocation process, the current situation arose in which toll calls were priced above their allocated costs, monthly subscriber charges were priced below their allocated costs with the degree of subsidization further dependent on geographic area.

Fixed subscriber plant costs consist of 3 major components; the local loop (connection from subscriber to local switching office), customer premises equipment, and inside wiring. The local loop is the largest component of the fixed subscriber costs. It consists primarily of copper wire which connects the subscriber to a local switching office. The technology employed in local loop construction has not changed substantially since the introduction of telephone service. For this reason, local loop costs continue to become an ever increasing proportion of total costs and particularly since technological developments have allowed cost reductions in switching and long distance transmission facilities.

The introduction of competitive long distance carriers necessitated a review of the toll support system. Competitive carriers would have a significant advantage if they were allowed to interconnect without making a contribution towards subscriber plant costs. It was decided that they would make a contribution, but less than that made by AT&T, to reflect the difference in quality of interconnect facilities and services. Currently, long distance carriers pay toll subsidy under an agreement known as ENFIA (Echange Network Facilities for Interstate Access) which was designed to reflect the difference in interconnect facilities provided to AT&T and Other Common Carriers (OCCs).

Interconnect facility differences include AT&T being provided "trunk side" connections designed for long distance service, while competitors are provided "line side" connections, designed for local service. In addition, while AT&T customers dial 10 or 11 digits to make long distance calls, competitors customers must dial 22 or 23 digits. Dial pulse phones can be used by AT&T customers, but only pulse signalling phones can be used by a competitors' customers. Finally, AT&T can provide accurate billing since automatic number identifications (ANI) and answer supervision are available to them. These operating differences between AT&T and its competitors will disappear as equal access arrangements are introduced throughout the US.

The threat of competition and the realization that services which are not cost based can be very attractive to competitors, led to the the FCCs decision to largely eliminate toll support of local fixed costs and to introduce subscriber access charges. Further, the threat of local bypass by large telecommunication users was another consideration leading to the access charge decision. According to the U.S. Congressional Budget Office, "The Commission reached its decision to replace the present system of sharing toll revenues for four reasons: efficiency, discrimination, bypass and universal service".(10)

The toll support system was considered inefficient because it discouraged toll usage and discriminated against those persons who made payments in excess of the cost of the local service provided. In addition, many large telecommunication users leased private lines which made no contribution towards local fixed costs. This meant, smaller users who could not economically justify private leased lines, paid a larger contribution to local fixed costs than very large telecommunications users. This too was considered discriminatory. Therefore, it was believed that subsidy would encourage the development of completely private systems or the use of private long distance facilities in conjunction with local plant provided by the local Telco, thus avoiding the long distance subsidy payment. Because these calls are carried over private facilities to a corporate switchboard and switched to local facilities, they are not identified as long distance calls and the subsidy payment is avoided. This has come to be known as the "leaky PBX problem". Finally, it was believed that extensive local bypass by large users could jeopardize the universality of telephone service. As stated by Boettinger, "...a desire for universal service, produced subsidized prices for the nation's home. But it requires high barriers to entry to be viable."(11)

Access charges will result in lower costs for subscribers who make a large number of long distance calls. In addition, access charges could differ significantly amongst local telephone companies since the fixed costs of providing local service varies with many factors, including technology used, accounting practices, and the size of the subscriber base. To partially offset this, the FCC's access charge rules will require long distance carriers to pay for traffic sensitive costs and to contribute revenue to a "Universal Service Fund" designed to assist local telephone companies with unusually high fixed costs. However, most of the subscriber plant costs currently allocated to interstate service will be recovered through direct subscriber charges. Had access charges completely replaced toll subsidy in 1982, the average monthly subscriber access charge would have been $5.00.(12) This means that some subscribers will also face local rate increases in addition to access charges, since on average the upper limit of the access charge is less than that required to replace toll subsidy.

This raises concerns over the impact of access charges, particularly on residential customers. The major concern being the universality of telephone service given the hardship additional charges could place on some subscribers. Although studies indicate that demand is inelastic and few subscribers will discontinue service, this does not adequately address the hardship question nor the availability of telephone service at a reasonable cost.

In summary, a decision to return to cost based pricing, at least for the fixed local costs subsidized by interstate toll revenue, arose when it became apparent that toll competitors would have a significant advantage if toll subsidies were not levied against them. In addition, technological advances and regulatory changes made it possible for large telecommunications users to economically establish private networks and avoid the subsidies. Leased private networks were also proving more economical and these too made no contribution to fixed local costs. It is no wonder that large telecommunication users would seek cheaper communications since according to Schiller, "...they often comprise 2% to 4% of revenues - the second or third largest operating expense"(13). With the divestiture of AT&T into 22 BOCS, it was feared that AT&T as the predominant long line carrier, would also bypass the local network and avoid toll subsidies.

The major concern was that bypass would end the universality of telephone service. On the other hand, a return to cost based pricing could also affect the universality of telephone service and, at the least, would place a hardship on many subscribers, particularly low income customers. Thus, universality is argued on both sides of the issue and remains to be adequately resolved.

3.1.2 FCC Proceedings

On March 28, 1984, the FCC issued Public Notice No. 3206, "Request for Data, Information and Studies Pertaining to Bypass of the Public Switched Network". This public notice followed the FCCs decision to delay implementation of access charges for residential and single line business subscribers until June 1985 and it was hoped that the responses would assist the FCC in their review of the overall access charge decision.

Comments and studies were primarily received from major users such as utilities, corporate, governmental, educational and service organizations and from the BOCs or their representatives. The major users consistently argued that bypass was not a threat, while the BOCs argued that it was, with each side presenting studies supporting their basic argument.

Many of the arguments and studies presented, are largely dependent on the definitions of both bypass and competition, and the FCC will undoubtedly establish these prior to any further decisions.

Central to the issue of bypass is the issue of cost based pricing. In general, the telephone companies argue that subsidies and price averaging by keeping their long distance prices above costs, invite bypass and competition. Although the introduction of access charges to replace the interstate toll subsidies may discourage some bypass, there is still sufficient incongruency in pricing to make bypass and competition attractive. Thus, telephone companies, in general, advocate implementation of the access charges and more flexibility to allow pricing to be based on actual economic costs.

Major users, generally do not see bypass as a serious threat and show far more concern for the effect that FCC decisions may have on the development of new technology. In addition, they do not feel that private systems should be charged a subsidy to support local fixed costs and again, most often, the argument is that private systems are not truly bypass systems.

The major arguments from those that feel bypass is a threat can be summarized as follows:

1) bypass exists today and is growing

2) long distance demand creates a demand for local bypass facilities

3) the greatest bypass threat is from facilities that connect a customer location directly to an interexchange carriers' Point of Presence

4) a small percentage of large customers generate a high percentage of total revenues and bypass of these customers would have the most serious consequences. These customers are in the best position to bypass

5) studies have shown that customers identify costs as their primary bypass motive

6) bypass will encourage resale leading to even more bypass

7) customers lost to bypass will be difficult to recapture

The major arguments for those that feel bypass is not a threat can be summarized as follows:

1) bypass is often precluded as a choice because of diverse operations and decentralized management

2) the quality and availability of carrier facilities and services are the main reason for existing bypass

3) other than cost stability and certainty, cost is not the prime consideration in choosing bypass

4) the belief that a competitive marketplace will lead to lower costs for all users

5) economic health depends on all firms being able to maintain their market position and this is dependent on access to the most up to date and economical communication media and techniques

6) many systems have unique safety, control, security and reliabilty requirements that cannot be met by the local carrier and because of the critcal nature of the communication should be under the control of the user

7) the threat of bypass has made the Telcos more receptive to user needs and open competition can only improve the situation

8) while cost is not generally cited as the prime reason for bypass, it is generally accepted that bypass systems operate at significant savings

The consequences of bypass as seen by the local telephone companies is the impact to universality of service, with predictions of bypass and increased rates continueing, until the few subscribers left on the network could not afford to support it. While these are the gloomiest predictions, the general concensus is that local rates would increase much more substantially than the proposed FCC access charges if bypass is not at least curtailed. Therefore, recommendations to the FCC consist of implementation of proposed access charges, more flexible pricing, cost based pricing and the ability to compete in a fully competitive market.

Major users do not feel that bypass can have a very serious impact, particularly because it is limited and will remain as such. They advocate a more conservative approach be taken by the FCC, with no drastic policy changes. Most importantly, they want freedom of choice and do not want any restrictions to affect the development of new technologies and services.

The FCC must sort through the conflicting data, information and studies that it requested and somehow estimate the extent and impact of bypass on local networks. Thus, "The debate engulfing the industry now is how quickly these reforms should be phased in - and how far they should go."(14) Although the FCC has received considerable response to their Public Notice, it is clear that the voluminous response will not make it any easier to draw conclusions and make decisions regarding bypass.

3.1.3 Alternatives

There are two leglislative proposals in existence which could affect the access charge implementation and therefore bypass, and the FCC will also be making some important decisions regarding access and bypass independent of any legislation.

method note

Introduced in the past session of Congress were Bills H.R. 4102 and S. 1660. These two pieces of legislation serve to illustrate that many alternatives could be proposed to resolve the bypass issue and indeed, the FCCs many changes to the current access charge plan is further proof of this. What is not clear is the impact that each alternative will have, particularly in the long run.

Bill H.R. 4102 is primarily concerned with the economic hardship that higher access charges might impose and therefore suggests that access charges never be levied against residential or single line business subscribers. This means a toll subsidy would still be required and therefore the incentive for large telecommunication users to bypass would still exist. However, the bill further proposes that a fixed charge be levied against private facilities, on the basis that private facilities may leak traffic into the local network and that the local network provides backup facilities during overload conditions. Disadvantages of this proposal include monitoring and enforcing charges on private facilities, the possibility that charges set too low will cause bypass to grow leaving the remaining subscribers even worse off or that charges set too high would discourage competition and bypass to the extent that cost reductions and new developments will not be realized.(15)

Bill S. 1660 is primarily concerned with providing additional time before the final decisions concerning subscriber access charges are implemented. The Bill therefore proposes to delay the implementation of residential and single line business subscribers until Jan 1, 1986. The disadvantage of this proposal include it being seen merely as a decision postponement and therefore does not provide any useful signals to the market.

There are many other alternatives that could be chosen by the FCC and each would have their associated drawbacks and consequences. We feel that whatever the alternative chosen, a system must be in place that can quickly react to any adverse effects through the necessary modifications and adjustments.

3.1.4 Potential Impact in the U.S.

It is generally felt that the greatest threat of bypass will be from the establishment of direct connections between a long distance carriers Point of Presence and a customer premise for the specific purpose of avoiding usage based access charges. While many companies cannot economically establish a completely private system either because traffic is too low or too diverse, these same companies may find it economical to avoid usage charges and establish direct connections to a long distance carrier. This will depend on a number of factors including the access charge. The worst possible outcome is one where access charges induce bypass, which causes further increases in access charges and more bypass until prices are above what many customers can afford.

LOCAL BYPASS

To establish the likelihood of such a scenario, the FCC prepared a quantitative assessment of local exchange bypass.(16) The study was based on the fact that subscribers will bypass when the savings on usage charges pay for the fixed cost of private facilities. Two causes were taken into effect by the study. One being that rising access charges added to toll rates would reduce the demand for toll service and the other that rising access charges would induce more local bypass. The purpose of the study was to see if an equilibrium price exists where a particular access charge would not reduce toll demand or induce more bypass. The study concluded that the 1984 level of access charges was sufficient to induce the largest business customers to bypass the local network. Further, the revenue lost from these subscribers meant substantial increases in access charges which would lead to further decreased demand and more bypass. In the end, no equilibrium price could be found and the study concluded that all customers would find alternatives to switched access whether it be discontinued service, or some form of private or shared facility.

Several forms of bypass exist today and other ways of avoiding local charges are also being devised. For example, many large customers have established their own private facilities. Further, by means of the "leaky PBX" as previously described, subscribers using private lines leased from long distance carriers can avoid their share of the local costs .Larger customers will also have access to teleports, in which communications are sent over transmission links from a customer location directly to the teleport, and from there via satellite to another teleport or to a private satellite antenna. Teleports will handle sufficient long distance voice, data and video traffic to make this form of communication extremely economical for its users. (17) So much so, that even the local phone companies are considering joint venture deals with teleports. For example, Southwestern Bell says it will announce some sort of joint venture in 1984.(18) Teleports are just one example of shared facilities. Other possibilities include "smart buildings", a term which "refers to the shared use of telecom facilities and services in a building or group of buildings by tenants who are seperate business entities."(19) Long distance services can be resold to tenants by the real estate managers, since sufficient traffic would allow direct connections to be established, probably via satellite. As noted by Cooke, "The cost of using the Bell System's private lines and the growing threat of increased charges for local loops are making users more and more receptive to the idea of using a shared-transmission service."(20) info utility?

As the above examples illustrate, there does exist a number of alternatives for bypassing the local telephone network. Further, there appears to be sufficient incentive for some, particularly the largest telecommunication users to choose such alternatives. The quantitative analysis conducted on behalf of the FCC only viewed bypass from a cost saving perspective. As pointed out by many respondents to the FCCs Public Notice 3106, there are many other reasons why telecommunication users would choose alternative facilities, including the need for higher quality and more reliable services to be provided on a more timely basis. Had the FCC study also considered these factors, the results could still not have been more pessimistic. Yet the FCC study is only one of many conflicting studies which have tried to analyze the impact of competition in an industry that has long existed as a monopoly.

The question still remains as to the ultimate impact of local bypass in the U.S. The FCC quantitative analysis suggests that ,"the current revenue requirements from usage charges will cause the switched network to unravel in a cycle of increased access charges, increased bypass and decreased demand, increased access charges, and so forth with no stopping point." (21) On the other hand, others suggest competition is desirable for the sake of tehnological innovation. As noted by Jasper, "AT&T did not pioneer, but did later offer, services first made available by others,including high-speed data transmission and packet switching. Competitors and private communication systems have taken the lead in bringing microwave, satellite and computer technology into domestic telecommunications."(22) Others believe that universal service is the right of every individual and should be protected even at the expense of economic efficiency. The only thing that is clear is that the impact of bypass has, is, and will be felt in the U.S. for a considerable time to come. How far reaching these effects will be, can only be determined by the decisions on access charges and bypass that have yet to be made and implemented. While we can make no predictions, we do feel that the system of checks and balances and the extensive review that is under way is the proper forum for dealing with these issues, and especially when considering their potential consequences.

3.2 Impact on Canada

3.2.1 Comparison of Canadian and U.S. Telecommunication Environment

In the U.S., toll competition has been allowed since MCI first entered the long distance market in 1975 with its Execunet service. At that time MCI was only paying local business line rates for its' interconnecting facilities. Once the decision was made to allow toll competition , the question of cost based pricing and subsidies was raised. Since toll revenues subsidize local fixed costs, it was realized that if a long distance competitor did not contribute to this subsidy, they would have an unfair competitive advantage. It was therefore determined that long distance competitors would contribute to the subsidy. The size of the contribution also created quite a debate since other common carriers (OCCs) received interconnection of an inferior quality to AT&T. In 1978, an agreement was reached which set the contribution to be paid by the OCCs. This agreement still exists today and because of the inferior facilities offered, the OCCs pay a contribution considerably less than AT&T.

Even with competition, it is still estimated that AT&T controls approximately 95% of the long distance market. Therefore, it was not until Jan. 1, 1984, with the divestiture of AT&T, that local bypass by long distance carriers became a serious threat to the remaining 22 local operating companies. According to a 1983 FCC study, "There is little doubt, however, that AT&T has the capabilities and the resources to bypass local telephone plants on a widespread basis."(23) This threat was also the result of pricing policies and subsidies associated with local and long distance services.

During the same time period, great concern was raised over the construction and leasing of private facilities , particularly by large telecommunication users. As previously noted, neither local leased or private facilities made any contribution to local fixed costs and even users with long distance private facilities were finding ways to avoid paying any share of local costs. Again, outdated pricing policies were largely blamed.

It became clear to the FCC that something had to be done regarding pricing practices that were established under a monopoly regime and were ill suited for a competitve environment. Thus, the FCC in Dec 1982, announced its decision to implement access charges and the first changes were implemented in April 1984. There is still great debate over the access charge decision and bypass.

In contrast to the U.S., Canada has just completed a lengthy CRTC hearing to review long distance competition. The CRTC hearing will affect the telephone companies over which the CRTC has federal jurisdiction. These consist of Bell Canada, B.C. Tel, Terra Nova Tel and Northwest Tel. The remaining telephone companies are under provincial jurisdiction. Like the U.S., Canada established monopoly pricing policies with regard to local and long distance service. In the Telcos view, long distance revenues subsidize local fixed costs, allowing local monthly rates to be held below cost. While the major long distance contender has offered to pay equivalent subsidies, this has not allayed the fears of the telephone companies that competitors will bypass the network and avoid the subsidy. Thus the issue of rate rebalancing has also been raised. In its submission to the CRTC on Interexchange Competition, Bell listed the following reasons for cost based pricing: "the change in Canadian opinions and attitudes, technological development and bypass, and consumer choice".(24)

There is no doubt that the potential for local bypass could exist if long distance competition is allowed. However, the extent or seriousness of this bypass has yet to be quantified. Also, like the U.S., the use of private facilities is receiving much greater attention. The cost of local private facilities based on Bell(CRTC)22May84-303 IC Supplemental Attachment, suggests that in Bell's view rates are generally below cost and therefore make no contribution to the local fixed network (Bell(CRTC)22May84-303 IC), "since rates for local channels are generally below cost...", further Bell provides a sample of these local channels, including Class A, B and C Signal Channels, Sub-Voice Grade

Channels and Voice Grade Channels). Further, technologies such as radio in particular, could make it easier to establish privately owned facilities subject to spectrum availability and radio licensing policies. These facilities could result in lost revenue subsidies and create upward pressure on local rates.

3.2.2 Potential Impact of U.S. Bypass on Canada

It is unlikely that anything comparable to the divestiture of AT&T will occur in Canada. Telephone companies will continue to provide both local and long distance services. Thus a comparable threat of long distance carrier bypass does not exist in Canada unless competitors gain a considerable share of the market. There is no way such a prediction can be made at this early stage. However, it is likely that the facilities offered by competitors will at least be comparable in the sense of equal access to those offered by the major telephone companies so that competition if allowed, will at least begin on an equal footing. Thus the Canadian situation is not totally comparable to the U.S. However, the U.S. long distance competitors will also be receiving comparable facilities to AT&T by late 1986 and in spite of this, it is still predicted that AT&T will retain over 90% of the market.

Recent Canadian policy decisions such as liberalized earth station ownership as reflected in the Minister of Communication's announcement of April 10, 1984 will have a direct bearing on the use of private facilities particularly by large users as would the licencing of private microwave systems. However, as in the U.S., there are many conflicting views regarding the impact of private facilities on the local network.

Canadian telecommunication policies have tended to follow those of the U.S. in the past with similar consequences. The greatest impact that differing policies could have in regard to competition, rate rebalancing and licencing of private networks, would probably be in the area of technological innovation and development. Canada has long been a forerunner in the development of new telecommunication technology and care should be excercised that policy and regulatory decisions do not compromise Canada's position in this important area.

4.0 LOCAL PRIVATE NETWORK BYPASS IN BELL CANADA TERRITORY

As discussed in the methodolgy, it was decided to assess the impact of local bypass in Bell Canada territory under four seperate scenarios, in order to take into account the uncertainty that exists in the telecommunication environment, particularly in light of the pending regulatory decisions on interexchange competition and rate rebalancing. While there are many possible outcomes to the current proceedings and many possible operating scenarios under which local bypass may be assessed, we have chosen four that we feel provide a framework to allow further analysis once the outcome of the regulatory proceedings are known.

4.1 Toll Competition With Toll Subsidy

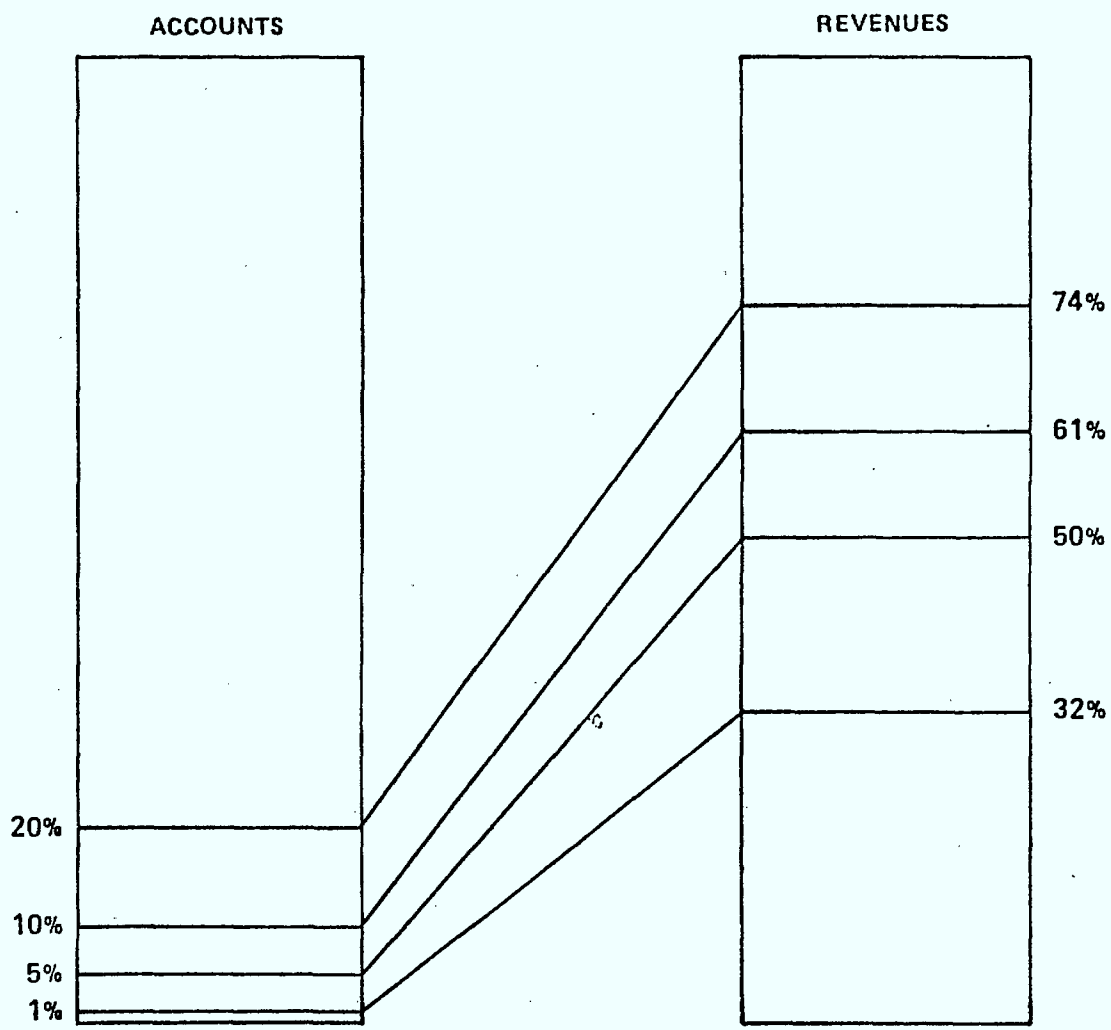
Under this scenario we have assumed that toll competition is permitted and nonrestrictive as to potential entrants. Toll competitors will either be resellers, in which case facilities are leased from the Telcos and services resold or these toll competitors will have established privately owned facilities. In either case the competitor still requires access to the local telephone network for call completion unless facilities are established on an end to end basis. Without these end to end facilities, we assume that in the absence of rate rebalancing, toll competitors will pay a subsidy to the local telephone company of the same magnitude as Bell claims exists today. Based on Bell Canada's 5-Way Split Study, Bell's toll subsidy for 1983 was in the order of $0.62/$1.00 of toll revenue.* Although, competitive pricing could increase toll volumes and therefore toll revenues which might impact the subsidy, we have not considered this.

Assuming competitors are required to pay a substantial percentage of their toll revenues to subsidize local costs, it will be prohibitive for many competitors, particulary resellers, to enter the long distance market. Comparing this to the current US situation, long distance operators pay access charges to the local operating companies, however, because of differences in the quality of access,

*As noted earlier, Bell's 5-Way Split Study has received considerable criticism and the whole question of cost allocations, which have resulted in Bell's toll subsidy claims, has yet to be resolved.

CHART 4.1

BELL CANADA PERCENTAGE DISTRIBUTION OF CUSTOMER ACCOUNTS TO BUSINESS & RESIDENCE MESSAGE TOLL SERVICE REVENUES



competitors to AT&T pay substantially less. Under current debate, is whether AT&T competitors can maintain their presence once equal access is introduced. That is, without the price differential that currently exists, it may not be economically feasible for AT&T competitors to remain in the long distance market. With the requirement for a substantial toll subsidy, the same situation is projected for Canada.

Given the above, we therefore expect minimal toll competition. Further, for the toll competitors that did exist, there would be a strong incentive to avoid local subsidy payments. Avoiding subsidy payments is only feasible where it is possible to establish private local facilities that directly connect the customer to the toll competitors network, thereby bypassing the local network. CRTC Decision 79-11 already permits this type of interconnection, however, we feel that a decision in favor of toll competition would further stimulate this type of activity. Toll competitors, by establishing private local facilities to their toll network, would avoid the subsidy, which in Bell's view amounted to $1.24 billion in 1983 or 62% of the $1.99 billion toll revenue. The impact on local subscriber rates will depend on how much of this subsidy is lost not to toll competition but only to toll competition which also includes local bypass.

Although we attempted to obtain data on the toll revenue distribution of large users and their relative geographic location from Bell Canada, we were unsuccessful since this information is confidential. However, Bell did submit the percentage distribution of customer accounts to business and residence message toll service revenues as part of its response to Interrogatory Bell(CRTC)22May84-202 IC. This is included as Chart 4.1 and indicates that 74% of message toll revenues are derived from 20% of the business and residence accounts.

These 20% of accounts would likely be the prime targets for toll competitors to establish dedicated facilities to the customer premise. However, to economically establish private lines to the toll facilities requires a sufficient volume of calling. Unlike the US, Canada does not have the volume of traffic that might result in the establishment of many of these facilities such as Teleports. (ie compare the 1983 US $ 40 billion toll revenues with Canada's $ 4 billion). Canada because of its distribution of population centres has a single traffic corridor, east to west, and primarily concentrated between Quebec-Windsor and Vancouver/Victoria (CRTC jurisdiction), compared to the US

with its several dense traffic corridors. Further the logistics associated with establishing private facilities would prevent many competitors from doing so. First, there are right of way restrictions associated with wireline facilities and licensing difficulties due to the congested spectrum in major urban centres associated with nonwireline facilities.

Therefore, it is our opinion that given the assumptions as outlined above, namely, minimal toll competition and minimal opportunity for those toll competitors that did exist to economically establish private facilities from their toll network to a customer's premise, that minimal local bypass will occur as a result of toll competition. To quantify this conclusion, and to investigate the potential impact on subscriber rates, we present the following analysis.

Lost Toll Revenue		Lost Toll Revenue From Bypass		Lost Toll Subsidy		Monthly Increase per Subscriber
%	$ millions	%	$ millions	%	$ millions	$
1	19.9	50	10.0	62	6.2	0.08
5	99.5	50	50.0	62	31.0	0.38
10	199.0	50	99.5	62	61.7	0.76
12	238.8	50	119.4	62	74.0	0.91
15	298.5	50	149.3	62	92.6	1.14

This analysis is based on Bell Canada's 5-way split study results for 1983. It assumes that the same level of toll revenue, $1.99 billion and the same subsidization level, ie $.62/1.00 of toll revenue. The estimate of the subscriber increase is based on equating the lost toll subsidy amount to Bell's estimate that a 150 million dollar decrease to this subsidization would result in monthly rate increases of $1.85 for all residence and business non-measured individual lines and trunks subscribers. (Bell(CRTC)22May84-303 IC, Supplemental, Rate Rebalance). In the analysis, we have chosen what we consider to be a worst case scenario, in which toll competitors will bypass the local network for 50% of the toll revenue they derive. Therefore, Bell would lose the toll subsidy associated with this revenue.

As the above figures indicate, even if Bell Canada were to lose 15% of its toll revenues and lost the subsidy for 50% of this revenue due to bypass, the impact on subscriber rates would be in the order of $1.00 . This impact is also based on acceptance of Bell's subsidy allocation. If in fact, the entire network access costs should not be allocated to the local network, the size of the subsidy is reduced and the impact on subscriber rates would be less. Even a worst case increase of $1.00 is less than that recently adopted by the FCC for residence and single line business subscribers who will pay a $1.00 access charge beginning in June 1985 and which will increase to $2.00 in June 1986. Further, our calculations are based on a totally static market which is not expected to be the case. In comparison to the U.S., AT&T in the last five years has only lost approximately 5 - 10% of its market share to competitors. Despite this, AT&T has seen growth in its long distance market, in the order of 4% per year. Thus, our figures represent a worst case scenario and given our assumptions, the impact on subscriber rates would probably be less.

4.2 Toll Competition and Rate Rebalancing (Flat Rate Local Service)

Under this scenario, we have assumed that toll competition will be allowed and rates will be rebalanced to align service prices with costs in accordance with Bell's view. The rates to be charged have been derived from Bell's submission to the CRTC on rate rebalancing, Bell(CRTC)22May84-303 IC. Although Bell's approach was based on "rate rebalancing with no further competition", for the purposes of this study these rates are used since they are indicative of the level of charges. Based on this scenario and these assumption, the most likely candidates for local bypass are those with a large number of local lines. These local lines could serve three purposes:

1) to access a toll competitors network,
2) to access the telco local/toll network
3) local private leased lines.

Bell's proposed five year cumulative overall increases to Primary Exchange Individual Service rates are between $11.60 and $20.20 per line, per month. These substantial rate increases will provide an incentive for local bypass for both residential and business subscribers. It should be noted that bypass cannot be total since there will still be a requirement for connection to the local network and the ability to bypass will very much be dependent on traffic.

It is residential customers who's rates will increase the most. However, there will be some offset through reduced toll charges. At present, residential subscribers have the least potential for local bypass. At best, savings could be achieved through a sharing approach in which concentration of traffic could result in fewer local lines required. While this is not total bypass, it does deprive the telephone company of some local revenues. At todays rates, there are few complexes of a substantial enough size to make this approach cost effective. However, given the extent of the proposed rate increases this could be a viable alternative particularly for new buildings and even new residential subdivisions. (See Attachment 2, Local Network Bypass Case Study 3)

Businesses could also adopt a sharing approach through the implementation of "smart buildings". However, there are few buildings or complexes large enough to warrant this investment today. With the proposed rate increases, there could be a proliferation of "smart buildings", despite the fact that communication management will then be the responsibility of the building owners or managers.

Today many large businesses such as banks, hospitals, hotels, and retail chains etc. have a requirement for local private circuits and many of these circuits are leased from the local telco. With the proposed rate increases, these businesses will have an incentive to seek out more cost effective facilities through either telco competitors or by establishing a private network. The cable companies and Cantel are two examples of potential competitors. The cable companies have clearly demonstrated a desire to enter the interactive data communication area and Cantel will likely establish a private microwave network connecting their cell sites to their cellular switch. This microwave network could be further extended and capacity leased to meet the needs of various businesses.

Another incentive for businesses to bypass the local network is to access a toll network and to thereby avoid at least this much of the local facility costs. However, given the proposed decreases in toll rates, we believe there would be minimal competition and therefore less associated local bypass.

Based on Bell's fifth year projection, toll rates would decline by approximately 55% for calls below 100 miles and approximately 63% for calls beyond 100 miles. In addition, a further 25% discount for calls between selected cities would apply. These cities include Toronto, Montreal, Ottawa/Hull, Quebec, Hamilton, London, Kitchener/Waterloo and Windsor. Given the level of discount proposed and particularly between the major centres, it is unlikely that much toll competition would result. Certainly, resellers who purchase bulk facilities from Bell or some other carrier could not profitably offer long distance service, unless there was some other incentive such as a value added service to attract customers and for which additional charges could be levied. In the case of carriers who own existing private facilities, they could potentially enter the long distance market. At present, there are only three potential entrants in our view; CNCP, Cantel and the cable companies. CNCP has an incentive to provide total service to its customers. Cantel will have facilities established connecting major metropolitan centres and may want to utilize excess capacity through resale. The Cable companies are less likely candidates because of the prohibitively high costs of two-way upgrading. Despite these potential entrants, we believe that rate rebalancing as suggested by Bell would minimize toll competition and as such, provide little opportunity for associated local bypass in order to access a toll competitors network.

In conclusion, rate rebalancing will increase the incentive to bypass the local network through either sharing or the use of dedicated local facilities. However, the extent of this bypass, is not expected to have a substantial impact on the local network nor on the subscriber rates, particularly, since these rates would already have been substantially increased by Bell.

To quantify these conclusion we present the following analysis.

Lost Local Revenue		Monthly Bill and Increase per Subscriber ($)					
		Rate Gr.(*) 3		Rate Gr. 10		Rate Gr. 18	
%	$(millions)	Bill	Inc.	Bill	Inc.	Bill	Inc.
1	26.3	23.13	0.23	26.00	0.26	33.08	0.33
5	131.5	24.05	1.15	27.04	1.29	34.39	1.64
10	263.0	25.19	2.29	28.33	2.58	36.03	3.28

Note * - Rate groups are defined as per Bell Canada. Charges vary depending on the rate group to which a subscriber belongs.

This analysis is based on the Bell Canada 5-way split study results for 1983. It assumes that the same level of local revenue requirement, $2.63 billion. To estimate the subscriber increase, we used Bell's fifth year subscriber rate projections for various rate groups needed to generate 2.63 billion in revenue. (Bell(CRTC)22May84-303 IC, Supplemental, Rate Rebalance) We assumed that Bell's costs would remain at this level, but could not be recovered totally from these subscriber charges because of revenue lost through bypass. Once bypass has occurred the remaining subscribers must make up the shortfall in revenue resulting in higher rates.

As illustrated, in comparison to the increases as proposed by Bell Canada, further increases as a result of bypass are not substantial. Even at the 10% level of local bypass, which we consider to be a worst case scenario, monthly increase range from $2 to $3. Therefore, although we do expect rate rebalancing to stimulate local bypass, the impact on the end user and on the network in general cannot be considered severe.

Further, we should emphasize that in using Bell's data, particularly the local revenue requirements, we have chosen a worst case scenario, since the local revenue required is based on recovering costs including all network access costs. Changes in the cost allocation assumptions would result in a lower local revenue requirement and therefore lower subscriber charges. Thus the impact on subscriber rates would be less than that assumed above.

4.3 Toll Competition and Rate Rebalancing are Allowed (Local Measured Service)

In section 4.2, we discussed the potential outcome of allowing toll competition and rebalanced rates according to Bell's CRTC submission. In this submission, Bell proposed flat rate local service charges, however, suggestions have been made in the past and by Bell to implement local measured service. The following analysis refers only to the differnce LMS would have on the degree of local bypass.

Certainly, residential customers would not have the same incentive to bypass if local measured service were implemented instead of flat rate local service. As discussed previously, residential customers could in some cases arrange to share facilities, and while this is not total bypass, it does deprive the telephone company of some local revenues. However, sharing still involves averaged rates for all participating subscribers. With local measured service, the bulk of the subscribers bill is based on actual usage and for many subscribers sharing would be less advantageous.

Local measured service would also increase the complexity of implementing "smart buildings". As with residential customers, many business customers would probably prefer individual local measured service to a shared billing approach. Thus, to be acceptable to all tenants, "smart building" managers would probably have to incorporate the ability to measure local usage into their switch. Administration and billing would be more complex and costly. Thus, there would be less incentive for both building owners and business tenants to adopt a "smart building" approach.

Low volume business customers also would be less likely to seek out resellers if rates are based are local measured service, since these low volume customers could likely not realize any cost advantage.

The other plausible reason for business customers to bypass the local network would be to gain direct access to a long distance network. As discussed before the impact of rate rebalancing particularly as suggested by Bell Canada would be to substantially reduce any toll competition and therefore any bypass of the local network to access a competitors network would be minimal. Direct access to the telco long distance network would probably result in some form of interconnection fee comparable to the local measured service charges and therefore would not prove cost effective.

Thus, it is our opinion that local measured service as a result of rate rebalancing would probably serve to further reduce local bypass.

4.4 Maintain the Status Quo

This scenario assumes no toll competition and no rate rebalancing (We appreciate that the status quo could change substantially as a result of the current CRTC cost inquiry and there is the possibility that subsidies could be partially or totally eliminated.) Based on this scenario we see minimum local bypass occurring. First, Bell suggests that in many cases local private circuits are subsidized by toll revenues and are therefore priced below cost. (Bell(CRTC)22May84-303 IC, "since rates for local channels are generally below cost...", further Bell provides a sample of these local channels, including Class A, B and C signal Channels, Sub-Voice Grade Channels and Voice Grade Channels). Because of this, customers have little incentive to seek out alternatives such as resellers or the implementation of private networks. Also, local private networks are established on a point to point or point to multi point basis. In many cases there is insufficient volume to justify the establishment of a local private network.

Secondly, without toll competition, a major incentive to bypass the local network in order to access a competitors toll network thereby reducing local charges, no longer exists. The only subscribers then likely to bypass the local network under this scenario, are those who can afford to establish private toll networks. These networks, would be point to point or point to multipoint and this suggests a very large volume of traffic between any two points. As discussed earlier, unlike the US, Canada does not have the volume of traffic, particularly with its single east to west traffic corridor, that might result in the establishment of many of these facilities. Further the logistics associated with establishing point to point facilities would prevent many from doing so. Therefore, it is our opinion that maintaining the status quo would result in minimal local bypass.

5.0 LEGAL AND REGULATORY IMPLICATIONS OF BYPASS

There will undoubtedly be many legal and regulatory ramifications associated with local bypass in Canada. Before exploring the consequences of local bypass, the following is a review of the current regulatory and legal environment.

All federally chartered telephone companies are regulated by the Canadian Radio-Television and Telecommunications Commission. These consist of B.C. Tel in British Columbia, Bell Canada in Ontario, Quebec and part of the Northwest Territories, Terra Nova Telecommunications in Newfoundland and Northwest Tel in part of the Northwest Territories and Yukon. In the prairie provinces, all telephone companies, with the exception of `edmonton telephones' which is regulated by the City of Edmonton, are provincially regulated by their respective Boards of Public Utilities. This includes, Manitoba Telephone System, Saskatchewan Telecommunications and Alberta Government Telephones. With the exception of Terra Nova, all Atlantic Canada provincial telephone companies, which include Newfoundland Telephone, Maritime Telegraph and Telephone in Nova Scotia, New Brunswick Telephone Company and the Island Telephone Company in PEI, are regulated by their respective Provincial Utilities Boards. In addition, there are a number of smaller independent telephone companies, such as Thunder Bay Telecommunications, operating in Ontario and Quebec Telephone in Quebec that are regulated by the Ontario Telephone Service commission and the Regie Des Services Publiques respectively. Independent companies operating in limited access of other provinces are also regulated by provincial authorities.

Canada is unique in that its, "... telecommunication industry represents both federal and provincial incorporation of companies; private and public ownership; Canadian and foreign ownership; and finally, regulation by all three levels of government in our confederation - federal, provincial and municipal."(25)

With BC Tel and Bell Canada servicing over three quarters of the telephones in Canada, it is evident that the CRTC has the greatest influence over regulatory developments. Further it is the CRTC that is responsible for regulating national carriers such as CNCP Telecommunications and Telesat Canada.

The decisions and policies that will affect telecommunications in Canada have become more crucial and will have more far reaching effects than ever before . Since the 1970's, rapid technological innovations have resulted in integrated systems of data and voice, and it is these innovations that have precipitated a re-evaluation of the monopoly concept. Prior to 1970, a relatively stable technology existed, and it was in this environment that the telephone companies strove to provide universal service through value of service pricing. As a result, customers no matter where their location, came to expect service at a comparable price. Central to the issue of competition and bypass are the questions of universal service and pricing structures. As technology developed, the demand for customer choice, particularly from the business community, has grown, and it is the impact of this desire for choice creating competition, not only on the universal service aspect, but on Canada's economy in general, that must carefully be considered.

According to Bell Canada, the concept of universal service has resulted in cross - subsidies, in particular, from long distance service to local service support. In Bell's view, even the largest urban Canadian centres in Bell Canada territory are not self supporting in regard to local services, as evidenced by Bell's proposed local rate increases for all rate groups, included in their rate rebalancing submission. Therefore any policies that result in reduced toll support must inevitably result in higher local rates. However, this result may have less impact on the Canadian economy than inhibiting competition. Competition could lower long distance rates, allow consumer choice amongst suppliers and cause suppliers to introduce services at a faster pace. It is generally accepted that communications and economic growth are intricately related. As described by A. Lapointe (former Senior Assistant Deputy Minister in the Federal Department of Communications:

> "Under conditions of advanced industrialization, telecommunications can no longer be considered as simply one among a number of important industrial sectors; rather it must be seen as the nervous system of the entire economic order. Unless that system works extremely well, all the other parts will have difficulties coordinating their activity, with the resultant problems of duplication, wastage and inefficiency. In this sense, the telecommunications industry is a crucial component of the economic infrastructure: if it fails to perform adequately, all the rest of the economy suffers."(25)

Communication rates, particulary toll rates, are already lower in the US than those in Canada and there is every evidence that this differential will increase. Thus, U.S. businesses already have a cost advantage over their Canadian counterparts and rigid adherence to the status quo could result in foregone goods, jobs, investment, R&D, markets and exports for Canada.

In addressing the issue of regulatory reform in Canada, Dr. Pal, an Assistant Professor in the Political Science department of the University of Calgary, suggests that the major issues to be faced by the regulators concern autonomy, integrity and citizenry. He states:

> "...- the arguments for regulatory reform, particularly deregulation, make only a limited sort of sense. Typically, the arguments focus primarily on economic costs and benefits, while the state, as the state, must take into account its autonomy, integrity and citizenry. The telecommunications revolution threatens all three to the point of dissolution. It has the power of dissolving autonomy because control of data, culture and carriage services will reside elsewhere. It threatens to dissolve integrity because it ignores borders. It consequently can dissolve the citizenry as juridical entities through international homogenization, and by reducing their effective privacy and rights. No state, save the United States with its preponderant lead in the field, can contemplate these developments with equanimity."(26)

There is no doubt that Canadian telephone companies, as a result of cellular mobile telephone service, private ownership of transmit earth stations, interconnection of Radio Common Carriers and the possibility of private microwave systems, already face a competitive challenge. As stated by E.J Polanski, Chairman and Chief Executive Officer, QCTV Ltd., Edmonton:

> "Large scale stand-alone service applications are going to be made with increasing bypass alternatives. All kinds of bypass techniques will get around the carriers in the linkage business. Working against the carriers, additionally, there will be introduction into the marketplace of more competitive products and services."(27)

Further, Canada is likely to see greater policy debates as result of such decisions occuring in one regulatory jurisdiction and not in another. Although there have been few court challenges to the existing regulatory arrangements this could be changing. For example, there are two cases in particular currently before the courts;

1) AGT vs CRTC, CNCP et al, which concerns an application brought by AGT before the Federal Court to prohibit the CRTC from hearing CNCP's application for approval to interconnect its facilities with AGT in the same way that approval has already been granted by the CRTC for CNCP interconnection with Bell Canada and B.C. Telephone. CNCP took this initiative in the view that AGT was an interprovincial telecommunication undertaking subject to federal and not provincial jurisdiction.

2) 'edmonton telephones' vs AGT, which concerns an application brought by 'edmonton telephones' before the Alberta Superior Court for a declaration that AGT is an interprovincial undertaking and therefore not subject to regulation under certain sections of the Alberta Public Utilities Board Act.

These legal actions have important implications for telecommunication policy making and regulations, and there may be others of equal importance in the future.

Policy makers and regulators alike, face a very difficult and demanding challenge, in addressing the issues of deregulation, competition and bypass. Further the regulatory environment of Canada requires cooperation and communication amongst the various provincial and federal regulators if policies are to be uniformally applied across Canada. It seems certain that if the various regulators cannot reach some agreement, it will be left to the courts to decide and this could be very costly and time consuming. As stated by the Honourable B. Payne, Minister Without Portfolio, Government of Alberta, "... advances in technology, increasing demands by the users of communications services and competition have all combined to make the need for strong and careful policy development by government a matter of critical and urgent priority."(29)

6.0 Summary of Study Findings

Technical Considerations

In the early sections of the report, technologies applicable to local network bypass were reviewed. In this section we concluded that the technology was available and could be economically implemented. The most likely technologies to be implemented consist of: microwave
coaxial cable
fibre optics.

These technologies can be implemented on an end to end basis or on a network basis. Some of the more widely used applications of these technologies are in local area networks (involving the transfer of data among nodes within a network), teleports (a receiving and transmitting point for local or long distance communication) and digital termination systems (local packetized microwave radio system). In addition, there are two carriers who have or will have established fairly substantive local networks that could be adapted to provide services that would bypass the local telephone network. These are the cable and cellular carriers.

In Section 2.2.2, case studies were presented that demonstrated the economic viability of local bypass (See Appendix 2 for detailed cost analysis). These cases served to illustrate, that the technology is currently available to bypass and that this technology can, in many cases, be implemented at cost savings over comparable facilities that might be provided by Bell Canada.

Regulatory Considerations

At present, limited local network bypass occurs, with the exception of private leased facilities offered by the telephone companies. The CRTC and DOC, are considering the issue of local bypass in the overall context of increasing public pressures for competition in telecommunications.

The CRTC, however, are not the only regulators in Canada, and the question of their jurisdiction is currently before the courts. Telephone companies across Canada are regulated on either a federal, provincial or municipal level. This makes it very difficult to establish a policy that will be uniformally accepted and implemented across Canada. Without this uniformity, companies operating in more than one province find themselves having to adhere to different sets of rules.

End User Considerations

There are many disadvantages and advantages associated with local bypass from an end user perspective. Local bypass would allow subscribers a choice in their selection of facilities. This allows subscribers to select facilities that meet their specific requirements. The subscribers choice will usually be based on the cost of facilities, their reliability, implementation time, value added services, and restoral time in case of failure. When subscribers have alternatives to choose from they generally benefit through greater selection and earlier introduction of products and services. Businesses by selecting cost effective facilities that meet their requirements can improve efficiency and productivity. This leads to growth with its many spinoff benefits such as job creation, investment and export. Further, on an international basis, companies have a better chance to compete if their communication cost are more in line with those of their international competitors.

Also, when subscribers have a choice, manufacturers generally respond by creating new services and products. A case in point is the telephone set, in which few alternatives were available until subscribers were allowed to own their terminal set and to select the vendor. Therefore from the manufacturing point of view, the industry stands to gain from increased competition.

These advantages must be weighed against the disadvantages associated with local bypass. Since the local network has evolved in a monopoly environment, end users have come to expect reliable service at a reasonable cost. That is, the local network developed with the objective of achieving universal service. When local bypass occurs, some subscriber revenues are lost. However, the costs associated with providing and maintaining the local network do not change in the same proportion. The resulting shortfall in revenue must be acquired through other means, most likely higher subscriber charges. Increased charges threaten universal service.

End users have come to expect a fast response for service associated with their facilities. There is no guarantee that all bypass alternatives could be provided with the same level of service that has come to be associated with those provided by the telephone companies.

Telco Perspective

In quantifying the impact of local bypass on the local telephone network and subscriber rates, we have based the analysis on data associated with Bell Canada. This simplified approach was taken since Bell and B.C. Tel service over three quarters of the telephones in Canada, with Bell serving the highest ratio, and therefore the greatest impacts will result from bypass in Bell territory.

From Bell's perspective, local bypass is closely related to the issues of toll competition and rate rebalancing. Bell argues that local costs are subsidized through toll revenues, therefore, toll prices are much higher than required based on an acceptable rate of return. In Bell's view, this invites toll competition and depending on the local interconnection arrangements and costs, could also result in local bypass by the toll competitors. Therefore, Bell has proposed that rates be rebalanced such that local subscribers bear what Bell views the full cost of service to be. However, if rates are rebalanced in an across the board fashion, then certain local area users could end up subsidizing other local area users and this could also invite local bypass.

Bell feels that with rates closely associated to costs, investors and consumers would more likely behave in a manner which would promote new services and technologies. it is for these reasons that we have considered local bypass in light of toll competition and rate rebalancing.

Bell's allocation of costs to local and toll service has received considerable criticism from the CRTC (Decision 79-11 and the Report of the Inquiry Offices with Respect to the Inquiry into Telecommunications Carriers Costing and Accounting Procedures, Costing of Existing Services - 30 April/84), as well as other hearing participants including CNCP. The major criticism regards Bell's allocation of all access costs to the local network. This approach results in local costs exceeding revenues. The amount of toll revenue subsidization is entirely dependent on the allocation of these access costs.

Impact of Local Bypass in Bell Territory

In assessing the impact of bypass in Bell territory, four separate scenarios were considered in order to take into account the uncertainty that exists in the telecommunication environment, particularly in light of pending regulatory decisions on interexchange competition and rate rebalancing. The four scenarios are as follows:

1) Toll competition with toll subsidy
2) Toll competition and rate rebalancing (flat rate local service)
3) Toll competition and rate rebalancing (local measured service)
4) Maintain the status quo

Scenario 1 concluded that if toll competitors were required to subsidize the local network to the same extent that Bell claims it does today, they would have the greatest incentive to bypass the local network, but the extent of this local bypass would be very much limited. Given this, the potential impact on local subscribers was estimated based on the loss of toll subsidy that would result if toll competitors avoided this subsidy by providing private facilities between their toll network and a customer location. With lost toll revenues in the order of 1 to 15% and with 50% of the available subsidy lost due to local bypass, the impact to subscriber rates would vary from $0.08 to $1.14, respectively. We feel that lost toll revenues at the lower end of this scale i.e. a few percentage, is the most likely. Therefore, based on this scenario, bypass is minimal with little impact on local subscriber rates.

Scenario 2 concluded that the potential for local bypass would most likely occur as a result of local facility sharing or the use of dedicated local facilities, but the extent of this local bypass is expected to be minimal. Therefore, the impact on the local network or on subscriber rates is not expected to be substantial. The impact on subscriber rates would vary from a low of $0.23 to a high of $3.28, depending on the rate group, for local bypass ranging from 1 to 10%, respectively.

The impact on subscriber rates, in both Scenario 1 and 2, was based on Bell Canada data which, noted earlier, allocates all access costs to local network costs. This approach should be considered a worst case analysis. The impact on subscriber rates would be even less that that noted above if even some of these access costs were allocated to the toll network costs. The greater the allocation to toll costs, the less the impact is on local subscriber rates as a result of local network bypass.

Scenario 3 concluded that rate rebalancing implemented on a local measured service basis would result in minimal local bypass.

Scenario 4 concluded that there would be little incentive to bypass the local network if the status quo were maintained since local facilities including dedicated leased facilities are in many cases, according to Bell, subsidized through toll revenues.

In conclusion, we have no reason, **as of yet**, to believe that local bypass will be significant in Canada.

Recommendations

While it is our opinion that local bypass is minimal within the confines of this study, a more in-depth study should be made, taking into account specific information on subscriber costs and revenues which was unavailable for reasons of confidentiality. In addition, this in-depth study would have the benefit of knowing the outcome of the CRTC decision on rate rebalancing and interexchange competition and could therefore focus on the impact of local bypass given that market environment.

Further, a more in-depth study could review the impact of local bypass in all provinces. As discussed in the report, the regulatory environment is quite varied across Canada, as is the distribution and concentration of businesses. It would be useful to evaluate the impact of bypass, in each province from the point of view of the Telco, the business subscribers and the residential subscribers.

ATTACHMENT 1

LOCAL PRIVATE NETWORK BYPASS QUESTIONS

LOCAL PRIVATE NETWORK BYPASS QUESTIONS

The attached questions are based on the following study definitions and assumptions:

Classification of Subscribers

I. Residential subscriber.

II. Small business subscriber - generates less than $1,000/month in total telephone service revenues.

III. Medium business subscriber - generates between $1,000 to $10,000/month in total telephone service revenues.

IV. Large business subscriber - generates over $10,000/month in total telephone service revenues.

Definitions and Assumptions

1. POT service - includes residential phone service, business lines and trunk lines.

2. Local Special Services - includes all voice and voice grade data services requiring local dedicated facilities that are not switched at a Bell local exchange, i.e.
   - OPX
   - tie trunk
   - voice grade data channel

3. Interexchange service - any service that is provided across local exchange boundaries, i.e.
   - Message Toll
   - Watts
   - Others including
     - OPX
     - tie trunk
     - FX etc.

4. POT service is subsidized by Local Special Service Revenues and Interexchange Revenues:

Subscriber/Service

Residential	Small Business	Large Business
- POTS - Interexchange Services	- POTS - Local Special Services - Interexchange Services	- POTS - Local Special Services - Interexchange Services

5. Large business customers are most likely to take advantage of local bypass and as such will have the greatest impact on reducing their share of POT subsidy (see 4 above) and therefore will have the greatest impact on the proportionate potential increases to POT service charges.

6. Toll competition is allowed; however, access charges will compensate for any lost toll revenues used to subsidize POT service.

QUESTIONS

Please indicate any data that is confidential. This data will not be released and will only be used to assist us in drawing our study conclusions.

1. Are these assumptions reasonable, for the purposes of the study?

2. POTS total revenue requirements are provided from the serveral sources listed below. Please provide the appropriate breakdown:

POTS subscriber revenue	=	%
Subsidy from Local Special Service Revenue	=	%
Subsidy from Interexchange Revenue	=	%
Other _____	=	%
POTS TOTAL REVENUE	=	100 %

Please specify other.

3. Previously, we specified our classification of subscribers. We are interested in the percentage of local special service revenue generated by each class of subscriber. Please provide a percentage breakdown:

Classification of Customers		Percentage of Local Special Service Revenue Generated	
Residential		=	%
Small business		=	%
Medium business		=	%
Large business		=	%
	TOTAL	=	100 %

One of our study assumptions is that the majority of local special service revenue is generated by a small number of large customers. In looking for supportive data, we ask you to complete Table 4 which relates the percentage distribution of large customers to local special service revenues.

Example

1% of the large customers generate **10%** of the local special service revenues.
5% of the large customers generate **20%** of the local special service revenues.
20% of the large customers generate **50%** of the local special service revenues.

Table 4

1% of the large customers generate____% of the local special service revenues
3% of the large customers generate____% of the local special service revenues
5% of the large customers generate____% of the local special service revenues
10% of the large customers generate____% of the local special service revenues
20% of the large customers generate____% of the local special service revenues
40% of the large customers generate____% of the local special service revenues

5. Another study assumption is that the small number of large customers referred to in No. 4, tend to be concentrated in a few wire centres. Again we request supportive data in the form of the following table; which relates the above percentage concentration of large customers to wire centres:

Example

1% of the large customers are served from **10** wire centres
5% of the large customers are served from **20** wire centres
20% of the large customers are served from **50** wire centres

Table 5

1% of the large customers are served from _____ wire centres
3% of the large customers are served from _____ wire centres
5% of the large customers are served from _____ wire centres
10% of the large customers are served from _____ wire centres
20% of the large customers are served from _____ wire centres

The total number of Bell Canada wire centres is _____.

6. We have assumed that the majority of large customers belong to one of the following major user groups:

Major User Groups Amongst Large Customers

Banks
Hospitals
Retail Chains
Utilities
Government
Manufacturing
Transportation
Communication
Service Sector
Others

Please provide the percentage of the local special service revenues of large customers generated by each major user group, and specify others if applicable.

7. Assuming the following loss in POTS subsidy resulting from local special service bypass, project the percentage increase in business (line and trunk) and residential rates given no rate rebalancing, full competitive entry to local special service bypass and all other costing elements remaining constant.

Percentage Loss of Local Special Service Subsidy	1%	3%	5%	10%	20%	50%	75%
Residential Rates Percentage Increase							
Business Rates Percentage Increase							

8. Much of this study has been designed to answer the following questions:

   1. Is there an incentive for subscribers to bypass the local telephone exchange network?

   2. If an incentive exists to bypass, what segment of the subscriber market will benefit?

   3. What would be the impact on the continuing availability of telephone service (POTS) at a reasonable price, given the potential loss of revenue to the telephone companies?

   Please provide any comments you have regarding the above three questions that would assist in our assessment of the impact of local network bypass.

9. Please provide a copy of the Company's response to Bell(DIR)22May84-130 IC and include any of the following information available, if it is not part of the submission, regarding customers feasibility studies of private intracity microwave systems:

customer location

description of local leased system including:

- locations served
- number of circuits for voice and voice grade data services
- length of connections
- life of plant

cost of local leased system

description of microwave system

cost of microwave system

ATTACHMENT 2

LOCAL NETWORK BYPASS CASE STUDIES

Case Studies

Case 1 - Comparison of DS1 Cable vs Microwave

This case compares the cost of establishing a dedicated facility, equivalent to 24 voice channels, using T1 carrier leased from a telephone company to the a cost of a private microwave system. The costs of the leased facility are based on Bell Canada tariff 5020 for meagaroute service as follows:

Bell Canada - Item 5020, Megaroute Service

3 Year Contract	Monthly $/Access	Service
Common Equipment	480	500
System Termination	70	200
Access Loop per 400M	40	
Link (each system)	40	
Channel each 400M each system	30	
Construction $ per 400M, single payment		1,800

Distance from Bell Switching Centre 2,800 metres

DS1 Cable Costs

No. of channels	24
Megaroute 5020 (1)	
- Number of accesses	1
- Common Equipment	$17,780
- System Termination	$2,520
- Access Loop	$10,080
- Construction	$12,600
- Link	$1,440
- Channel	$181,440
Total costs for 3 years	$225,860
Yearly cost	$75,287

Private Microwave System Costs

Master Station (1.5 GHz)	$56,000
Master station channel ends (24 @ $700)	$16,800
Remote station, protected	$18,000
Remote station channel ends	$16,800
Supervisory and Control	$10,000
Antenna Systems	$4,000
Tower Modification for Microwave ($10,000/site)	$20,000
Engineering	$3,000
Installation	$5,000
Contingency	$10,000
Total Fixed Costs	$159,600
Annualized Fixed Costs 15% cost of money 15 year life	$27,292
Annual Maintenance Costs (2% of total investment)	$3,192
Total Annual Costs	$30,484

Case 2 - Long Distance Resale

The elements of the system consist of (See Diagram 2.1)

a) Bell Canada Serving Office. This will be a DMS type office. Trunks may be 2-wire or 4-wire. Blocks of telephone numbers will be assigned to the access trunks from the Bell Canada serving office. Each user will be assigned a unique telephone number and a personal identification number (PIN).

b) Access Channels from Bell Serving Office. These channels are composed of access trunk equipment in the Bell office and four wire trunk extension channels using General Tariff item 950.3, dedicated circuits within the exchange.

Each channel will be equipped with E & M signalling and MF outpulsing. The costs per trunk are:

	$/mo	
- trunk equipment	25.00	
- E & M signalling	12.60	
- MF outpulsing	8.25	
- circuit charges (3.2 km)	44.00	
	89.85	$90.00

c) Telephone Number Blocks. These are priced at $82.00 per 100.

d) Access Trunks into Bell Serving Office. These trunks are four-wire with E&M signalling, MF dialing and answer supervision. Assuming 3.2 km of wireline extension, the costs per trunk are:

	$/mo	
- access trunk	100.00	
- E&M signalling	12.60	
- MF outpulsing	12.65	
- answer supervision	3.25	
- circuit charges (3.2 km)	44.00	
	172.50	$173.00

e) Private Switch. These machines are analog switches, and initially equipped with 50 switching paths. The units are capable of preparing call detail records and billings from standard software packages.

The costs of each switch are:

invoiced price	64,800	
duty 14.5%	9,396	
FST 9%	6,678	
Total Equipment Cost	$80,874	$81,000
Installation cost		$ 7,500

f) Dedicated Channels - These will initially be standard inter-exchange (IX) leased circuits from Bell or CNCP at monthly costs of $1,100 per channel. Telpak rates would apply for groups of 12 channels or more and we can assume a general discount in the order of 20%. Therefore:

- cost of each channel	up to 12	1,100/mo
	12 - 24	880/mo
	25 - 36	825/mo

Traffic Considerations

The numbers of access channels and trunks to the Bell serving offices and the numbers of dedicated IX circuits between the two cities are dependent on the traffic carried at specified grades of service.

a) General Assumptions. The telephone traffic carried will have the same characteristics as regular telephone traffic regarding:

- average message times (average of 96 seconds)
- call rates
- non-completed calls
- arrival distributions (Erlang)
- busy hour patterns.

b) Sufficient access channels will be installed to ensure that network grade of service is P.01.

c) Sufficient IX circuits will be installed to ensure that the delay in accessing any other remote city from another city does not exceed 25 seconds for 90% of the calls.

d) Each year is assumed to consist of 250 working days and there is no busy season. The traffic in the busiest hour is assumed to be 12% of the total daily traffic.

Traffic Capacities

The economic evaluation will determine the maximum number of billable minutes which can be carried each year for various system sizes and will determine the profitability (loss) for each system size and establish a break-even system size.

Table 1 shows the busy hour capacity in Erlangs , the % utilization of channels and the expected monthly traffic in minutes for tha chosen grade of service.

Table 1 also shows the traffic handling capacities of various sizes of access channel groups between Bell's serving office and the private switch in the originating city.

Table 2 shows the % utilization of various sizes of channel groups as a function of the traffic carried in Erlangs . From this the number of access channels, IX channels and access trunks for any volume of traffic carried can be determined.

Table 1 - Channel Capacities

	1X CHANNELS (GOS..10%)			ACCESS CHANNELS (GOS 1%)		
# of CHANNELS	ERLS	MINS/MO	% UTIL	ERLS	MINS/MO	% UTIL
6	3.6	37,500	60%	1.8	18,750	29.8%
12	8.9	92,700	74%	5.4	56,250	45.1%
18	14.4	150,000	80%	9.6	100,000	53.4%
24	19.9	207,000	83%	14.1	147,000	58.7%
36	31.4	327,000	87%	23.5	245,000	65.4%
48	43.2	450,000	90%	33.4	348,000	69.5%
60	----	-------	---	43.4	452,000	72.4%

Channel Sizing

For various volumes of traffic carried each month, the access channels and IX channels required in both directions can be computed based on the assumption that every IX channel has an associated access trunk to carry the traffic forward into the Bell serving office with no delay.

The ratio of traffic flows in one direction is assumed to be two-thirds that of the other direction. The facilities requirements associated with this ratio and various monthly traffic volumes are given in Table 2.

CITY 1/CITY 2 TRAFFIC FLOW: 2/3 OF TOTAL
CITY 2/CITY 1 TRAFFIC FLOW: 1/3 OF TOTAL

Table 2 - Facilities Requirements

	CITY 1/CITY 2			CITY 2/CITY 1		
MINS/MO	ERLS /BH	ACCESS CHANNELS	IX CHANNELS	ERLS /BH	ACCESS CHANNELS	IX CHANNELS
25,000	1.6	6	3	0.8	4	2
50,000	3.2	9	6	1.6	6	3
100,000	6.4	14	10	3.2	9	6
150,000	9.6	18	13	4.8	12	8
200,000	12.8	23	16	6.4	14	10
250,000	16.0	27	20	8.0	16	12
300,000	19.2	30	23	9.6	18	13

Revenues and Costs

All costs and revenues have been normalized to monthly equivalent, or estimated costs, so as to compare on a reasonable basis with Bell charges for services and facilities which are billed monthly.

Utilization of Capacity

Facility requirements were established based on acceptable grades of service and the appropriate channel group sizes were chosen to meet these grades of service at various traffic volumes. The costs associated with supporting that total capacity are included in the total cost analysis. On the revenue side it is assumed that capacity relief would be introduced when the facilities are 85% utilized. Accordingly, in the revenue analysis, only the potential revenues from 85% of the traffic volume in minutes, is included.

Billable Minutes

Not all traffic minutes carried are billable. This review assumes that approximately 5% of actual traffic carried is not billable, and hence the revenue from traffic carried is actually computed as 95% of the 85% utilization figure.

Revenues per Minute and per Call

Assuming for its City 1/City 2 long distance service Bell Canada charges 72 cents for the first minute and 61 cents for all subsequent minutes (based on actual Bell charges between two selected cities). In effect the minimum charge is 72 cents for a billable call. Looking at these two numbers would suggest that Bell's rate structure is really 11 cents per call completed and 61 cents for each minute of holding time.

We have chosen to compute revenues based on discounting Bell's present day-time tarriff by 1/3. If we had chosen a 20% discount, the resale service offering would be even more profitable and we believe would still attract the same customers.

The revenue analysis, therefore, is based on discounting the distance related charge and revenues are computed using:

- charge per call completed; 10 cents
- charge per minute used; 40 cents

The revenues per call are calculated from an earlier assumption that average call duration is 1.6 minutes (96 seconds) and from the fact that the number of calls per month is the number of minutes of traffic carried per month, divided by 1.6.

Consequently, the monthly revenues for various traffic volumes are:

REVENUES

MINS/MO	FROM CALL COMPLETIONS		FROM CALL DURATION		TOTAL $
25,000	1,330	+	8,075	=	9,405
50,000	2,660	+	16,150	=	18,810
100,000	5,310	+	32,300	=	37,610
150,000	7,970	+	48,450	=	56,420
200,000	10,625	+	64,600	=	75,225
250,000	13,280	+	80,750	=	94,030
300,000	15,940	+	96,900	=	112,840

Fixed Costs

There are two components assumed - general administration expenses for which $2,000/month is allowed and the capital costs of owning two switches.

The purchase price of each switch is $81,000 and the installation cost of each switch is assessed at $7,500 for a total installed cost of $177,000 for the two switches. Annual capital charges for equipment with a service life of 10 years, no salvage value and 12% cost of capital are 17.6% of installed cost or an equivalent monthly cost of $2,596, or $2,600. Total monthly fixed costs are:

- capital costs for two switches	2,600
- general administration expenses	2,000
	$4,600

Variable Costs for Leased Facilities

Table 2 provides the fecilities required and the individual costs have been previously detailed.In summary, access channels from the Bell office cost $90/month, access trunks to the Bell office cost $173/month and IX channels between the two cities cost as follows:

up to 12 channels	$1,100/month
12-24 channels	$ 880/month [Telpak]
24-36 channels	$ 825/month [Telpak]

Leased facilites monthly costs are:

MINS/MO	ACCESS #	CHANNELS COST	ACCESS #	TRUNKS COST	IX #	CHANNELS COST	TOTAL $
25,000	10	900	5	865	5	5,425	7,190
50,000	15	1,350	9	1,557	9	9,765	12,672
100,000	23	2,070	16	2,768	16	14,080	18,918
150,000	30	2,700	21	3,633	21	18,480	24,813
200,000	37	3,330	26	4,498	26	21,450	29,278
250,000	43	3,870	32	5,536	32	26,400	35,806
300,000	48	4,320	36	6,228	36	29,700	40,248

Maintenance Costs

Estimated at 2% of installed cost which is $3,600/month or $0.012 per minute of traffic carried.

Billing and Collection Costs

Estimated at $7.50 per user per month. ~With each user having 200 minutes usage~ per month, the monthly cost of billing and collection is $0.0375/minute.

Sales & Promotion

For $3,000/month, a sales target might be 40 customers who stay with the system for an average of two years. In two years these 40 customers will have generated (40 x 24 x 200=) 192,000 minutes of traffic at a sales & promotion cost of $3,000, or a cost per minute of $0.016/minute.

TOTAL COSTS

The total costs are accumulated in Table 3 for the various volume levels studied.

Table 3 - Total Monthly Costs

MINS/MO	FIXED	VARIABLE FACILITIES	MAINTEN-ANCE	BILLING & COLLECTION	SALES & PROMOTION		TOTAL $
25,000	4,600	7,190	875	940	400	=	14,005
50,000	4,600	12,672	1,410	1,875	800	=	21,357
100,000	4,600	18,918	2,100	3,750	1,600	=	30,968
150,000	4,600	24,813	2,550	5,625	2,400	=	39,988
200,000	4,600	29,278	2,900	7,500	3,200	=	47,478
250,000	4,600	35,806	3,250	9,375	4,000	=	57,031
300,000	4,600	40,248	3,600	11,250	4,800	=	64,498

Profitability Analysis

Table 4 provides Total Revenues, Total Costs and Profit (Loss) for each volume level studied. This table suggests that a breakeven point is in the order of 60,000 to 70,000 minutes per month, which corresponds to 300 users on the system - 200 in City 1 and 100 in City 2.

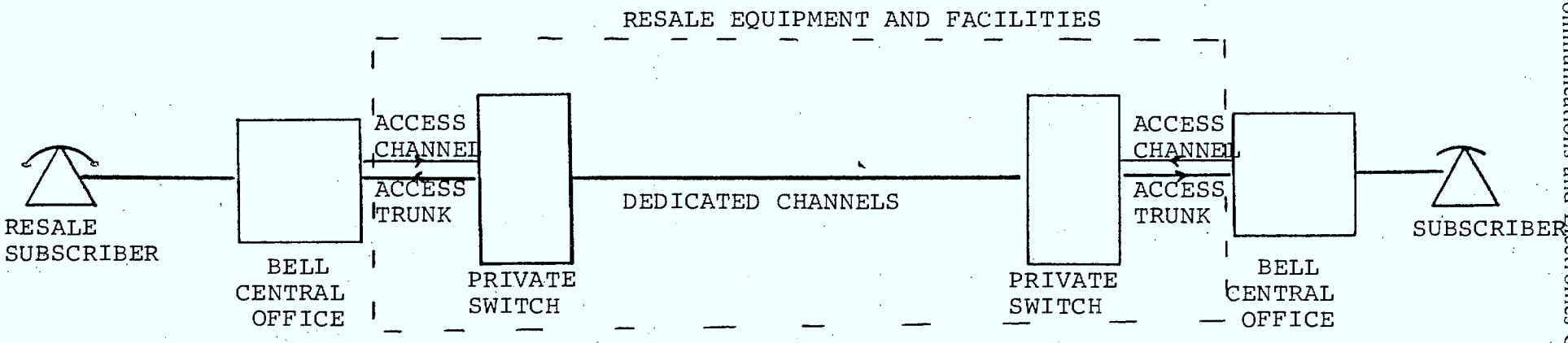
Table 4 - Monthly Profitability Analysis

MINS/MO	TOTAL REVENUES		TOTAL COSTS		PROFIT (LOSS)
25,000	9,405	-	14,005	=	(4,600)
50,000	18,810	-	21,357	=	(2,547)
100,000	37,610	-	30,968	=	6,642
150,000	56,420	-	39,988	=	16,432
200,000	75,225	-	47,478	=	27,747
250,000	94,030	-	57,031	=	36,999
300,000	112,840	-	64,498	=	48,342

DIAGRAM 2.1

LONG DISTANCE RESALE

NETWORK CONFIGURATION



RESALE SUBSCRIBER - Resale system user whose telephone number and personal identification number is assigned by the reseller
SUBSCRIBER - Any local telephone system user
BELL CENTRAL OFFICE - Serving office providing connection to resellers private switch
ACCESS CHANNEL - Dedicated leased facility from Bell serving office to private switch
ACCESS TRUNK - Dedicated leased facility from private switch to Bell serving office
PRIVATE SWITCH - Belonging to reseller
DEDICATED CHANNELS - Interexchange leased circuits

Case 3 - Multi-Tenant Buildings with Shared Facilities

This case compares the cost of a residential apartment complex sharing local access facilities to the cost of individual service for each unit. Case 3A uses a rate group averaged cost per subscriber line based on existing tarriffs while Case 3B uses Bell's proposed fifth year subscriber line charges (rate group average) based on their CRTC rate rebalancing submission, Sept 1984. Shared facility costs

Assumptions - 0.025 Erlangs per subscriber line per busy hour
- 0.01 Blocking factor
- building is located 1600 metres from the central office switch

Case 3A

Based on Erlang B tables, in conjunction with the above assumptions; 19 links are required between the building and the central office to accomodate 450 subscribers. Using Bell Canada megaroute tariff as in Case 1 (3 year contract), the following charges would apply:

Share Facility Costs

No. of channels	19
Megaroute 5020 (1)	
- Number of accesses	1
- Common Equipment	$17,780
- System Termination	$2,520
- Access Loop	$5,760
- Construction	$7,200
- Link	$1,440
- Channel	$82,080

Total costs for 3 years	$116,780	
Yearly cost		$38,927
Fixed equipment costs (switch + installation)	$50,000	
Annualized at 15% cost of money 15 year life		$8,550
Annual Maintenance (2% of fixed investment)		$1,000
Miscellaneous costs (ie Billing and Collection)		$1,000
Telephone Numbers ($82/100 numbers per month)		$4,920
Total Annual Costs		$54,397

<u>Costs - No Facility Sharing</u>

Apartment complex - 450 units

Typically monthly telephone charge per subscriber line	$10
Yearly cost per 450 Line	$54,000

Case 3B

Based on Erlang B tables, in conjunction with the above assumptions; 7 links are required between the building and the central office to accomodate 100 subscribars. Using Bell Canada megaroute tariff as in Case 1 (3 year contract), tha following charges would apply:

Shared Facility Costs

No. of channels	7	
Megaroute 5020 (1)		
- Number of accesses	1	
- Common Equipment	$17,780	
- System Termination	$2,520	
- Access Loop	$5,760	
- Construction	$7,200	
- Link	$1,440	
- Channel	$30,240	
Total costs for 3 years	$ 64,940	
Yearly cost		$21,647
Fixed equipment costs (switch + installation)	$50,000	
Annualized at 15% cost of money 15 year life		$8,550
Annual Maintenance (2% of fixed investment)		$1,000
Miscellaneous costs (ie Billing and Collection)		$1,000

Telephone Numbers ($82/100 numbers per month)	$820
Total Annual Costs	$33,017

Costs - No Shared Facilities

Apartment complex - 100 units

Typically monthly telephone charge per subscriber line	$26.58
Yearly cost per 100 line	$31,896

ATTACHMENT 3

CANADIAN EXAMPLES OF CABLE BYPASS

CANADIAN EXAMPLES OF CABLE BYPASS

ACTIVE

1) The Knowledge Network in Vancouver, British Columbia, is a joint project between Rogers Cable and the provincial government. It is a fully operational, 300 and 400 MHz mid split system which interconnects various hospitals, universities and police providing educational and informational services.

2) An alarm service provided by Ottawa Cable Vision in Ottawa, Ontario.

3) A traffic light system, similar to the London traffic light system is under construction by Rogers Cable in Brampton, Ontario.

4) A dedicated network in London, Ontario, constructed by Rogers Cable interconnecting University, St. John's, and Victoria hospitals.

DISCONTINUED

5) An alarm system in Victoria, British columbia, provided by Cableguard on an experimental basis to over 1000 subscribers. It was discontinued because it could not be economically provided.

6) Brockville Cable provided CB on cable on an experimental basis in Brockville, Ontario prior to 1981. This project was also not cost effective and was discontinued.

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KVA

KVA Communications
and Electronics Co.
364 Supertest Rd.
Downsview, Ontario
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