TELECOMMISSION

Study 8(c)

Northern Communications

The Department of Communications

TELECOMMISSION STUDY 8(c)

NORTHERN COMMUNICATIONS STUDY

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

This Report is to be considered as a background working paper and no effort has been made to edit it for uniformity of terminology with other studies.

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Northern Communications - General Appreciation

Canada's North is an enigma. It is both an old and a new land. Over thousands of years people in the North have devised and evolved a civilized culture despite the obstacles of climate and desolation. Yet it is a new land that we in the South are beginning to know and understand. We live in a decade when the dream of developing the North must be realized to foster the emergence of Canadian identity and horizons.

Communications are vital to initiate and sustain northern development. Communications can be a catalyst for cohesion and growth, and can overcome the barriers of distance and isolation. Telecommunications, meaning telephones, data, radio, and television, are one facet of communications which, in the broadest interpretation means an exchange of facts, ideas, opinions, and emotions between people.

The need for improvements in northern communications becomes more apparent every day. Requirements will increase as the pace of development accelerates. Existing systems are often inadequate or worked beyond their capacity. Careful planning is essential to ensure that effective communications for the future are available. A scheme of communications priorities must be prepared which is feasible, economical, and responds to anticipated needs; communications must be used first as an instrument of creation, then as a medium of consolidation, and finally as a means of recreation.

A new look at communications in the North is necessary. The task is no less than the completion of the building of Canada. But the difficulties in bringing an acceptable standard of communications services to the North are enormous. The territory is vast, the population is sparse, and the physical handicaps present a challenge that only foresight and imagination can surmount.

There is every indication that Canada's Arctic contains one of the world's important sources of oil and gas. A major find of these fuels anywhere near the scale of Prudhoe Bay would bring massive changes to the Canadian North. The technology for the extraction and transportation of fuels is well advanced and attests to the confidence that major discoveries are highly probable. Increasing energy scarcities in North America and instability in

the Middle East will guarantee that the exploratory activity must intensify.

The voyage of the "Manhattan" in the Northwest Passage resolved one very important issue. The indications now are that fuels will be brought from the High Arctic to southern Canada by pipeline. The Mackenzie route appears logistically favourable. Such a pipeline will need communications. Communications will be required during the construction phase and for control purposes when the pipeline is installed. High quality microwave systems will be needed to carry the control circuits safely and without degradation. It will provide the means to serve all communities within interconnection distance with a full gamut of telecommunications facilities.

The "Manhattan" also opened our eyes to the Eastern Arctic. The ship successfully navigated large sections of the Northwest Passage where minerals occur in abundance and with unusual purity. The tremendous ore bodies on Baffin Island lie temptingly close to the route taken by the "Manhattan".

Promising developments are also on the threshold of advancement in Northern Quebec. Huge nickel and asbestos deposits occur near Deception Bay near the Hudson Strait. There is a possibility of a major hydro-electric development on the west coast of James Bay.

There are areas in the North that are less conducive to economic progress. The District of Keewatin is in the early exploration stage but the type of industrialization that would provide a base for drastic communications improvements is not anticipated for some time. It is representative of areas where there has been concern expressed for improved telecommunications facilities essentially to meet social needs. Such areas present problems of capital investment for the telecommunications common carriers. In achieving the social objective of extending the widest access to telecommunications, the unit cost of terrestrial distribution bears an inverse relationship to population density - a feature that is apparent for both telephone and broadcasting services. It follows that, if equal service is to be provided, the cost per capita will be higher where the population is more widely dispersed and, for that reason, even more dependent on telecommunications than the urban population. This raises the difficult question of the extent to which these additional costs, attributable to the general objectives of social well-being and economic prosperity, should be borne by the direct beneficiaries, by the subscribers to the system, or by the general taxpayer.

It is necessary, in communication terms, to find a new definition for "the north". The geographers' definition of the north is the region above the southern boundary of the Yukon and Northwest Territories, which lies, for the most part, along the 60° parallel of latitude. But studies have revealed that areas of communication inadequacies extend deep into the southern parts of

the Provinces. Generally speaking the lack of telecommunications services occurs at the 55° parallel in the Provinces of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and Newfoundland. It is estimated that there are about 32,000 people in the Northwest Territories, 18,000 in the Yukon, and about 196,000 people in the region between the 55° and 60° parallels. Throughout this great area, men have found it necessary to pool their resources if life is to be tolerable; governments have generally been less successful, perhaps because conventions and rules that have been found effective elsewhere may look foolish when they are frozen.

The provision of efficient communications in the North affords no exception to the need for a common approach and a pooling of resources. The situation now is that the dearth of reliable common carrier services has meant that agencies have installed their own systems. Unfortunately, the proliferation of systems not only deteriorates overall service, but reduces the economic base for the expansion of commercial services. Communication surveys have demonstrated that the public, government agencies, and industry are not even receiving a minimum standard of service in northern areas. About 240 communities or settlements have been identified as candidates for new or improved services. Some of these have populations up to 500 and a few of 800. In establishing these requirements the premise was assumed that every permanent settlement having a population of over fifty persons should have facilities for telephone service not subject to outages due to atmospheric conditions.

Care must be exercised in not considering the North as a homogeneous area in meeting communications needs. The areas of prime concern are (1) the Districts of Franklin and Keewatin (2) northern Saskatchewan and Manitoba (3) northern Ontario and Quebec (4) northern Alberta (5) northern British Columbia and Newfoundland.

At the Northern Communications Conference, which was held at Yellowknife in September, 1970, it became evident that the principal concern of people who live in the North is that their special requirements for communications demand priorities different from those established by outsiders without regard to local conditions. The appeal of radio broadcasts is lessened if the language is not understood; live television is all very well, but not particularly relevant for someone who is sick, or lost, and in need of assistance. The outstanding demands, it appears, are for reliable two-way fulltime voice-communication services, and for a broadcasting system which would permit local programming, opportunity for participation in community affairs, and better education.

An examination* was made of the technical options available to serve the North with improved communications. Three different techniques emerge. First there is the communication satellite and its promise to bridge electronically the distance and the silence. Then there is High Frequency (HF) radio and the more scientific application of this medium for upgrading commercial service. Finally there is the extension of terrestrial facilities using radio relay, troposcatter, cable, and wireline systems. Included in this category is the suggestion that attention be given to using the DEW Line and Polevault Systems more extensively for civilian communication purposes.

The Canadian North is ideally suited for exploitation of communication satellite technology. Communication satellites can provide direct high quality communication channels to locations without regard to distance or nature of terrain. Much of the Eastern and Central Arctic is such that it does not appear to be ever economically possible to provide an acceptable service to most of the settlements using conventional means. Studies of satellite potential have been done using the ANIK satellite, since this would provide solutions at the earliest time. Concurrently an investigation was made of the possibility of developing a communication satellite system specially designed for northern service.

The use of a communications satellite to provide service to individual subscribers in isolated areas carries with it a number of problems which will require considerable effort before satisfactory solutions can be worked out. New and sometimes unique solutions will have to be obtained to the problems of operating, signalling, billing, numbering, switching, supervision, local distribution, interfacing between the common carriers and Telesat, if the potentials of the medium are to be exploited.

A criteria used in the study of providing service by ANIK was that each settlement should have the capability of transmitting and receiving a single telephone circuit, and be able to receive a single radio program circuit for broadcasting purposes. The conclusion reached was that the cost of renting a channel would be about $3 million annually, and the cost of serving each settlement would be $100,000 annually.

The study of Ultra High Frequency (UHF) satellite revealed that the estimated annual cost per community to provide a single telephone channel is estimated to be about $25,000 for serving about 100 ground stations. This type of satellite could serve as many as 500 communities if a sharing of channels between communities was acceptable. The ground stations would be

* Telecommission Study 8(c) - Vols. 5 and 6.

cheap and suitable for fixed, transportable, and mobile applications. Unlike the ANIK systems, the cost of the service provided by the UHF satellite system would not be offset by revenues obtained from distributing general communications and television in southern Canada. Unlike the ANIK satellite to be launched in late 1972, a UHF satellite must be designed and developed. International frequency allocations need to be set aside for its occupancy of the radio spectrum. Such a system would be possible around 1978.

Much attention was given to the improvement of northern communications using High Frequency techniques. Until the advent of the communications satellite HF radio afforded the only means of communicating over vast distances when small circuit requirements had to be met. The high cost of satellite communications will certainly ensure that HF systems will continue in operation at least in this decade.

There are many ways to improve existing HF radio services. New generations of solid state equipment will enable reliabilities to be achieved which are at least one order of magnitude better than equipment now in service. Reduced maintenance and power requirements made possible by solid state design generally assists operation in northern conditions. Improvements in frequency stability are possible and necessary if coding techniques are to be employed on commercial systems.

But it is in the area of HF propagation and prediction that the most significant improvements in service can be realized. Accurate predictions have been developed and are available within the Department of Communications. The Telecommission served a useful purpose in bringing together scientists concerned with prediction of optimum frequencies for HF services, and the common carriers who are now exploiting the potentialities of computer predictions for improving commercial services.

It is quite remarkable that Canada has been in the fore-front of scientific research and experimentation in HF radio, yet the quality of commercial HF services lags far behind similar services provided by other nations. The closing of the gap behind sophisticated research and marginal operations will demand initiatives by the Department of Communications. New licensing procedures will be necessary to realize the full advantage of HF radio. This may involve (a) closer monitoring of frequency usage (b) publication of guidelines and procedures for the HF bands, similar to those for the microwave bands (c) making available optimum frequency working maps (e) re-evaluation of frequencies assigned large users on a traditional basis.

Two types of terrestrial systems were also considered in the northern content: troposcatter systems and microwave systems.

Troposcatter radio systems provide reasonably good quality circuits with cross-sections to 120 voice channels or more. These systems provide excellent telephone and data services, but installation costs are very high and they are not capable of carrying television. Normally they are heavily supported by large government (defence) contracts.

Two major systems operated by the U.S.Air Force operate in the Canadian North. There is the DEW Line which runs laterally along the Arctic Coast, and the Polevault (North) system for rearward communications to southern Canada. This latter system commences at Cape Dyer and proceeds down the East Coast of Baffin Island and Labrador to Goose Bay.

A finding of the Telecommission Study is that the DEW Line and Polevault systems can be used for the benefit of communities that are adjacent or close to stations of these systems. Communities could be tied into these excellent trunk facilities if simple and inexpensive VHF links were installed. The main stumbling block is the cost of renting circuits for long distances in the DEW Line and Polevault systems. It is estimated that the annual cost of providing the interconnection equipment and rentals is between $50,000 and $100,000.

But it is the long term future of these military systems that must be studied more carefully. There is a possibility that the DEW Line will be phased out in the next seven years. This possibility should be considered and the potential of a re-equipped and re-organized civilian system investigated.

The Polevault (North) troposcatter system is a high quality trunk system that might be better operated by our telecommunications common carriers. Recently the Polevault (South) system was acquired and a similar take-over of the Polevault(North) system should be carefully considered. A decision to take over this system would depend on favourable lease back terms for the rental of USAF military traffic on the system.

Solid state advances in microwave equipment are making radio relay systems less reliant on transportation. Previously, roads or railways were needed before the installation of microwave systems could be contemplated. Now it is possible to enclose low cost equipment in a single weather-proof container than can be transported easily to any part of Canada. Strings of these repeaters can be used to join smaller centres to satellite ground stations or to interconnect directly with southern terrestrial systems. These repeaters make use of power sources integrated into the basic housing design. Fabrication is completed at the factory and once installed isolated repeaters need only be visited one or two times a year.

It is clear that technology for meeting the telecommunication needs of the North already exists. The challenge of the next few years will consist of selecting the right technologies to meet social, political, and economic objectives within limited financial resources.

There is no doubt that an adequate telecommunications base in the North to support social progress, industrial development and government administration, will not be achieved unless a major impetus is given to expansion programs, on a broader scale than has previously been attempted. First, attention must be given to planning and financing to stimulate coordinated activity by the agencies concerned.

Some way must be found to pool plans and coordinate effort. Research indicates that there has been little or no interfacing between groups in many areas and if such a lack of coordination continues there is a danger of incompatible programs blocking national progress.

It seems that there is a legitimate role for the federal government as the coordinator provided that there is no invasion of consitutional functions nor threat of federal monopoly in any suggestions for coordination that may be put forward. Two proposals for a coordinating agency have been put forward* to give concentrated attention to northern communications expansion programs. Participation in the coordinating agency will come from (1) the federal, provincial and territorial governments, (2) the telecommunication common carriers, (3) native associations and representatives of the consumer viewpoint. The main purpose of the agency will be to describe a cooperative approach towards the resolution of northern communications problems.

It is interesting that both suggestions for the establishment of a unique agency to represent all northern interests would possess more than a coordination mandate. The proposals envisage organizations that would not merely be advisory, but have authority to determine procedures and methods, and even to commit resources. Such an organization might eventually evolve towards a development agency. There is no precedent in Canadian history for the type of oganization proposed but that should not be a deterrent to its creation. The organization should be able to absorb regional diversity, particularly since implementation of programs would be computerized according to provincial boundaries and agencies.

An added feature of a coordinating agency is that research activity could be steered and given a sense of purpose and direction. The universities would be brought into the areas of northern research. It might be possible to weld various research and

* Telecommission Study 8(c) - Vol.7 - Chapters I and III

academic units into an effective coordinated program working on a financial basis which would be susceptible to change. A cohesive program would do away with narrowly orientated, poorly integrated task forces.

Other approaches were considered in the Telecommission Study*to effect the necessary coordination, consultation, and participation in the northern scene. A consultative process is typified by the federal, provincial committee on finance; the Canada Water Act offers an example of planning working with a joint federal group; the funding of the Trans Canada Highways jointly by the federal and territorial governments has a record of success that might well be carried over to the communications sphere.

No major expansion of northern communications can proceed without the funding of initiatives on a large scale. Several questions require a response: How much capital should be set aside for the expansion of northern communications relative to other infrastructure, e.g. transportation, housing, education, etc? What amount is required to bring the level of existing services up to satisfactory levels? What should be the proportion of federal, provincial, common carrier and private industry contributions?

An appreciation of the amount of capital that should be invested in communications is a matter of judgement related to tangible returns and the attainment of strategic objectives. It is interesting to note the magnitude of expenditures and revenues in a related field to communications - transportation - as funded by the federal government. The annual federal expenditures for air, marine, roads, and meteorological services in the territories and extreme northern parts of the prairies were $31 million in 1965-66. This increased steadily to $56.7 million in 1969-70. Corresponding revenues were $6.02 million and $10.8 million. The trend is for transportation revenues to increase and the gap between expenditures and revenues to widen.

For comparison purposes a tentative plan submitted by the Trans Canada Telephone System for utilizing the ANIK satellite and providing ground distribution systems puts annual costs at about $10.5 million. Such a plan would effectively resolve most telecommunications problems in the Districts of Franklin and Keewatin, and the Provinces of Quebec and Newfoundland. About $6 million of this amount is for the annual rental of satellite transponders for Telesat Canada. This order of expenditures is not out of line if communications are to be brought to the level of transportation services.

* Telecommission Study 8(c) - Vol.7 - Chapter I

What are the sources of capital that could contribute to significant programs for the expansion of northern communications? First, the telecommunications common carriers might bear losses through cross subsidization as the price for their franchise and the extension of the capability of their networks. Second, the Federal Government might contribute a share to compensate for the difference between annual operating expenses and revenues where facilities are provided at a loss to meet social and non-commercial objectives. Third, user charges above standard rates might in some way be borne by agencies who obtained special advantage from the stimulated expansion of northern services, e.g. Canadian Broadcasting Company and the Ministry of Transport. Fourth, the provinces might contribute to improved communications in the northern extremities of their regions if they require accelerated programs to serve their communication needs. Fifth, private industrial communication requirements might be met by these concerns and not require subsidies unless the overall economic development of a region is envisaged.

The advantages of distributing funding responsibility cannot be over-stressed because major programs can be tackled with less risk and trepidation if the costs are shared.

Northern public telecommunications services are presently provided by two common carriers. North of 60° latitude C.N. Telecommunications serve the Yukon and that part of the Northwest Territories west of 102° longitude. Bell Canada provides public telecommunications services to the east of the 102° longitude in the Districts of Franklin and Keewatin.

This division was apparently made to avoid destructive competition in areas where revenues were low. But it is an unusual division for the circumstances. On the one hand a Crown Corporation operates in an area which is rapidly becoming economically self-supporting while a private corporation serves an area where such a situation will not occur for a long time. Is this arrangement impeding the realization of improved telecommunication services throughout the Territories? The Telecommission Study did not address the optimum common carrier arrangements for northern telecommunications but the question does require examination.

The Telecommission Study has provided detailed information on the magnitude of the problem of expanding northern telecommunications in economic, social, and technological terms. The areas of further work and decision have been identified. It will be necessary to:

(a) verify and authenticate the information collected on communication requirements by survey trips and traffic analysis for each region of the North. This work must take into account probable demographic, social, and economic trends.

(b) Compare, select, and integrate the various technologies into the national telecommunications system and develop a timetable for implementation of planned initiatives.

(c) Investigate the feasibility of a national coordinating body to synthesize the position and views of all agencies active in the North, and to encourage participation by the northern people in the preliminary planning process.

(d) Plan major programs for the expansion of general communication systems for the next five and ten year periods. Particular attention should be given to identifying the necessary research and development to meet anticipated operational requirements in the 1970-80 period.

(e) Determine the magnitude and the sources of funding that are needed to embark on a program of substantial and progressive improvements in northern communications.

(f) Study the adequacy of present institutions for serving the North and consider alternative arrangements to achieve most expeditiously the necessary advance in telecommunications services.

Isolation - spiritual and physical - has been a facet of northern life. Improved communications may be a sovereign remedy. The task is to see that isolation is ended and replaced by sound and effective communications to, from, and within the North.

CHAPTER II

Prospects for Northern Development

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Central to the development of the North is the pace of industrialization. In the short run the emphasis will be on the extraction and transportation of fuels and minerals and the construction of hydro projects for energy sources.

These industries are necessary but not sufficient to provide the basis for permanent settlement and sustained growth. Attention must also be given to social development and to the protection of the ecological environment. This chapter is concerned primarily with economic development with particular emphasis on mineral and fuel prospects in the Territories.

The Canadian North can be divided into broad regions when relating economic prospects to telecommunications planning. First, there is the Yukon, Northern British Comumbia and Alberta, and the Great Slave and Mackenzie Delta areas of the Northwest Territories. Economic activity is intense in this general region and telecommunications already exist, or can be seen to evolve naturally, to meet industrial requirements.

Then there is a central region comprising the Provinces of Saskatchewan, Manitoba, Ontario, and the District of Keewatin. Here the pace of development is slow and there is no reason to expect that telecommunications facilities will be forthcoming as a response to the compelling forces evident in the Western region.

Finally, there is the Eastern region comprising Quebec, Newfoundland (Labrador), and Baffin Island of the Northwest Territories. This region is at the threshold of economic development. It can be expected that telecommunications will gradually extend to the larger centres as development proceeds but the prospects for adequate services being extended to communities for social purposes is not great. An added difficulty is that most communities in the Eastern region are well above the tree line with intervening geography both barren and forbidding.

Mineral Potential

The Yukon and Northwest Territories comprise approximately 40 per cent of the land area of Canada and contain large extensions of the Precambrian Shield and the Cordillera areas which are favourable for mineral exploration. Current mineral production in the two

Territories, however, is only 3 per cent of that of the whole of Canada. This comparison suggests that the mineral resources of northern Canada are much less developed than those of southern Canada and the low ratio of developed deposits to possible deposits makes northern Canada a promising area for mineral exploration.

In recent years many, as yet undeveloped, mineral deposits have been located. There are several known lead-zinc deposits in the Yukon and Northwest Territories that are in this category. Two lead-zinc deposits in the Anvil area of the Yukon are estimated to contain 15,000,000 tons of 9 per cent combined lead-zinc metal. Another deposit 120 miles northeast of Anvil is reported to be higher grade, but lower tonnage. In the Pine Point area of the Northwest Territories there are two known deposits of lead-zinc of sufficient grade and tonnage to be brought into production.

Significant deposits of lead-zinc have been found in the Arctic Islands, on Little Cornwallis Island and northern Baffin Island. Underground development of the Baffin Island deposit has commenced. The full potential of all these lead-zinc areas has yet to be determined and there is little doubt that lead-zinc deposits offer the best promise for additional production in the near future.

A number of extensive iron deposits have been located in the North. The Mary River deposit on north central Baffin Island and the extensive Snake River deposits of the northern Yukon, have undergone a series of studies to determine the feasibility of bringing them to production. Problems of transportation, beneficiation and a need for long term contracts at stable prices deter development. Additional sources of low grade iron-ore are being explored on Melville Peninsula and central Baffin Island.

The exploration for gold and silver continues throughout the North and, although a number of small underground mines have had intermittent production, it seems that only high grade silver deposits such as those of the Mayo District in the Yukon and the occurrences near Great Bear Lake are rich enough to support an underground operation. The prospects for discovery of additional economic gold deposits appear to be best in the region north of Yellowknife.

Exploration for copper in the Northwest Territories has centred on the Coppermine River, the Bathurst Inlet area, Victoria Island and the east arm of Great Slave Lake. As a result, several deposits grading 2 - 4 per cent copper and estimated to contain from 2 million to 5 million tons have been located.

In the Dawson Range of the Yukon a porphyry type copper-molybdenum deposit is reported to contain a billion tons of low grade mineral.

Several other similar deposits have been or are being developed in the United States and British Columbia and this latest discovery raises hopes of similar development in the Yukon Territory. It is evident that the North American Cordillera is a very favourable area for deposits of this nature.

Nickel has not been mined in the northern territories since 1962 when the mine at Rankin Inlet on the west shore of Hudson Bay closed. However, the Wellgreen nickel-copper property in the Kluane Range of the Yukon is under development. Recent exploration to the northeast of Artillery Lake in the Northwest Territories has, so far, not given indication of any deposits, however, this area and the Great Slave Lake East Arm area, where two small high-grade deposits are known, continue to receive attention. The Selwyn Mountain ragion of southern Yukon is known to contain at least one deposit of tungsten in excess of one million tons and it is likely that several further deposits may be outlined.

A belt highly favourable for asbestos deposits crosses the central Yukon in a northwesterly direction. The Clinton Creek mine near Dawson and the Cassiar mine in British Columbia just south of the Yukon Border are in this belt. Prospects of finding additional deposits in the belt are considered to be excellent.

Uranium exploration activity has been accelerated in areas containing geological features similar to those of the Elliott Lake area of Ontario and the Wollaston Lake area of Saskatchean, and activity remains high in the areas to the east of Great Bear Lake and to the southeast of Great Slave Lake. Discovery of uranium mineralization in the central Keewatin district will undoubtedly further encourage exploration on the 10 million acres of prospecting permit rights that were granted in 1969.

Everyone associated with the mineral industry in the two Northern Territories is confident that the present expansion will continue. It must be realized, nevertheless, that many of the deposits discovered in northern Canada are still dormant while equivalent deposits in southern Canada are the sites of producing mines. The costs of exploration, development and transportation still remain a significant barrier to mineral exploration and development.

The pattern of mining development that began in 1964 and now dominates the industry in the North demonstrates that the cost factor can be overcome. In that year, Cominco Limited began shipments of lead-zinc ore from its open-pit mines at Pine Point, Great Slave Lake. To encourage this development, the Federal Government co-operated in providing transportation facilities, a townsite and hydro-electric power from a site southeast of Pine Point on the Talston River. Similar co-operation has been extended in later developments.

Not all deposits can be mined by open-pit methods and underground mining will continue in importance. It is, nonetheless-encouraging that many of the deposits being discovered can be developed as large open-pit mines operating on a low cost per ton basis. Developments in the transportation field, particularly the possible lengthening of the shipping season in Arctc waters, will assist both the exploration and development arms of the industry, and while the Yukon Territory and the western provinces of Canada supply markets on the Pacific rim, the future markets for the mineral resources of the eastern and high Arctic regions may be the many-fold industries of Europe.

It may be expected that active mining areas will exist in the North within the next one or two decades in the central and southern Yukon, the Great Bear and Great Slave Lake regions, the central and southern Keewatin, the Arctic Islands and the Arctic region of northern Baffin Island, and that mines will be established many hundreds of miles closer to the North Pole than has previously been the case. The cold, lonely path of the prospector and the geologist will become the daily route of the engineer, the miner, the truck driver and all their associates in the operating phase of the industry.

Oil and Gas Potential

There is every indication that Canada's Arctic contains one of the world's important sources of oil and gas. A major find of these fuels anywhere near the scale of Prudhoe Bay discoveries would bring massive changes to the Canadian North. The technology for the extraction and transport of the fuels is well advanced and attests to the confidence that major finds are highly probable. The increasing energy scarcity in North America and instability in the Middle East will guarantee that exploratory activity will intensify in the next few years.

If oil and gas are found they will probably be transported through the Western Arctic to southern markets by pipeline. Plans are being considered for two piplines for moving oil and gas

from the North. The oil and gas pipelines would have their source in the Mackenzie Delta near Inuvik and Tuktoyaktuk. They would run along the Mackenzie River and cross Northern Alberta to Cold Lake. From Cold Lake they would follow a great circle shortest-distance route to Emerson on the Manitoba-North Dakota border. The pipelines would diverge in the Fort Simpson-Fort Liard area so the oil pipeline could terminate at Edmonton. From Edmonton the oil would be sent along existing pipelines towards eastern Canada and cross over to the United States.

Trans-Canada Pipelines have expressed interest in building the gas pipeline while the Mackenzie Valley Pipeline System is pursuing the oil pipeline possibility. A competitor of Trans-Canada Pipelines, Consolidated International, has also expressed interest in constructing pipelines throughout the Mackenzie River area.

The pipelines would have a diameter of 48" and would lie two or three feet underground in most areas. In some areas they might be supported above ground to avoid permafrost difficulties. The estimated cost for each pipeline is in the order of $1.6 billion. If sufficient reserves of gas were found in the Mackenzie Delta it would be possible to commence construction in 1973. The pipelines could be completed by 1975 and the total complement of pumping stations installed by 1978. These pumping stations would be spaced about 35 miles for the gas line and 50 miles apart for the oil line.

Communications facilities would be required during the construction stage and for control purposes when the pipeline is installed. The ultimate requirement is for about 32 data channels at a transmission rate of 600 bits/second, 5 voice circuits, and some mobile channels along the line.

The permanent communication facility would have to be microwave radio or wide-band cable to satisfy stringent transmission requirements for the long distances involved. If microwave radio is used, it would have to be the large-capacity type to ensure that the data signals are not degraded over the length of the system. This would mean that the system would have spare capacity that could be employed to meet other needs. Since the Mackenzie River poleline system operated by Canadian National Telecommunications from Hay River to Inuvik does not have sufficient capacity to meet anticipated traffic growth, the availability of a trunk system financed by the fuel companies would be fortuitous. It would appear feasible to build a microwave system in about two years if the capital commitment were made.

Hydro Potential

The report "Communications in the Canadian North" shows those areas which have been surveyed for hydro electric potential. No further discussion is given here.

Broader Aspects of Northern Development

Economic development can result in effects that are neither beneficial nor desirable for the well being of the northern people or the environment. The communications planner of the future must consider ecological effects. He will have to take care that high transmission towers do not take a toll of migrating birds; similarly wire systems should not endanger animals in the vicinity. If old lines are abandoned, they should be cleaned up. The caribou should be allowed free movement because many people depend very substantially on caribou and moose for their food. Any disturbance of animal balances is of profound importance to them and the cost of meeting claims for loss of income or food sources must be written into the contingencies which may arise. It follows of course that the most stringent conditions must be worked out to safeguard against indiscriminate hunting by crews. Once the routes for pipelines and communications are reasonably firm, but before they are indelibly written in, the assistance of the Director of Game for the Yukon and his counterpart for the Northwest Territory should be sought. It must be remembered that in addition to natives pursuing the traditional way of life in the Yukon and Northwest Territories, there are many professional big game guides and fishing lodge operators whose livelihood may be affected by injudicious timing of communication construction. A number of recent reports show oil spill problems in such places as the Mackenzie and at Boundary Lake on the B.C.-Yukon border. The communication operators and their construction contractors should be encouraged to seek the advice of experts to ensure their plans and methods do not disturb the people or the ecology.

In addition to developing a sensitive liaison with the native interests and game authorities, the planner should try to minimize fire risks. The Forestry Branch should be consulted at an early stage in the planning not only to ascertain their communication needs but also to secure suggestions for communication routes through low-risk areas.

"The wind of change" blows strongly throughout the North. The planner will hear and read of pressures for constitutional changes and greater local autonomy. Even if these changes occur and take the form of regionalization of the Yukon and Mackenzie with a more protected form of administration for the eastern Arctic, it does not appear that these changes would introduce communication problems that would call for drastic reshaping of facilities in the western region. In the eastern region, a change in administrative direction might complicate communication patterns.

It is urgent that the humanist and social scientist obtain some measure of control over the electronic environment we are creating and bring some of the developments into focus. Dr. P. McTaggart Cowan has addressed this problem and he spells out some of the important parameters confronting the communications planner who is reminded that today he has not only a technical, but a moral responsibility too.

> "The pressures of northward expansion from the populous areas of the south are inevitable; we must get ready for them. Tourism and recreation will be followed by development of communities - slowly for the first fifty years, thereafter at an increasing speed. We must learn now how to develop these new communities, so that we can be ready to provide the environment for man where communication is the medium and the message.
>
> As we spread northwards, networks of high energy - gas and electricity - will cross with networks of renewable resource transportation - water flowing south to the parched throats of the unfortunate humans of the middle latitudes.
>
> We must learn how to create the proper environment for these new communities now. If we do not, the Middle North over the next hundred years will be populated with people who are running away from the new society because they cannot adjust to it and we will have a mammoth social problem. If we do, the Middle North will attract the imaginative members of the next generation - the young and the young at heart. They will have their opportunity to build from the ground up and to create communities to their pattern, and the area will prosper and lead.
>
> We must fill the North with communications and an abundance of energy. These will be practical by the year 2,000."

CHAPTER III

Northern Telecommunication Requirements

CHAPTER III

NORTHERN TELECOMMUNICATION REQUIREMENTS

This Chapter is a preliminary statement of telecommunication requirements for the Canadian North. The area covered includes the Yukon and Northwest Territories, and the northern parts of the Provinces of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and Newfoundland. Several field trips were undertaken to investigate, first hand, the adequacy of services in the Yukon, Mackenzie Delta and Great Slave Area, Baffin Island, Northern Quebec and Labrador. Surveys of existing telecommunications facilities were briefly made in the Provinces of British Columbia and Alberta. Information on the Provinces of Manitoba, Saskatchewan and Ontario is based on surveys conducted by the Department of National Health and Welfare.

An attempt was made to obtain information on communication requirements in places that could not be visited by the distribution of a communications survey questionnaire. The questionnaire was circulated to as many agencies as possible that were active in the North by the Department of Communications and the Trans Canada Telephone System. Each provincial telephone company was responsible for submitting responses on their provinces to the Telecommission Study. The questionnaire attempted to elicit present and future communication user requirements. An attempt was also made to assess the adequacy of existing communication systems in the areas visited or surveyed.

GENERAL REQUIREMENTS FOR TELEPHONE, DATA, AND TELETYPE SERVICES

There are three broad user categories for northern communications services;

(a) General Public
(b) Government Agencies
(c) Business and Industry

(a) General Public

There is a tremendous need for telecommunications to

serve the general public in northern Canada. This need exists not only in the two Territories but extends deep into southern Canada. A typical community deprived of adequate communications has a population varying from 50 - 800. In the majority of cases these communities are occupied by Indians or Eskimos. These communities have either no telecommunications or are connected into the national telephone network by High Frequency (HF) radio stations that do not provide a sufficiently high degree of reliability.

This study had adopted the following criteria to permit a quantitive assessment of which communities are entitled to improved telecommunication services:

(1) Every permanent community having a population greater than 50 should have at least one telephone channel for intra and inter-regional communication and access to the national telephone network. Local exchange facilities for intra-community use should be provided.

(2) Service should be available on a 7-day 24-hour basis.

(3) Reliability should be in the order of 95% and prolonged outages should not exceed ½ day in the worst (and exceptional) cases.

(4) Communications should be sufficiently private to allow the transmission of confidential information.

It should be appreciated that the above criteria may not find general acceptance, but they can be used as a first attempt to establish benchmarks for northern requirements.

There are circumstances where the establishment of the above criteria will not be completely satisfactory. It may not be desirable to use population statistics as the only assessment index. The planning of communication facilities such as local exchange switching, distribution, and interconnecting toll facilities may require a more effective measure such as household count rather than population as the important statistic.

(b) Government Agencies

Government agencies in the Territories and the Provinces have a requirement to use telecommunications facilities for administrative purposes. They require a telephone voice channel and a teletype channel for connection to regional centres. The telephone channel should meet the reliability and availability requirements discussed above for General Public Services. The teletype channel should be capable of carrying low speed data at a rate of 60 - 100 words per minute. The major government

users are the Provincial and Territorial Governments and their agencies and federal agencies including the Ministry of Transport, National Health and Welfare, Indian Affairs and Northern Development, Energy, Mines and Resources, R.C.M.Police, and the Department of National Defence.

For communities with a population of 300 or more there is a requirement for Telex or TWX service.

(c) Business and Industry

The industrial requirement for the retail traders and the transportation companies is similar to the above government needs for northern telecommunications. But industry has special additional needs particularly in the mining and oil exploratory fields. For oil, gas, and mineral exploratory work there is a need for transportable stations which can be easily moved at short notice. These stations should be able to transmit voice and data signals to a base or regional centre for onward routing to southern Canada. When large industrial projects are launched, such as large mines or hydro works, there is a requirement to transmit many voice channels and data signals at speeds of 1200 and 2400 bits/second.

A general rule for traffic in northern areas is that 75% of telephone calls are of an intra-regional nature. The essential requirement is for remote communities to contact their regional centre where connections can be made to the national network. From the regional centre the major portion of telephone calls are destined for southern Canada.

The North has many special communication requirements apart from services that are to be connected into the national telephone network. The harshness and desolation of the environment and the life of the residents render further communication needs important. Concern has been expressed that many northern residents involved in hunting and fishing activities do not have any means of communicating with their resident communities. More important, they do not have the means to alert their home communities if an emergency develops.

The priorities for telecommunication services are:

(1) A reliable telephone (voice) service so that emergency or urgent situations can be reported and help obtained.

(2) A reliable telephone (voice) service for intra-regional communications both for the general public and government agencies.

(3) A reliable teletype channel for the transmission of hard copy messages by government agencies.

(4) Reliable inter-regional telephone (voice) and teletype circuits.

(5) Trunk facilities for the transmission of audio (first priority) and video program material for broadcast distribution. (See Chapter III).

(6) Facilities for the transmission of medium or high speed data to and from industrial centres.

(7) Telex or TWX connections to communities with populations in excess of 300 for government administration.

Since intra communications are high on the list of priorities the North has been divided into the following regions for planning purposes:

(a) Baffin Region

(b) District of Keewatin

(c) Arctic Islands

(d) Arctic Quebec

(e) Northern Manitoba

(f) Northern Saskatchewan

(g) Northern Ontario

(h) Yukon

(i) Labrador Coast

(j) Northern Alberta

(k) Northern British Columbia

(l) Mackenzie Delta and Great Slave Area

A synopsis of the requirements of the various regions is given below and details are given in the Telecommission Study 8(c) report - Volume III. Attention is given primarily to general public and government needs since the areas of industrial mining and exploratory activity are reviewed in Volume 2 of Telecommission Study 8(c) entitled "Economic Prospects for the Territories"/

(a) Baffin Region

The survey revealed that 11 locations in this area require reliable voice and data communications. Existing service is by HF radio only. There are HF systems operated by Bell Canada, Ministry of Transport, R.C.M.P., and the Hudson Bay Company. The residents of the communities, the Territorial Government, and the transportation companies have voiced their concern about the inadequacy of the public services in this region. The communities where reliable voice and teletype services should be provided, and the distance to the nearest trunk interconnection point, are:

Location	Population	*Distance
Arctic Bay	250	750
Broughton Island	350	300 (75)
Cape Dorset	588	225
Clyde River	292	450 (325)
Grise Fiord	100	900 (600)
Hall Beach	250	475 (2)
Igloolik	530	525 (35)
Lake Harbour	200	75
Pond Inlet	412	650
Pangnirtung	642	175 (125)
Resolute Bay	254	950 (425)

All communities are tied into Frobisher Bay for administrative purposes. From Frobisher Bay there is a heavy requirement for traffic to southern Canada. Frobisher Bay is the regional centre of the Territorial Government and it is expected that traffic to Yellowknife will increase substantially in the future. An urgent requirement exists for reliable communications between Frobisher Bay and Resolute Bay on Cornwallis Island. Resolute Bay is the centre of activity for such communities as Grise Fiord, Arctic Bay, Pond Inlet and Clyde River.

Apart from the requirement of the Territorial Government for reliable communications for the administration of the region, the Department of National Health and Welfare must have reliable communications to support health services. In the event of illness it is important that doctors at Frobisher Bay can communicate with local nurses or area administrators in the remote settlements to give emergency instruction. It is also important for community administrators to contact Frobisher Bay for aircraft if patients have to be flown out to Frobisher Bay for treatment at this regional centre, or for subsequent transfer to Montreal.

* Distances in brackets show how far the community is from the DEW Line or Polevault System.

Airline companies are dissatisfied with the existing services in the Baffin Region. Requests have recently been received from Atlas Aviation to establish their own HF radio system operating out of Resolute Bay. Airline companies have a particularly serious requirement to know the weather and landing conditions before they travel to or from remote communities.

Nordair has expressed strong dissatisfaction with communications in the Baffin Region. They have indicated a requirement for reliable voice and message communications at the following places:

Povungnituk	Pond Inlet
Lake Harbour	Clyde River
Arctic Bay	Broughton Island
Resolute Bay	Pangnirtung
Grise Fiord	

They desire communications to those points from Frobisher Bay and Montreal. In their opinion the present public service is very inadequate and in cases of emergency they have to use the HF radio systems of the R.C.M.P. and the Oblate Fathers.

The Glaciology Division of the Department of Energy, Mines and Resources has two base HF stations on Baffin Island working several transportable stations. It is expected ultimately that the number of base stations will increase to 10, while the number of remote transportable stations may be increased to 20. Messages are carried between remote stations and from the base stations to Ottawa.

(b) District of Keewatin

The survey revealed that ten locations in this area require reliable voice and data communications. Existing service is by HF radio only. There are HF systems operated by Bell Canada, C.N. Telecommunications, the Hudson Bay Company, R.C.M.P. Missionnaires Oblats de Marie-Immaculee, and the Ministry of Transport. Exchange facilities for local distribution exist in most communities. The Territorial Council, the Territorial Government, and transportation companies have complained about the inadequacy of public service in these regions. The communities where reliable voice and teletype services should be provided, and the distance to the nearest trunk interconnection point, are:

Location	Population	Distance
Baker Lake	596	375
Belcher Islands	210	350
Coral Harbour/Southampton Island	310	450
Chesterfield Inlet	220	325
Eskimo Point	480	150
Gjoa Haven	250	225
Pelley Bay	180	225
Rankin Inlet	430	275
Repulse Bay	146	525
Whale Cove	200	225

There is also a community of interest with settlements in the Baffin Region. Keewatin District is presently administered from Churchill, Manitoba. There is a requirement for solid communications, by other than HF radio means, for communications between Baker Lake and Churchill, and between Baker Lake and Yellowknife. The Department of National Health and Welfare has a requirement for reliable communications to support health services. Communications from Churchill to southern Canada are good but there is no reliable system or circuit linking Churchill with the Keewatin communities.

(c) Arctic Islands

There is a requirement to serve seven communities on the Arctic Islands with improved public communications. There is also a requirement for communications in this area to serve government and industry exploration activity and scientific surveys. The Glaciology Division of the Department of Energy, Mines and Resources have a requirement for communications between stations at Barnes Ice Cap (73°W, 70°N), Generator Lake (71°51'W, 69°38'N), and Decade Glacier (69°48'W, 69°38'N). Communications are required between these stations and from the station at Generator Lake to the Per Ardua Glacier (76°35'W, 81°32'N), and from there to Ottawa. The Department has plans for an additional field area at Southeast Ellesmere Island, so that communications from this area will be needed.

It would appear ultimately that this Department will require extensive telemetry networks throughout the Arctic to relay data to Ottawa or some other large centre. There will also be a requirement for voice communications between field operators for emergency and administrative communications.

The major oil companies have expressed interest in transportable stations in the Arctic Islands to transmit voice and data information to points in southern Canada such as Edmonton or Galgary. Presently communications are required for exploration activity. Precise numbers cannot be given for the number of transportable stations required. The oil companies presently work into a private HF radio system to Edmonton. An entrepreneur at Edmonton has recently established a telephone answering service for HF radio to the High Arctic, which is used by many oil companies. There are complaints now that the service is inadequate and that remote stations have to queue for long periods before their calls can be completed. It is noteworthy that the existing HF system is used for voice communications only but that the availability of a medium speed data link has been requested. Another point for consideration is that planning should take place now to meet requirements in the event that there is a major oil discovery on the Arctic Islands.

In summary for oil exploration activity, flexible communications systems should be designed to meet requirements at short notice in areas of the Arctic where oil exploration is proceeding.

The communities where reliable voice and teletype should be provided, and the distance to the nearest trunk interconnection are:

Location	Population	Distance
Bathurst Inlet	50	180
Holman Island	180	325
Paulatuk	100	250
Perry River	50	125
Sachs Harbour	132	260
Spence Bay	270	280
Thom Bay	50	300

(d) Arctic Quebec

There are 26 locations in Arctic Quebec having a requirement for new or improved telephone and data services.

Communities in Arctic Quebec are connected to the telephone network by HF radio. There are also HF systems operated by the Hudson Bay Company. The communities where reliable voice and teletype services should be provided and the distance to the nearest trunk interconnection point are:

Location	Population	Distance	Location	Population	Distance
Eastmain	171	120	Nemiscou	172	
Fort Chimo	701	400	One Goeland Lake	100	
Fort George	1300	200	Obedjiwan	400	100
George River	194	375	Paint Hills	535	150
Grand Lac Victoria*	211	30	Payne Bay	159	275
Great Whale River	965	300	Port Harrison	515	500
Koartak	97	200	Povungnituk	639	375
Ivugivik	117	300	Rapid Lake	139	
Lac Albanal*	200		Romaine	704	
Lac Evans*	50		Rupert House	832	90
Lac Simon*	239		Sugluk	337	250
Leaf Bay	50	350	St. Augustine*	900	
Manouane*			Wakeham Bay	194	200

* Clarification of the status of these communities is required.

There is likely to be a communication requirement for Raglan Mines on Deception Bay to support a large asbestos operation in this part of Quebec. The requirement is for voice and data transmission. Communications with Frobisher Bay are requested.

Nordair has complained about the quality of services in Arctic Quebec. They are anxious to have reliable communications to the following points:

Fort George	Asbestos Hill
Great Whale	Raglan Lake
Port Harrison	Douglas Harbour
Povungnituk	Wakeham Bay
Ivugivik	Payne Bay
Deception Bay	Fort Chimo

Fecteau Airlines indicate that they are interested in having good communications to the following points: Gagnonville, Seneterre, Paint Hill, Cape Jones, Povungnituk, Sugluk, Wakeham Bay. Mining companies have a requirement for transportable stations.

Occasionally, there is a demand for communication channels handling data at the rate of 2400 bits/sec. (Teletype information is also required at a speed of 100 words per minute.) Error rates of the order of 1 error in 10^5 bits is desired. The usual need is for transportable stations to operate into major centres, preferably those in southern Canada.

(e) Northern Manitoba

There are 34 locations in northern Manitoba having a requirement for new or improved telephone and data services. Most of the communities concerned are populated by Indian people. The requirement is for reliable public telephone service and a communications system to support health services provided by National Health and Welfare. Steps were taken recently to implement an HF radio system by Manitoba Telephone System in co-operation with the Department of Communications and National Health and Welfare. But this is an HF system which is not considered adequate for permanent service because

a) The reliability cannot approach an acceptable level for emergency communications;

b) There is no provision for public telephone service to serve the communities with reliable trunk connections to the telephone network;

c) this system is dedicated to the use of National Health and Welfare only and public access to the system is not possible.

The places where requirements exist are as follows:

Location	Population	Distance	Location	Population	Distance
Berens River	763	90	Nelson House	1282	35
Bloodvein	308	60	Oxford House	800	298
Brochet	637	77	Pauingassi	160	120
Cross Lake	1840	38	Pinedock	109	45
Dauphin River	80	28	Popular River	385	135
Easterville	344	25	Pukatawagan	836	7
Garden Hill	1129	208	Red Deer Lake	62	6
God's Lake Narrows	887	258	Red Sucker Lake	218	258
God's Lake	83	258	Sault Point	60	30
God's River	50	258	Shoal River	490	
Granville Lake	80	110	South Indian Lake	477	150
Hole River	300	7	Split Lake	400	15
Jackhead	242	60	St. Theresa Point	880	208
Little Black River	168	18	Shamattawa	344	107
Little Grand Rapids	450	110	Wasagamach	450	208
Matheson Island	160	50	Waterhen	677	40
Moose Lake	630	38	York Landing	80	8

* MTS state that they presently provide some form of public telephone service in all communities having more then 50 people. Respondents to the Communications Survey Questionnaire do not agree that the services provided meet their requirements.

It appears that the Province of Manitoba is in need of improved telecommunication facilities that will connect the above communities into the national telephone network. The number of HF stations licensed to private operators is in the order of 1,000 stations. Licensees include such diverse agencies as the Department of Indian Affairs, and Health and Welfare for Manitoba, United Church of Canada, Lamb Airways, Sherritt Gordon Mines, Ltd., Central Geophysics Ltd., etc. It is interesting to note that the Manitoba Government Air Services have a very extensive communication network serving northern Manitoba. They have base stations at The Pas, Thompson and Norway House. The system is used for air-ground communications for the agency's operations in northern Manitoba, for aircraft in constant contact with the ground for patrol purposes, and for protection purposes. This agency expresses satisfaction with the capability of its own system to handle its particular requirements, although there is no indication that the public need has been fulfilled.

(f) Northern Saskatchewan

About 50 communities in northern Saskatchewan require improved communications. The communities are inhabited by Indian bands. Most of these communities are tied into a system operated by the Department of Natural Resources of the Saskatchewan Provincial Government over HF radio. The premise is that the service to these communities is not sufficiently reliable, nor is an adequate level of service maintained. The Department of Natural Resources provides telephone service for the general public in addition to a number of provincial departments such as the Departments of Highways, Forest Products, Saskatchewan Power Corporation, Department of Indian Health Services, etc. The Department of Natural Resources serves the northern subscribers with HF radio base stations at

i) Lac La Ronge
ii) Buffalo Narrows
iii) Brabant Lake
iv) Cree Lake
v) Stoney Rapids
vi) Uranium City
vii) Wallaston
viii) Flin Flon
ix) Meadow Lake
x) Hudson Bay
xi) Prince Albert

The quality of transmission of the network, as admitted by the Department of Natural Resources, is unsatisfactory. There are difficulties in transmission and there are difficulties in providing operating schedules on an 8-hr. 5-day week basis. There is considerable jamming of the network in view of the large number of stations in the system.

Specific agencies in Saskatchewan have indicated requirements for special services to support their operations. These facilities are required to

(a) provide trunk facilities for the Department of Education to transmit radio and perhaps television programs to northern schools;

(b) Saskatchewan Power Corporation require more efficient and reliable communication systems for monitoring and controlling the electrical power network;

(c) The Saskatchewan Hospital Services Plan needs a basic reliable communications system between their various hospitals and clinics in northern Saskatchewan in addition to a means of communication with southern hospitals for information, emergencies, etc.;

(d) Industries such as pulp and sawmill operators require reliable voice and data facilities. It is predicted that the pulp and sawmill complex in the Canoe Lake area will require these facilities.

Note: Future needs identified by the Department of Natural Resources include a new air transportation system for northern settlements requiring communications support. Very long range plans for northern hospitals would include data facilities with long line terminals to a central computer for diagnostic and data purposes. The Department of Highways would like a more reliable private communications system, and the Anglo Rouyn Mine has a potential need for a system to carry voice and data transmission to southern areas.

The communities where new or improved voice and teletype services are required and the distance to the nearest trunk interconnection point are -

Location	Popn.	Distance (mi)	Location	Popn.	Distance (mi)
*Albertville	78	on trunk route	Ile-a-Crosse	941	104
*Aylsham	176	" " "	Island Falls	178	60
Beauval	486	85	La Loche	1090	200
Black Lake	415	100	*Mayfair	114	on trunk route
Buffalo Narrows	611	130	*Meath Park	198	" " "
Canoe Lake	320	80	Molonosa	214	15
Chitik Lake (I.R)	260	2	Montreal Lake	90	
*Chitik Lake	134	on trunk route	Patuanak	118	105
*Choiceland	493	" " "	Pelican Narrows	130	35
*Christopher Lake	163	" " "	Pinehouse Lake	336	58

Location	Popn.	Distance (mi)	Location	Popn.	Distance (mi)
*Clemenceau	60	on trunk route	*Rabbit Lake	225	on trunk route
*Codet	187	" " "	Red Earth	372	50
Cree Lake	57	165	*Reserve	187	on trunk route
*Creighton	1904	on trunk route	Sandy Bay	561	65
Cumberland House	628	55			
Deschambault Lake	253	29	*Shipman	69	" " "
Dillon	90	127	Shoal Lake	182	55
Dore Lake	112	72	*Snowden	65	on trunk route
*Dorintosh	102	on trunk route	Southend	114	116
*Erwood	119	" " "	Stanley Mission	156	37
*Flin Flon	527	" " "	Stoney Rapids	123	116
Fond du Lac	398	55	Sturgeon Lake	615	25
*Frenchman's Butte	111	on trunk route			
*Glen Bush	55	" " "	*White Fox	389	" " "
*Green Lake	744	" " "	Wollaston Lake	57	222
*Gronlid	151	" " "			

* Clarification of the public services available at these locations is necessary.

(g) Northern Ontario

There is a requirement for telecommunications services for telephony and data transmission in 31 locations in northern Ontario. The essential requirement is to support health services of the Department of Health and Welfare. The communities where new or improved communications are required and the distance to the nearest trunk interconnection point are -

Location	Popn.	Distance	Location	Popn.	Distance
Angling Lake	125	170	New Osnaburgh	600	21
Attawapiskat	441	140	North Spirit Lake	100	112
Bearskin Lake	270	170	Ogoki	195	144
Big Trout Lake	550	160	Pikangikum	661	60
Cat Lake	157	75	Poplar Hill	150	80
Deer Lake	120	115	Round Lake	434	
Fort Albany	220	80	Sandy Lake	850	140
Fort Hope	450	85	Sachigo	140	190
Fort Severn	144	450	Slate Falls	110	68
Grassy Narrows	485	36	Weagamow (Round Lake)	144	150
Kasebonica	100	167	Webique	105	160
Kashechewan	350	84	White Dog	495	35
Kingfisher Lake	90	111	Winisk	134	330
Lansdowne House	350	100	Wunnummin Lake	209	120
Lac La Croix	141	36			
Lac La Seul	506	23			

The Ontario Provincial Government have indicated their dissatisfaction with existing services. They hope to introduce an airstrip program for northern Ontario, and they are giving equal priority to communications improvements in this program. The Department of Communications is entering into a crash program with Bell Canada and the Department of National Health and Welfare to install an HF system to support health services. This system is a temporary measure and will not meet the standard of reliability ultimately required. It is also a dedicated system that will not serve the needs of the general public for a telephone service into the national telephone network.

(h) Yukon

The existing telecommunication facilities in the Yukon for telephone and data service are satisfactory. The only permanent community that is unserved by reliable telephone service is Old Crow in the northwestern portion of the Territory. The Yukon forestry service operates an HF system that is unreliable and not properly maintained but this is for a special purpose where connection to the national network is not a prime consideration. The Commissioner of the Yukon Territory has indicated that he is very satisfied with the quality of service in his Territory.

(i) Labrador Coast

A special survey trip was made to examine the status of telecommunications facilities in Labrador. It was hoped that the information gained from a detailed investigation of this area could be extrapolated to communication problems in other remote areas. The communities where new or improved communications are required and the distance to the nearest trunk interconnection point are -

Location	Population	Distance
Batteau	75	55
Davis Inlet	175	45
Indian Tickle	70	50
Makkovik	400	52
Nain	650	95
Packs Harbour	125	12
Paradise River	150	
Pitts Harbour	60	
Postville	125	47
Rigolet	150	70
Spotted Islands	150	60

(j) Northern Alberta

In northern Alberta the important problem is to provide telecommunications services to communities inhabited by Indian bands. There is a need for reliable trunk facilities and for

* Alberta Government Telephones state that only 5 communities have need for improved services. Conflicting information has been received on the status of services and must be clarified for future planning effort.

exchange facilities. The communities where new or improved telecommunications are required, and the distance to the nearest trunk interconnection point, are -

Location	Popn.	Dist.	Location	Popn.	Dist.
Anzac	225	24	Fort McKay	176	13
Atikmeg	420	20	Fox Lake	475	61
			Gambler	183	
Cadotte Lake	85	39	Garden River	125	72
			Gift Lake	370	26
Chipewyan Lake	150	67			
			Indian Cabins	63	1
Conklin	150	42	Janvier	191	45
Driftpile River	502		Jean D'or	424	32
			Sandy Lake	110	19
Little Buffalo Lake	105	42	Sturgeon Lake	735	
			Utikoomak Lake	155	
Loon Lake	150	18			
Meander River	300	1			
O'Chiese	500				
Peerless Lake	85	18			

Many oil companies operate extensively in northern Alberta and make use of their own private HF systems for communication to Edmonton. There is a heavy requirement for transportable stations providing voice and data communications into the telephone network.

(k) Northern British Columbia

A requirement for new or improved telephone and data services exists in 14 communities. The need is for adequate connections to the telephone network for public use and to support health services provided by the Department of National Health and Welfare. The communities where new or improved services should be provided are as follows:

Location	Population	Distance
Blueberry River	70	148
Dease Lake	100	267
Eddontenajon	174	250
Halfway River	100	25
Kincolith	412	50
Kitkatla	470	40
Kitwancool	198	15
Nation Lakes	under 250	130
Omineca	96	170
Stewart Trembleur	439	105
Takla Lake	under 250	170
Takla Landing	under 250	170
Tahltan	144	320
Telegraph Creek	150	250

(1) Mackenzie Delta and Great Slave Area

Communications in this area are generally good. Service is provided along the Mackenzie River by the Mackenzie Poleline system. Improved or new communication facilities are required at six communities:

Location	Population	Distance
Coleville Lake	67	
Fort Liard	160	300
Nahanni Butte	85	300
Lac La Martre	168	140
Snowdrift	209	125
Rocher River	150	100

There are difficulties in establishing adequate telecommunication services in remote communities that go beyond a technical problem of establishing connections. One major problem is the selection of people who are prepared to accept the administrative responsibility of telephone company agents. The telecommunication common carriers point out that they have attempted to install emergency facilities in remote communities but have been unable to find local residents who would be responsible for collecting toll revenue. The common carriers also indicate that a population of 300 may represent a relatively small settlement which would not justify the installation of Telex or TWX services. Particularly in the northern parts of some of the provinces, e.g. Northern Alberta, it would be preferable to establish reliable telecommunications at main government centres if a regular aircraft schedule is maintained with the smaller settlements. This view is not shared by government agencies who feel that the cost of transportation could be reduced if high quality telecommunication services were available.

SPECIAL REQUIREMENTS

The requirements stated in Chapter I have concerned the provision of point-to-point services for public telephone and data services and for certain government agencies, such as the Territorial Governments and the Department of National Health and Welfare, for the transmission of administrative messages. However, there are agencies which operate in the North to serve particular functions, e.g. the Ministry of Transport, Department of National Defence, R.C.M.P., Hudson Bay Company, and the Canadian Broadcasting Company. Their requirements are discussed below.

Ministry of Transport - Navigational Requirements

Air Traffic Control

Positive control of aircraft (both Military and Civil Aviation) over Canadian territory is carried out where radio aids are installed and reliable two-way voice circuits are available on a 24-hour 7-day week (landline, microwave, tropospheric scatter cable).

Flight information and control clearances are transmitted to the Area Control Centre by either peripheral facilities whereby the controller and the aircraft pilot may talk directly to one another, or the message may be relayed by a third party such as an aeradio station. For example, an aircraft in range of Cambridge Bay Aeradio may pass a flight message to the Radio Operator over the air-ground facility and the operator will immediately pass the message to the controller at the Area Control Centre in Edmonton over an ATC Interphone circuit.

Any improvement to the communication capability in the Central Northern Region would enhance the control of aircraft through that area and make it possible to extend the ATC Interphone system to such points as Baker Lake and Coral Harbour through Churchill and Great Whale on the eastern shore of Hudson Bay possibly through Moosonee.

Extension of reliable commercial telephone capability north of Cambridge Bay to Resolute would enhance the ATC capability of providing Air Traffic Services to the users in the Arctic Control Area.

Marine Aids to Navigation

There are 12 Marine Radio Stations north of the 55th Parallel in support of shipping in northern waters including Hudson Bay. These stations provide a safety service to shipping and ship-shore communications for the handling of operational and paid messages as well as providing weather synopsis and forecasts and dangers to navigation. Many of these stations are physically combined in an Aeradio station and all are connected to the national computerized teletype network.

U p to the time of the first MANHATTAN trip in the summer of 1969, no serious communications problems were encountered. This was, no doubt, because the northern resupply operation was planned in advance each year, and because of its short duration and simplicity involving only C.C.G. ships and a few others chartered by the Canadian Coast Guard. This type of operation rarely demanded more than one or two short operational messages from each ship each day and because of the non-urgent nature of the great majority of such messages, delays in reception were often tolerated or even unnoticed. The present system although not 100% adequate for today's type of operations nevertheless meets the needs in normal circumstances.

However, except as now arranged for the LOUIS S. ST. LAURENT, that is radioteletype in the vessel with use of the private MOT circuits from Resolute and Cambridge Bay, the present system is incapable of handling quickly the volume of traffic anticipated if the Northwest Passage is to be used by commercial ships. It is certainly less capable of handling the type of instant communications that would be required in emergencies such as major oil spills, marine disasters, epidemic diseases in ships, etc. Means of direct voice communications with ships in the Arctic are at present unavailable except through the High Seas Telephone Service with vessels within radio coverage of Halifax or Vancouver. Vessels are of course out of coverage of these two stations most of the time during Arctic operations. Another

consideration of the present system is that facsimile transmissions for ice and weather maps, as they now originate from Halifax and Edmonton with a minor contribution from Frobisher, are not received too well in some areas of the Arctic in which C.C.G. ships operate. To sum up, the present communications system is short of being fully adequate for the operations now conducted in the Arctic. However, owing to the short duration of these operations each year and the type and number of ships taking part, it would perhaps be hard to justify high cost improvements in the system except in parallel with an increase in marine activities and a lengthening of the shipping season in those regions.

As far as future communications requirements are concerned, provided that the present plans for exploitations of Northern resources through the Northwest Passage materialize, it is evident that the delays in communications that are now experienced because of lack of coverage, poor propagation, saturation or simply because of lack of means in some parts will then be non-acceptable to the Canadian Coast Guard and commercial users. It is envisaged that, if the Northwest Passage is ever used on an extended season as some people think is possible, the volume of communications will greatly increase because of the greater number of ships in the Arctic and also at least for some time because of an increase in scientific, ice, weather and other information (data) transmitted from each vessel.

Apart from the operational traffic mentioned above, there would also be an increase in communications on the part of individuals in ships, including some Government Coast Guard ships, which would remain in the Arctic for more extended periods than at present.

The advent of mammoth tankers as well as other large type vessels in the Arctic, would bring an extra and very definite need for a Marine Communications System capable of handling a large volume of communications with the shortest delays possible. In this instance, the necessity is apparent of having a system capable of handling emergency communications of the highest priority such as during a marine disaster or even a light grounding involving tankers which could pollute the northern seas and coasts if their oil cargoes were to escape. In such emergencies it is conceivable that a Canadian Coast Guard vessel could be required to remain on the scene as a communications centre during salvage or cleaning up operations.

A Marine Communications System covering the Arctic waters in the future should be one capable of providing solid coverage for radioteletype, C.W., voice and facsimile anywhere along the main Arctic Sailing Route from Alaska to some point within coverage of East Coast stations. To complete the network, it would of course be necessary that all shore stations in the system be equipped with radioteletype and the means necessary for the quick forwarding of marine traffic to southern destinations. Direct voice communications by duplex with ships anywhere along the Route would be a must for the type of emergency situations mentioned earlier and every shore station in the system should be capable of handling such calls. Lastly, the system should be capable of handling a volume of traffic such that it would not become saturated during peak periods or by extra traffic caused by emergency situations.

Future communications requirements in the North will, to a very great extent, be dictated by the amount of marine activities and the length of shipping seasons. As there have been no firm decisions made yet by potential exploiters of northern resources, it would be a bit premature to state future requirements in more definite terms.

Supporting Communications

A number of years ago the Ministry of Transport established a national teletype communications network primarily to support aeronautical operations. The network has been upgraded and extended over the years and a fully automatic computerized teletype network is scheduled for commissioning in September, 1970, replacing the present semi-automatic network. The network will interconnect all Ministry of Transport establishments having reliable landline facilities through a Montreal based computer. Delivery from any one point on the network to any other point in Canada will be almost instantaneous and well within a five minute delivery requirement for operational messages. The Canadian network also forms part of the world wide aeronautical fixed teletypewriter network. In addition to Air and Marine Operational traffic and Meteorological traffic, Ministry of Transport Administrative messages are passed over this network on a lower priority basis.

At the more northerly or isolated points the national network is extended by means of radio circuits. The Ministry of Transport is presently converting their radio circuits to either LF, RTT or HF SSB voice and/or RTT circuits. Where practical LF circuits are established using an existing

non-directional beacon for transmitting purposes. These transmitters operate at 400 watts although high power NDB's (2 KW) are utilized at Baker Lake, Cambridge Bay, Coral Harbour, Resolute Bay and Frobisher. The HF SSB circuits make use of 500 watt P.E.P. transmitting equipment.

The Ministry ofTransport have established base radio stations at Churchill, Baker Lake, Chesterfield Inlet, Ennadai, Resolute, Eureka, Isachsen, Mould Bay and Alert to provide communications for field and survey parties operating in range of these points.

In addition to the Air and Marine Operational messages Meteorological messages and MOT Administration messages handled on the computer network, other Government Departments' administrative messages and commercial messages may be handled on the radio circuits where no other communications facilities are available. This traffic is routed to the nearest landline interchange point where it is transferred to commercial circuits.

Meteorological Communications

Weather Observing System

The weather observing system of the Canadian Meteorological Service comprises a network of stations located at specified intervals throughout Canada.

Stations on the complete network may be operated by one or any of the following:

CON - Contract (with private person, corporation, etc.)
DND - Department of National Defence
ITCA - International Telephone and Telegraph Arctic Services, Inc.
JAWS - Joint Arctic Weather Stations (United States Weather Bureau/Meteorological Service of Canada).
MSC - Meteorological Branch, Department of Transport.
MAR - Marine Services, Department of Transport.
PCSP - Polar Continental Shelf Project.
TEL - Telecommunications and Electronics Branch, Department of Transport.
USN - United States Navy.

Stations located north of the 55th Parallel are either CON, JAWS, ITCA, MSC, TEL, or combined MSC/TEL and one PCSP.

As of March 1, 1970, the meteorological communications system was converted from semi-automatic operation to a computer controlled switching system. The system consists of a number of individual circuits, operating at 100 w.p.m. connected to a third generation Collins Model C-8500 computer, located at C.N.T. Headquarters in Toronto.

The teletype equipment, circuits and the computer switching equipment for the system are leased from CN/CP Telecommunications and sub-contractors such as Quebec Telephone Company, Alberta Government Telephones, etc.

An efficiency rating of 95% is generally considered as acceptable for Met. operation. Anything less usually results in complaints and the need for supervisory attention.

Ideally, all stations on the weather reporting network should be connected to circuits controlled by the computer, which allows data to be picked up direct and weather information fed to the station from the computer. Another advantage is that stations will obtain a hard copy of data required for meteorological support, by use of teleprinter equipment. However, it is recognized that this may not be economically feasible nor practical, particularly for stations located in remote areas. For these stations, the requirement is for suitable communications that will ensure the collection of data within the transit times of 10-30 minutes and the dissemination of data to the stations.

In regard to physical operational requirements it is desirable that failures or outages to any new northern circuits would be kept to the same minimum as that for regular landline. Garbling or error rate (as distinct from outages) is of importance in computer operation and in the transmission of a large amount of digital data containing symbols and numbers. Circuit assurance and parity checks are proving useful if only to indicate questionable sources. While there has definitely been improvement in northern communications, it should still be pointed out that weather information from this area is as much or more vital than that in other areas. Any new measures designed to upgrade reliability, accuracy and consistency in day-to-day communications to the north country would be invaluable.

In addition to the teletype system, the Ministry of Transport operates two separate and distinct facsimile systems, National/Regional and Supplementary, for the transmission of weather charts by facsimile communication processes.

The transmitting stations to the National/Regional network are the national transmitting centre: Central Analysis Office (CAO) at Montreal and six Regional transmitting centres at: Halifax, Montreal, Toronto, Winnipeg, Edmonton, and Vancouver. (At certain periods of the year, Resolute and Frobisher may act as radio transmitting stations for ice information).

The Supplementary network has only one transmitting centre, CAO at Montreal. The transmissions on both networks are made to a large number of recording stations, with most of the stations under Meteorological jurisdiction, the remainder operated by Department of National Defence, government offices other than Transport, Provincial Governments, Universities and industry.

Most of the stations are located south of the 55th Parallel except the following:

Fort St. John
Yellowknife
Whitehorse
Frobisher
Inuvik
Resolute

The networks consist of a main trunk circuit, emanating from Montreal (CAO) and extending to Victoria on the West Coast and to St. John's on the East Coast. The main circuit is routed over the microwave facilities of the Telegraph Companies' landline circuit extensions to recording stations.

In addition to the landline circuit, two stations, Edmonton and Halifax, make a radio facsimile broadcast of the charts received to designated areas. The Edmonton radio facsimile broadcast is intended for reception by stations in the Arctic areas and ships operating in Arctic waters, equipped with facsimile equipment. The Halifax radio facsimile is operated by DND and is mainly intended for ships operating in the Northern Atlantic.

The landline circuits have a general efficiency rating of 90 to 99 per cent. For radio facsimile transmissions, the efficiency rating varies between 30 and 75 per cent.

The operation of a facsimile network at 120 rpm requires good quality circuits of voice frequency or better, with conditioning for phase delay and other conditions a requirement.

An operating efficiency of 95% or higher is desirable. When the rating is below 95% usually the quality of reproduction suffers, or the chart is not received resulting in requests for re-transmission. In view of the much lower percentage figures for radio facsimile reception, it would be desirable to have as many of the present radio recording stations converted to landline, or its equivalent, as possible.

Department of National Defence Requirements

A. General - A study is under way investigating and detailing the future tasks and roles of the newly formed Northern Region Headquarters (NRHQ). The results of the study will be presented for consideration in October, 1970. From this study, communications planning will evolve. Meanwhile, we can list the requirements which are known at this time and possibly forecast future trends.

B. New Requirements - The following requirements are known at this time:

(1) Fixed Locations

(a) Yellowknife, NWT - This is the location of a Canadian Forces Liaison Detachment. This detachment is serviced by local telephone service and has access to a Telex terminal operated by another federal agency. The NRHQ will be relocated from Ottawa to Yellowknife by November, 1970, and will require the following service at that time:

(i) Teletype: DND provided terminal equipment with a 60 w.p.m. commercial line from Yellowknife to Edmonton, Alberta. This terminal will operate as a detachment of the Canadian Forces Communications System on an eight hour, five day per week basis with a full-period capability when required.

(ii) Telephone: A 10 line, 50 local PABX with direct-in-dialing capability will be required for local service. Long distance voice service to selected locations in the South and to communities in the North will be required. An accurate forecast of long distance traffic volume is not possible at this time, however, an estimate of two outgoing and two incoming messages per day would appear adequate for planning purposes.

(2) Whitehorse, Y.T. - This is the location of a Canadian Forces Liaison Detachment. This detachment will continue for the next year at least to be serviced by local telephone service. An estimated message volume of one outgoing and one incoming message per day exists at this detachment. At this time this traffic is being handled through another government agency.

(3) Mobile Land and Air Units - These units operate out of permanent bases in the South. When deployed on tasks or exercises in the North, they will provide their own radio communications to NRHQ and their southern bases. Requirements will occur for local telephone and/or teletype service at advance bases or airfields in the North to support these mobile units, however, no firm requirement can be forecast at this time.

(4) Canadian Rangers - Detachments of the Canadian Rangers exist at virtually every settlement North of 55° latitude. While routing communications between NRHQ and each detachment will only average one telephone call or message in each direction per year, it is imperative to our national security that quick emergency communications be established between these detachments and NRHQ Yellowknife when required. Since the volume of traffic cannot justify full time service to each of these detachments,DND will be dependent on the assistance of other federal agencies and commercial concerns to provide communications in time of civilian or military emergency.

C. Future Trends - While it is safe to forecast increased military interest and activity in the North, it is too early to predict what form this activity will take. Two of the more likely areas of military activity that would affect northern communications are the following:

(1) Search and Rescue - This task could be carried out by military units either permanently sited in the North or units deployed as required from the South with a small headquarters and communications detachment permanently located in the North. In either case the permanent site for such a unit would be associated with a large airport/ DOT facility such as Yellowknife or Inuvik and would be capable of providing emergency surface and ground to air HF (SSB) communications throughout the North.

(2) Northern Region Detachments - Depending on the scope and direction of military activities in the North it is possible that NRHQ will deploy several small (three to five men) permanent detachments. These detachments would be responsible for such things as liaison with local government and civilian agencies; ground search coordination, coordination of local Ranger activities and providing an advance base and other assistance to mobile ground and air units from the South. These detachments would require voice communications (telephone or radio) to all government and commercial agencies within their local area of responsibility and both voice and teletype communications to and from NRHQ Yellowknife. These local detachments could be located in any or all of the following communities:

(a) Whitehorse, Y.T. - Present Canadian Forces Liaison Detachment.

(b) Inuvik, NWT. - Associated with Canadian Forces Station, Inuvik.

(c) Alert, NWT. - Associated with Canadian Forces Station, Alert.

(d) Frobisher Bay, NWT- At present a detachment from Maritime Command, Halifax.

(e) Resolute Bay, NWT - Possible site of Canadian Forces Liaison Detachment.

(f) Churchill, Man. - Possible site of Canadian Forces Liaison Detachment.

HUDSON BAY SYSTEM

The Hudson Bay Company radio system is an extensive one. Comprised of seventy-five stations, it is represented in the North of all the provinces, and in the Northwest Territories, including the Arctic Islands.

The system was established to provide an administrative link between the Hudson Bay Company's stores and administrative centres in Edmonton, Winnipeg and Montreal.

However, use of the network to relay messages for government and commercial groups is substantial and growing. This "outside" traffic is relayed to the nearest commercial outlet in accordance with Hudson Bay Company licence provisions. These

outlets include the Department of Transport, the Canadian National Telegraph , and several telephone companies.

A charge of $1.50 for 50 words (25 cents for each additional 10 words) is levied over and above the phonogram or telegram rates that may apply. A daily schedule is observed of two to three transmissions daily, with the public commercial radio outlet concerned.

RCMP SYSTEM

The RCMP own, operate and maintain their HF radio system and provide for 24 hour operation where necessary. Their radio system is operated primarily as a point-to-point communications service. In northern Canada, and less densely populated areas, where due to vast distances involved, VHF-FM mobile radio range is insufficient, HF radio is also used as the main mobile communication service. The RCMP system, apart from its use for carrying administrative traffic for the Force, is also the most reliable emergency system available covering the North. Reliability is very high because stations can work between each other and do not necessarily have to home onto a particular base station . By relaying messages between adjacent locations it is possible to communicate quickly though indirectly between two points.

Volume 3 of Telecommission Study 8(c) contains a detailed listing of all stations operated by the Hudson Bay Company and by the RCMP. It is apparent that both these agencies would be able to use more reliable service provided by terrestrial or satellite means if such service could be made available on economic terms. This is particularly so in the case of the Hudson Bay Company who permit the public to make use of their system for a small charge. Since the RCMP system is a very effective and reliable system for the use of the Force it is unlikely that this agency would be quite so anxious to curtail their own operations.

CANADIAN BROADCASTING CORPORATION

The first two contributions to Telecommission Study 8(c) entitled "Communications in the Canadian North" and Catalogue of Communication Systems in Northern Canada" describe those facilities which are presently available in the North for the transmission of television and radio services. It can be seen there is no transmission capability for bringing live television to the Yukon, Northwest Territories, and northern parts of the Provinces generally above the 55° parallel. Network radio service

does not reach the District of Keewatin, Baffin Island, or the Arctic Coast. Many communities in the northern parts of the Province are similarly not connected to the CBC radio network. Those locations lacking live television and medium wave radio network service are listed in the Tables at the end of Volume 3 of Telecommission Study 8(c)-3.

Radio

It is clear from the recommendations of the Yellowknife Communications Conference that the first requirement is for each community to have its own broadcasting station. This station might be a low-power radio transmitter (LPRT) to be used for education, information, entertainment, and social action purposes.

The second requirement is for these stations to be connected intra-regionally, inter-regionally, and finally to the national radio CBC network.

Presently, the CBC operates two networks in the Territories - the Mackenzie and the Yukon networks. The Yukon network consists of stations at Fort Nelson, Watson Lake, Swift River, Cassiar (B.C.), Teslin, Whitehorse, Haines Junction, Destruction Bay, Beaver Creek, Dawson City, Carmacks, Mayo, and Elsa. The Mackenzie network has stations at Hay River, Pine Point, Fort Smith, Uranium City (Sask.), Fort Providence, Yellowknife, Fort Simpson, Wrigley, Fort Norman, Norman Wells, Fort Good Hope, Inuvik, and Fort Chippewyan (Alta.). Both these regional networks broadcast, in addition to regular CBC programs, programs in Eskimo, Chippewyan, Slavee, Cree, and Loucheuse.

The following requirements have been identified for the extension of network radio service.

(a) Extension of the Mackenzie network to the eastward to cover the Western Arctic - with Inuvik as the program centre.

(b) A new regional network established to cover the large Indian population of Northern Manitoba - possibly from a program centre at The Pas.

(c) A regional network originating at Churchill to cover the Keewatin communities.

(d) A French regional network to cover communities on the Labrador Coast.

(e) Extension of the Labrador network to cover communities on the Labrador Coast.

(f) A regional network for the East Coast of Baffin Island and the communities on the Arctic Coast.

Television

The Eskimo and Indian people of the North have not so far expressed a priority need for the reception of television programs in their communities. Their main concern, if live television is brought to them, is that the program material should be suitable for their culture and education. However, it is probable that the younger generation of native people will respond to television if the problem of programming can be solved.

The need for live television has been stressed by northern residents who have come from the south, and particularly by industry, to encourage longer turn-arounds of labour forces. The requirement for live television is evident in those communities having Frontier Package Service because delayed programs have not been well received.

No community in the Yukon or Northwest Territories has live television now. It appears that the priority at the moment is to serve large, particularly industrial, centres. Since industrial development in the Yukon and the western part of the Northwest Territories is far ahead of the Central and Eastern Arctic, it is likely that live television will be brought to these areas first. But television can be a potent instrument for education and would be most effective for this purpose if programs were originated in the North - say Yellowknife.

TERRITORIAL GOVERNMENT ADMINISTRATION

A statement of requirements would not be complete if some mention were not made of modern communication techniques to assist government administration.

The use of communication as an instrument of government has not been exploited very intensively. The present reliance is on telephone with short wave radio for work in forestry. A great gain in efficiency might be achieved by print-out equipment, facsimile units for police identification, central filing of records and claims without the need for outlying offices or expensive journeys to urban points and also for

recording, storage and retrieval of land titles, company records, chattel mortgages, etc. Some legislative changes might be needed but the Land Titles Act and Companies Ordinance are long due for overhaul. The federal government could consider the possibility of up-dating Territorial administrative methods as a pilot project in the governmental use of modern computer and communication technology. Car Licences, vehicle records, business licences, game licences, fishing licences, and all the statistical studies to evaluate the economic and sociological health of the area all involve detailed procedures which should lend themselves to programming.

CHAPTER IV

Northern Communications Conference

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NORTHERN COMMUNICATIONS CONFERENCE

A Northern Communications Conference was held in Yellowknife, N.W.T. between September 9 and 11, 1970. This Chapter records the purpose, oganization, and recommendations of the Conference.

The Northern Communications Conference provided the first opportunity for the people of the North to be heard on a variety of communication topics and issues. It enabled them to express their views and present their needs for communication services. About 200 people attended the Conference. They came from all parts of Canada, some came from remote and isolated parts of the North, others from the major southern centres. Involvement by native participants was articulate and sustained. Representatives of government, industry, universities and the professions came primarily to listen and obtain direct experience of the northern environment. A distinctive feature of the Conference was contact and surprising unanimity on communication priorities by peoples of different cultures and disciplines.

The Conference was intended to focus attention publicly on the relevance of communications to northern needs and aspirations. Active participation was encouraged and information sought to guide and affect policy formulation. The expectation was that the unusual blend of experts from the social and technological sciences would respond to communication problems and produce recommendations that were imaginatively conceived to stimulate future action.

CONFERENCE ORGANIZATION

Initial meetings to discuss the holding of a Conference on Northern Communications were held in the summer of 1969 and involved primarily government officials. By the fall of 1969 a commitment had been taken by both the Department of Communications and the Department of Indian Affairs and Northern Development to share the financial expenses of a Conference on Northern Communications, and a number of academic groups were contacted with respect to sponsoring the meetings and organizing its program. By the autumn of 1969 a program committee composed

of officials of the Department of Communications, the Department of Indian Affairs and Northern Development, the Boreal Institute of the University of Alberta and the Arctic Institute of North America met in Ottawa. A Liaison mechanism with both the Northwest Territorial Government and the Yukon Territorial Government was established.

From the outset it was decided that the Conference should be held in the North, that it should look at the problem of communications in its widest aspect, both technical and sociological and that it be structured so that those attending could participate fully. The format finally established was to break the Conference into six half-day sessions with the first three being considered basically as information type meetings with papers to be presented and discussed. This would be followed by two sessions of workshop discussions where participants of the Conference would analyze the information and put forward their own ideas. Finally the Conference would meet for a plenary session to discuss the results of the workshop.

The organization of the Conference provided for the circulation of articles and papers prior to the meeting, and their presentation in synoptic form by their authors. Panel Sessions were arranged for the purpose of (a) exploring what telecommunication facilities exist and identifying particular areas of communication needs, (b) reviewing technological options for improving northern communications and (c) assessing the implications and impact of communications on the social and cultural life of the northern residents.

SPECIFIC RECOMMENDATIONS

1. There is an urgent requirement to provide reliable two-way telephone and teletype services to remote communities in the Territories and northern parts of the Provinces. The prime need is for telecommunication facilities to support essential health and emergency services. Priority must be given to establishing telecommunication links between remote communities and centres where hospitals are located, e.g. Frobisher Bay. The northern residents want good facilities for:

    a) intra-regional communications
    b) inter-regional communications
    c) local exchange connections

    This reliable service should be available to permanent communities having populations greater than 25 or 50 on a 7-day 24-hour basis and not be subject to outages due to climatic or

other natural variations. Reliable telephone and teletype services are also required by Territorial and Provincial Governments and by federal agencies for administrative purposes. A teletype circuit is essential for administration when the community has more than 300 people. More sophisticated services (medium and high speed data) should be provided where demand is indicated by commercial agencies.

The situation generally is that existing point-to-point services are inadequate and that problems are particularly acute in the District of Keewatin, Baffin Island, and the Arctic Coast. High frequency (HF) radio as presently operated does not meet required levels of service.

2. Radio broadcasting is very important to northern residents. Presently there are large areas, such as the District of Keewatin, without broadcast services. Each community should have a radio program service for education, information, entertainment, and social action purposes. This service might be established by low-power community operated radio stations. Programming in native languages should be encouraged. Full participation and operation by local people is recommended. Community ownership - as distinct from CBC overlap - should be investigated. Consideration should also be given to higher-powered AM broadcasting stations to serve complete regions. Relaxation of regulations and technical standards to permit the use or development of low cost equipment should be encouraged if this does not interfere with public safety and convenience. The stations at Churchill and Inuvik provide a service that could be used as a precedent for other areas.

3. Low power community broadcast stations should be connected intra-regionally, inter-regionally, and to the national radio CBC network. Northern orientation of programming is essential. Radio network service is presently unavailable in the Central and Eastern Arctic and along the Arctic Coast. The CBC short wave service is unreliable and subject to long outages due to fading. Steps to improve this service should be taken. Radio coverages should be available to everyone as the essential means of mass communication in the North. The CBC Northern Service should be established in the North (perhaps at Yellowknife) and be given full program control including choice of what it wants from the national network.

4. Nomadic or hunting groups should be provided with low cost radio units to contact their resident community in emergency or other urgent situations. Special equipment may have to be developed for the purpose and have incorporated a homing device in addition to voice capability. A task force of technologists

and users should be formed as soon as possible to pursue this concept. The equipment should be inexpensive, portable and rugged for Arctic conditions.

5. More extensive use should be made of technology for educational and social development purposes. Services such as video tape recorders (VTR), films, sound cassettes, and records are flexible and economical. Video Tape Recorders are particularly valuable and should be widely distributed for local use. They can be used effectively for group-interaction discussions and for recording community news and events for subsequent presentation to government legislators and staff. Video tapes can be exchanged between communities for regional dissemination of news and affairs. Regular air lifts of video and audio tapes should be considered. Each community should have trained personnel for the necessary maintenance of equipment. Primary power sources within communities are required. Video Tape Recorders might be installed in isolated communities as part of a pilot study to aid in establishing program requirements for regular TV service.

6. Live television and Frontier Package Coverage service should be extended to more communities in the North with programming suited to the northern needs. This may mean an additional channel on ANIK to ensure:

    a) that the transmission medium exists for carrying northern network programming,

    b) the feasibility of programming originating in the North (possibly Yellowknife) can be developed. It is recognized also that the availability of live television could stimulate industrial initiatives.

    Concern is expressed by native people that programming designed for southern audiences would distract and disturb their culture. It would also widen the generation gap between the older traditional groups and the younger people who have been exposed to the southern way of life.

7. The attitude of some northerners is that the ANIK satellite falls short of their expectations in that all their immediate needs will not be met. It is recommended that funds for the expansion of ground systems in the North must not be prejudiced by expenditures for the ANIK satellite which is designed to benefit all Canadians and not just the northern residents.

8. There was interest expressed in direct broadcasting to home receivers and the advantages of the technique in education. Research should be actively pursued to realize the potential of satellite communications for this purpose.

9. The common carriers should give adequate preventive maintenance service on a routine basis. A long range programme should plan at giving education to northern operators so that they can become permanent maintenance men in the North; interest in amateur radio clubs should be fostered.

10. A pool of portable equipment should be made available in every settlement to be leased or loaned to all trappers and others who are leaving the settlement and are going on traplines to permanent camps, oil sites, etc.

11. An inventory be compiled of radio frequencies in use, systems, equipment, and purpose in northern Canada so that services can be optimized and duplication eliminated.

12. The Postal Services in the North are too slow and deliveries proceed by extremely indirect routes. This service is very important to residents and improvements are required.

13. Attention should be given to communication at the interpersonnel level. This means direct communication between white and native people. Sensitivity training can help close the gap between the "haves" and the "have-nots".

GENERAL OBSERVATIONS

Many far-reaching and general observations on northern communications were made during the Conference. It should be appreciated that they were not all discussed in the Plenary Session, and were not necessarily endorsed by all attendees or the sponsoring organizations.

Northern problems have now reached the point where they require much more urgent and national attention. The pace of change is rapid and it may be necessary to allocate more resources to meet this situation. Improvements in northern communications will require large capital investment. Action is required to respond to four pressures -

(a) Commercial development particularly by oil and gas industries will produce massive needs for transportation and communications. These needs will materialize in the next few years.

(b) The communications needs of native people in the North have not been adequately taken into account. The result is that they are not realizing their potential or full capability.

(c) The increased interest in Canadian Control and surveillance of the North places importance on the availability of adequate and reliable communications capability. This includes areas in a marine region 100 miles off the Arctic Coast and internal uninhabited regions such as the District of Keewatin and the Archipelago Island.

(d) The advent of communication-satellite and the launching of ANIK provides the instrument for serving the North with reliable communications both for general telecommunications and broadcast services.

2. The Department of Communications should assume over-all planning responsibility within the federal government for northern communications and it should have a special northern group for the purpose. It is recommended that a Task Force be established in the Department as soon as possible. The group should be multi-disciplinary with initial responsibility to -

(a) Establish liaison with native associations, settlement leaders, consumer groups, and the people so that the areas of concern and the order of priorities for communications can be determined. Opinion surveys should be carried out using modern techniques such as video and audio tape recordings.

(b) After listening to the communication requirements the Task Force should set goals and objectives for improving northern communications.

(c) Inform northern residents of advance planning affecting them so that any necessary adjustments can be made. Northerners should be given full information on options through conferences, seminars, and through personal contact. Members of the Task Force must travel extensively in the North. At certain times Plenary meetings should be held where regional representatives can meet with government officials.

(d) Arrange for native groups to be advised and given information in their own language telling them how to formulate their communication needs. Booklets or brochures would be helpful. They would identify what

steps are to be taken in requesting extended telephone or broadcast coverage. A public relations program might be initiated to explain to northern people the purpose and role of agencies such as DOC, CBC, TCTS and CNT. Application forms and their completion should be explained where necessary.

(e) Follow-up recommendations of the Yellowknife Conference by determining research needs so that the necessary programs of study can be delineated and sponsored.

(f) Ensure that factual and easily understandable information is made available on Telesat's satellite - its role and the services it will bring to the North.

(g) Stimulate continuing activity so that the impetus and interest created by individuals at this Conference is maintained.

3. It is recommended that an Institute on Northern Communications be founded to study all forms of communications, both technical and social. This body would be equipped to respond to hearings of public bodies, to prepare and submit briefs, and to carry out research in establishing communication needs. It should be staffed with full-time native researchers and should be located in the North, not in southern universities. It should also be given an ample budget for travel throughout the North. It would work in the areas as described above for the Task Force of the Department of Communications and in addition -

(a) Investigate the possibilities of programming in Eskimo and Indian languages for widest coverage and communication, and further the attainment of uniformity in language among groups using different dialects.

(b) Prepare five-year programs to establish the requirements and priorities to meet the objectives of the Institute.

4. Until the necessary machinery is available, northern residents with communications problems should channel them through native spokesmen, nurses, teachers, RCMP, missionaries, etc. who in turn would convey their message to the regional administrators. Then the information would be passed along to the proper authorities in territorial, provincial and federal government departments.

5. The North, in terms of communication requirements, means not only the Yukon and Northwest Territories, but the northern parts of seven of the Provinces. Ten levels of government are involved. Lack of administrative unity must be compensated for by a dialogue between governments. The juxtaposition of systems or networks cannot achieve the desired result of a total communications facility. There must be cooperation and coordination between the different levels of government if available services are to be optimized.

6. Communications policy must be consistent with overall national policy and objectives for northern development and the general trends of economic development. It appears that the North will change rapidly in the next decade both economically and demographically. Relatively large urban centres will form at the centres of resource activity and the smaller northern settlements will disappear. The importance of good north-south communication is stressed to accelerate industrial development.

7. Federal policies should be relaxed to permit Provincial and Territorial governments, municipalities, and northern communities to establish their own northern broadcast stations. Since the establishment of local community broadcast stations will require federal funding, the Department of Communications might provide aid and make the necessary regulations and controls.

8. Northern participants should in future be given more time to prepare for communications conferences and their representation should be increased. There should be more time for general discussion - questions from the floor do not constitute a dialogue in a way that native people find satisfying.

CHAPTER V

General Information and Broadcasting Services.

CHAPTER V

GENERAL INFORMATION AND BROADCASTING SERVICES

Most northern communities lack proper broadcasting and information services. This renders a harsh environment more inhospitable. A Royal Commission on Broadcasting has said that the North is not only silent but forgotten. But at last the technological means are becoming available to bridge this communications void. Before policy and financial commitments are made it is essential to determine northern communication needs and the best mix of technological choices to meet these needs.

It is interesting to look at the North as a consumer of total communication services. Rather than looking at different media choices in isolation it is tempting to enquire if an approach which considers all information sources and their interaction would be helpful in the northern context.

SOCIAL POTENTIAL OF COMMUNICATIONS

The potential of communications for social development in the North has not yet been grasped and pursued. The physical and psychological isolation of living in the North cannot be truly appreciated by a non-resident. If permanent settlement in a number of relatively large communities is to be achieved then the communication amenities of the South must be provided.

The native people need access to communications for their education, training, and the maintenance of their own cultural heritage. They must be able to reach out to adjacent communities, which are separated by great distances, to talk and keep in touch with their families and friends. Their integration into the main stream of the Canadian milieu will be difficult. It may involve their re-settlement or travel to the large northern centres such as Yellowknife and Frobisher Bay. This transition can be helped if they and the people left behind in the smaller settlements are not to be separated by both distance and silence.

The ownership, provision, operation, and maintenance of communications facilities offers a fertile field for native employment, expression, and development. Vocational schools are beginning to turn out native technicians who are ready for employment in the communications field.

COMMUNICATION NEEDS

There are two areas of communication needs in the North. First, there is a requirement for telecommunication services to permit point-to-point communication between communities. Telecommunication facilities for this purpose are functional and serve for the conveyance of messages by the public, industry, and government agencies.* Beyond this basic need there is a requirement to provide communications of the type mostly identified with broadcasting; but more precisely, this communication need covers the spread of information of all types in the oral, visual, and written form.

The North, to be kept adequately informed, must have access to all means of communication. This includes radio, computers, video and audio tapes, records, and even gossip. It is useful to review the availability of information sources in the North to appreciate the magnitude of the challenge that access to new or improved service entails.

1. Radio

The first and most basic means of mass communication in the North is radio. Radio broadcasts are of prime importance to people living in small isolated communities scattered over a vast area with few newspapers and little entertainment. It provides them with information on weather, road and flight conditions, health, fire and flood warning, entertainment; and community, regional and national news and comments. The only problem is that it is not always available. The following requirements have been identified for the extension of network radio service on a geographical basis in the North:

(a) extension of the Mackenzie network to the eastward to cover the western Arctic - with Inuvik as the program centre;

(b) a new regional network to cover the large Indian population of northern Manitoba - possibly from a program centre at The Pas;

(c) a regional network originating at Churchill to cover the Keewatin communities;

* Telecommission Study Volume III - Northern Communication Requirements.

(d) a French regional network to cover the eastern shore of Hudson Bay and northern Quebec;

(e) extension of the Labrador network to cover communities along the Labrador Coast;

(f) a regional network for the east coast of Baffin Island and the communities on the Arctic Coast.

2. Television

The capability to transmit television does not exist in the Yukon or Northwest Territories, or in many areas of the northern parts of the Provinces now. It should be noted that the Eskimo and Indian people of the North have not so far expressed a priority need for the reception of television programs in their communities. Their main concern, if live television is brought to them, is that the program material should be suitable for their culture and education. However, it is probable that the younger generation of native people will respond to television if the programming problem can be solved.

The need for live television has been stressed by northern residents who come from the South, and particularly by industry, to encourage longer turn arounds of labour forces. The requirement for live television is evident in those communities having frontier package service because delayed programs have not been well received.

3. Information Services

Survey trips to many parts of the North have indicated that there is an unstated but definite need for educational and information facilities such as films, books, video and audio tapes, newspapers, and prompt delivery of mail. No attempt has been made to ensure that these amenities are systematically distributed throughout the North.

Another area that should not be ignored is the need for telecommunication systems to allow the people of the North to communicate with each other intra-regionally. What is needed is simply a type of gossip network that provides an information need that is not met by normal telephone or teletype communications.

POSSIBLE SOLUTIONS

The possibility of improving and consolidating various northern communications services is discussed below.

(1) Radio

Two essential needs are to establish the means for local or community programming and to bring network services to northern settlements.

Community Broadcasting Stations

Volume 4 of the Telecommission Study contains a detailed scheme for establishing low power broadcasting stations in the North particularly in the High Arctic, for those communities not served by medium band stations of the CBC Northern Service. The stations would be operated voluntarily by the people of the community to broadcast programs of information and entertainment in the local language. The station would keep in touch with the 'outside' by means of the CBC's Northern shortwave service, particularly its news and messages in Eskimo. The stations would circulate their own programs on tape among themselves. The CBC's role in this scheme would be to train operators, advise on technical equipment, supply programs if requested and help the stations circulate their own taped programs. The government would buy the equipment and pay for its installation; the community would pay for its upkeep. Besides its effect on community development, the project would have a spinoff in familiarizing native peoples with the use of electronic equipment, a skill which could be useful to the young seeking work'outside'.

Network Connections

The establishment of community broadcasting stations leaves two open questions (i) how can the isolated local community stations be network connected, and (ii) what can be done about the existing CBC Low Power Relay Transmitters (LPRT) that are network connected but have no local injection option.

There is the problem of connecting local or community broadcast stations, as discussed in Chapter III, to regional and national radio networks. The reason why many communities of sizable populations are not connected now is that the transmission capability for carrying the radio programming simply does not exist. The ANIK satellite offers a solution to this problem. It was noted in Volume 3 of the Telecommission Study that point-to-point communications for

telephony and data services are the first priority for improved northern communications. In areas of the North such as the District of Keewatin, Baffin Island, and Arctic Quebec, the satellite may have to be used as the only economic way of bringing reliable radio communications to isolated communities.

Some consideration has been given in Volume 6 of the Telecommission Study to the installation of small earth stations capable of transmitting one or two telephone channels to the master station at Toronto. If it is decided to proceed with these stations, it is an incremental cost to ensure that each small earth station also has the capability to receive a radio channel. It cannot be overemphasized that a radio program channel to these communities should be provided at the same time that provision is made for general communications services.

There is also the problem of originating broadcasts from the North. There is no reason why the transmit telephony channel at the small earth stations should not be used for originating program material occasionally from remote communities in the North. Of course, the quality would be degraded since the bandwidth would be in the order of 4 KHz instead of 8 KHz for standard broadcast quality. But since local broadcasts from small communities would not take place very often this would be tolerable.

Local Programming on LPRT Stations

Presently the CBC LPRT stations are network connected without the means for the local injection of community news, information, and entertainment. There are a number of northern networks connecting LPRT stations but the program origination is at central points. As an example the Yukon network consists of stations at Fort Nelson, Watson Lake, Swift River, Cassiar (B.C.), Teslin, Haines Junction, Destruction Bay, Beaver Creek, Dawson City, Carmacks, Mayo, Elsa, and Whitehorse. All the programming emanates from Whitehorse and the capability does not exist for the other communities to inject their own local affairs for the benefit of people resident in these communities. Local information of a parochial nature is not of great interest for network distribution. A combination of network and local community broadcasting would be ideal.

This suggestion has policy and financial ramifications. The CBC LPRT network was established to keep costs to a minimum while providing a reasonable quality of broadcast services. The suggestion that local injection at the community level be permitted requires a change in operation of the LPRT network. The stations would have to be manned during the local broadcasts and small studios would be required to house the equipment for broadcasters. But a few local

communities are in a position to build or maintain their own studios and arrangements could be made for them to share the LPRT services. This might require agreement between the Community Council or other elected bodies and the Canadian Broadcasting Corporation.

Approval would also be required from the Canadian Radio-Television Commission to permit the changed operation of the LPRT networks.

One of the factors in support of a combined Community-CBC operation is that the need for native organizations to establish their own private networks would be avoided. There is no doubt that the pressure for private networks will intensify unless action is taken to provide a public network by the CBC that is responsive to native needs and aspirations. This alone might be sufficient to counter arguments that the cost of adding local injection to LPRT networks is prohibitive.

Short Wave Service

The CBC operates a short wave service to the North which, in the view of many northern residents, does not provide sufficient and reliable coverage. The suggestion has been made that attempts be made to enhance the signal level of short wave broadcasts and to use the service itself as a more effective medium for serving the North.

(2) Television

It will be some time before direct broadcasting of television signals can be received on home receivers. Until then the programs transmitted by ANIK will have to be picked up by ground receiving stations for broadcasting on a local television station. Only those with home receivers within the broadcast area of the local television station will receive the programs. Present planning is to establish earth receiving stations at all northern communities presently served by frontier coverage package service. In this way the majority of the people in the North will be served; although this means that there will be a concentration of earth receiving stations in the Yukon and western parts of the Northwest Territories.

Service by satellite will introduce programming problems. The northerners have indicated that they are not content to receive television programs produced for the people of Toronto, Winnipeg, or Vancouver. The native peoples consider these programs of doubtful value. If the television service is to meet the needs and wishes of the people of the North, native-born Eskimo, Indian, Metis, and White, as well as the transient population, it should be a mixture of local regional, and national programs as provided by the CBC in other regions

of Canada. The way to meet this northern regional need is to use one channel of ANIK especially for this purpose. A production centre for northern programs might be established in the North to transmit programs to the satellite for distribution.

It would appear that the most logical place for this centre would be Yellowknife. Yellowknife is on Mountain Standard Time, which is the medium zone of the five time zones in the North. It would be a convenient centre for receiving programs shipped from other stations of the northern service - Whitehorse, Inuvik, Churchill and Frobisher Bay. These stations should have a limited capacity to produce local video tape programs to ensure that Yellowknife and the Mackenzie District did not monopolize programming in the North.

(3) Information Services

Several trips to Labrador, Baffin Island, the Arctic Coast, Keewatin District, the Yukon and the Mackenzie Delta region indicate that there is a need for educational and informational facilities such as films and video tape recorders (VTR). The availability of a film service would provide many dividends. It is apparent that films of any kind, when shown to northern audiences, receive enthusiastic response. It is important that the community rather than a teacher or entrepreneur should decide the type of films to be distributed between communities. Selection has to be done through consultation with community leaders and Councils. An attempt should be made to reach all residents with material of direct interest to them.

Package programs could also be made available on video tape. This is particularly important for educational purposes. Prepackaged lessons and information programs could be made available and exchanged between communities. These programs could be supplemented with printed lessons or followup material as suggested for radio. This medium might prove to be an improvement over radio because of the possibilities of visual presentation and repetition of the material.

Considerable work could be done on the dissemination of a wide variety of books on a broad range of subjects. It is clear that in the school libraries visited in northern communities, there are not sufficient books to interest all adults and many of the children. The best service would probably be by air.

Departments of education could make more use of educational technology both in schools and in the general community, particularly radio, TV, VTR, and sound cassets. Each community could regard the school as a community centre, equipped with a range of resources such as books, pictures, slides, cassets, records, etc. The educational

experience must be made more flexible, less confined to the class room, making more use of the general environment.

Regional production and distribution centres could be created to serve educational needs, perhaps in cooperation with southern university centres. Also research in specific problems could be undertaken with cooperation between northern communities and southern research facilities.

Of particular importance to an adequate total information service is the need to present material on preventive medicine. In many regions with small isolated settlements provision of medical care is of necessity a communication and transportation problem. An educational program of preventative medicine by dissemination of literature, VTR programs, or by radio, would serve an invaluable purpose.

The importance of using native languages is stressed so that families can keep in touch with each other. It is oral communication that is so essential. In addition, educational, economic and linguistic patterns must be kept in mind. Appreciation must be taken of the variety of native dialects. The dissemination of programs of Eskimo and Indian languages could go a long way towards introducing an element of uniformity in language across the North. Some consideration should also be given to the need for communities to communicate with each other outside conventional telephone connections. This possibility is explored in Volume 4 of Telecommission Study 8(c), where a scheme for training native radio amateur operators is proposed.

(4) Computers

Experiments have been undertaken by the University of Western Ontario to provide computer assisted education courses at Inuvik from a central computer in London, Ontario. The possibility of using the computer for educational purposes and for information retrieval requires reliable transmission networks. This means that the Eastern and Central Arctic cannot make use of these facilities. However, communities equipped to receive telephony by satellite could be easily adapted for this purpose.

INTEGRATED INFORMATION AND BROADCASTING SERVICES

There are possibilities that have not yet been explored for the integration of broadcasting and information services of the types discussed above. There is the thought that program tapes, either audio or video, could be distributed around communities in the North

after they have been used for regular programming. The northern service of the CBC presents many programs over the northern network which could be sent around communities if suitable arrangements were made. Each community would need playback apparatus. The use of program tapes would be a valuable tool for educational purposes. Cooperative arrangements between the CBC and the Territorial Government might be encouraged. Another possibility is that communities could generate material on video tape which could be suitable for transmission by the CBC at a later date. This might be a cheap source of program material for northern broadcasting.

CONCLUSIONS

An integrated approach to the use of information media offers perspective, and perhaps direction, to the evolution of northern communications. It might offer a framework for the planning of telecommunication services and ensure that social needs are fully taken into account in the planning process.

Particular emphasis is given to the use of broadcasting as an instrument of social and educational development. This may be a utopian premise since it has largely failed in this role in southern Canada. But the situation in the North is different because the indigenous northern residents need special programming to realise their potential and aspirations.

Three factors combine to make the possibility of a total approach to northern communications thinkable. First, the increasingly important role of the Territorial Government offers a focus for coordinated action. Second, the recently created Department of Communications can act as a federal catalyst to stimulate northern communications on a broad front. Finally, transmission capability will shortly exist to extend voice, data, and television services to the North at high, but incremental, costs.

ANNEX TO CHAPTER V

NATIVE BROADCASTING AND INFORMATION NEEDS

The Canadian Metis Society, National Indian Brotherhood of Canada, and the Indian-Eskimo Association of Canada, presented a brief to the Special Senate Committee on Mass Media in December, 1969. Extracts from this brief concerning broadcasting and general information services are contained in this Chapter to ensure that a direct statement by native people themselves is included in the Telecommission Study.

Radio, Television and Films as a Means of Producing Social Change

1. Radio and television, together with films, can be effective agents of social change. Broadcasting, particularly television, is the most powerful influence on public opinion and social attitudes since the invention of printing. Broadcasting can be used as a two-way channel, sending information to the public and receiving the public's response in return. Properly used it can make the individual more articulate today than he has ever been in the past.

2. It can be of particular value in communication with the poor, most of whom lack the heritage of a literate education. Their communication is oral. Radio and television provide a natural means of communication for them. Broadcasting, properly used, can help promote the social changes needed to bring native peoples into the mainstream of Canadian life and their heritage from the past. Their traditional culture has been and continues to be destroyed by the impact of modern technology. A part of that technology - broadcasting - can help to restore the balance.

3. At present, Canada's broadcasting system does not serve as an agent of social change. It is more concerned with upholding the existing social order. It is oriented towards the middle class, the consumers - the people who buy the goods its advertisers have to sell.

4. In the past the CBC produced notable programs that resulted in social and political action. In the '40s, its daily farm broadcasts and weekly Farm Radio Forums were pioneering ventures that gave the farmer a strong voice in national affairs and in the '50s, the French Network's public affairs

broadcasts articulated the quiet revolution in Quebec.

5. More recently it has broadcast some excellent programs on poverty in Canada, including some on Indians, Eskimos and Metis. But these programs have been on an occasional and fragmentary basis, produced for middle-class audiences from the point of view of the outsider looking on. They act as an emotional catharsis to the troubled conscience of the affluent and serve as a substitute for action. They are not designed to promote social change. To do so, they would have to be produced on a regular and continuing basis.

6. The National Film Board was set up with similar aims to the CBC: "to initiate and promote the production and distribution of films in the national interest and in particular .... to produce and distribute and to promote the production of films designed to interpret Canada to Canadians and to other nations". It has been more enterprising than the CBC in producing films to promote change. In cooperation with the Company of Young Canadians it trained and equipped a five man Indian film crew that has produced three films with an Indian perspective. This is part of its series of films entitled "Challenge for Change", whose purpose is 'to improve communications, create greater understanding, promote new ideas and social change'. It has also cooperated with Memorial University in St. John's, Newfoundland, in a project designed to help the citizens of the isolated fishing community of Fogo Island to adapt to a changing economy. There is need for much more activity of this sort from the mass media.

WHAT OTHER COUNTRIES ARE DOING

1. Broadcasting is being used to promote social and economic development in other countries.

2. Both India and Japan have tele-clubs, with feedback after each program. Follow-up activity is usually developed spontaneously by the clubs and serves as democratic training in citizenship.

3. AIR (India) broadcasts 15000 hours of programs from 30 stations especially prepared for the villagers. It arranges to supply radio sets for the community centres in the villages. There are 25,000 radio forums in India with two-way broadcasting that stimulates free discussion.

4. In Japan television sets are placed in community centres and schools in isolated farming villages. Adult education starts before the television broadcast and is carried by it. The secretary of the community centre takes the initiative in organizing clubs and meetings but allows the people to make the decisions on activities. The program has led villagers to become active members in youth, women's and agricultural organizations.

5. In under-developed countries like Ghana and Mexico, radio and television are being used extensively to promote community development. Details of experiments in the mass media are given in various UNESCO Reports, notably "Mass Media in the Developing Countries" (1961) and "Developing Information Media in Africa" (1962).

6. In the interior of Australia the Australian Broadcasting Corporation has established extensive Schools of the Air programs by turning a network that was primarily for emergency purposes into a socially and educationally useful system. For this purpose, they have devised a transceiver that costs less than $150 a set.

PRESENT BROADCASTS FOR NATIVE PEOPLES IN CANADA

1. With these laudable objectives of the two publicly owned institutions let us look at what they and the private broadcasters are doing for native peoples.

Canadian Broadcasting Corporation

2. The only continuing program for Indians on the national networks of the CBC is INDIAN MAGAZINE, a weekly fifty-minute magazine-type presentation on the English radio network. Its producers describe it as "CBC's weekly forum for the opinions of Canada's Indians as well as news of Indian activities throughout the country".

3. A mimeographed summary of each week's program is mailed free to anyone requesting it. The mailing list is over 8,000. The host is Johnny Yesno, an Ojibway who was born at Fort Hope in northwestern Ontario.

4. In cooperation with the Indian-Eskimo Association, the Northern Service of the CBC is experimenting with a series of radio programs modelled on the Farm Radio Forum of the '40s and '50s. Their object is to produce an exchange of views among Indians and Eskimos themselves and also between experts and public officials and the public. The opinions of the native peoples are, where necessary, tape-recorded in their own language in their own communities. In Inuvik programs have been broadcast in English, Loucheux, and Eskimo; in Yellowknife in English, Dogrib, and Slavee.

5. The Northern Service broadcasts three programs a day, totalling nearly one and three quarter hours, in Eskimo by shortwave to the Arctic. The programs consist of news, information, opinions on matters of concern to Eskimos, legends, and other cultural expressions, and entertainment.

6. There are no programs for Indians or Eskimos on the French radio network of the CBC; nor on the French or English television networks.

Private Stations

7. None of the 230 private radio stations in Canada produces regular continuing programs for local Indian communities in English, French, or Indian languages. The only programs being produced by native people are the Alberta Native Communications Society (ANCS) programs in Cree and Blackfoot, carried on three Alberta stations (discussed more fully below) and INDIAN MAGAZINE, in whole or in part carried by stations affiliated to the English Radio Network of the CBC.

8. Nor are there any continuing programs for native peoples produced by private television stations or carried on the CTV Network.

Communities and Voluntary Groups

(a) The North

9. The tradition of small, locally operated community radio stations is well established in the North. Before the creation of the CBC Northern Service, they provided the only medium-wave broadcasts available in many remote and isolated communities. All but one closed down when the CBC Northern Service medium-wave service became available. The exception was Fort Simpson, Northwest Territories, which started up in 1961 with the cooperation of the Department of Indian Affairs and Northern

Development and has continued sporadically since, even though the community is now served by an LPRT connected to the Mackenzie network of the Northern Service.

10. A similar station started at Pond Inlet in 1967 without official approval but was later legalized. It operates at low power on AM. Its programs are mainly for and by local Eskimos, with technical help from officers of the Ministry of Transport. It is a prototype of the station that other remote and isolated communities in the eastern Arctic would like to have.

(b) Alberta

11. In 1966 a weekly fifteen minute radio program in Cree, sponsored by the Department of Indian Affairs and Northern Development, was broadcast by CKUA Edmonton. This developed into a weekly half-hour program broadcast on CKUA, CFCW Camrose, and CKYL Peace River. The interest these broadcasts aroused led to the formation of the Alberta Native Communications Society (ANCS) whose aim is to develop and promote better communication among the native peoples of the Province. Its membership is restricted to Indians and Metis who formulate and implement their own policies. Its executive director is Eugene Steinhauer, a Cree.

12. The weekly Cree broadcasts reach 56,000 native people in central-northern Alberta, as well as Cree-speaking listeners in British Columbia and Saskatchewan. CKUA Edmonton carried the broadcasts free as a public service; CFCW Camrose and CKYL Peace River are paid to carry them by the Alberta Native Communications Society from funds provided by ARDA.

13. In March, 1969, the ANCS sponsored a fifteen minute weekly Blackfoot Radio Program under the direction of Ray Many Chief and Leslie Healey, broadcast by CJOC Lethbridge. It consists of topics in both English and Blackfoot.

14. In 1969 the ANCS was awarded a $210,000 grant, one-third from Alberta's Human Resources Development Authority and two-thirds from the Federal Government's ARDA program. The grant will allow it to expand its services and develop new programs of field work and research into the needs of native Canadians. Among other projects it will expand the Blackfoot Radio Program.

15. Alberta Native Communications Service is currently exploring the feasibility of developing a series of community radio stations throughout Alberta to ensure that all native communities are served.

(c) British Columbia

16. The Society for a Coastal Area Network (SCAN), a voluntary group of citizens, has been set up to improve communications among the Indian people of the B.C. Coast. It was originally financed by grants from Simon Fraser University, Le Centre des Recherches Sociales of Montreal and the Catholic Archdiocese of Victoria. Last fall the Donner Canadian Foundation gave it a grant of $60,000. It has developed plans for a Radio and Visual Educational Network (RAVEN) linking Indian communities in coastal B.C. It believes that what is needed is a massive public education drive cutting across tribal divisions and shortcircuiting the requirement-bound and time-wasting structure of the schools. It therefore proposes a radio network linking up every community along the coast, supplementing the visual media that will be put at the disposal of the Indian people, video-tape and film, and the know-how necessary to make them serve their education needs.

17. It plans to use the newly developed Single Sideband transmitters for the network. The SSB have a range of over 350 miles and could provide virtually uninterrupted contact among isolated Indian communities. Indian leaders who have taken over direction of the project have chosen six pilot backbone communities scattered along the entire length of the coast: Skidegate, New Aiyansh, Bella Bella, Alert Bay, which is being phased out of operation, could provide a central coordinating station for the network. Some such centre will be needed to coordinate the distribution of visual materials which would be sent out in response to radio requests.

(a) Northern Ontario

18. Last winter a group of young Ojibway people in northwestern Ontario started a project called KENOMADIWIN whose purpose is to use radio as a means of community development. It plans to use a small mobile broadcasting van travelling between Indian communities to gather and record programs which will be broadcast to other towns and reserves in northwestern Ontario; thus providing a news service for Indians in the area. With the support of the Northwestern Ontario Project of the Company of Young Canadians, a Thunder Bay Communications Group was established. It applied to the Department of Communications for a certificate to establish low power AM broadcasting antennae at eleven sites in northwestern Ontario. The application was rejected because certain technical details required were not given, and because only the CBC and the Department of National Defence have been authorized to operate broadcasting stations with a power lower than 100 watts.

CHAPTER VI

Terrestrial System Options for Northern Communications

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Terrestrial System Options for Northern Communications

An investigation was made of the terrestrial systems options that are available to serve the North in Volume 5 of Telecommission Study 8(c). High Frequency (HF), Low Frequency (LF), radio relay, and tropospheric scatter systems were considered.

High Frequency Radio Systems

Except for earlier maritime operations, the 1930's saw the first HF radio communications established in the Canadian North. Since that time, particularly in the last twenty years, the communication systems reaching into the area have increased at a tremendous rate. From the earliest HF radio telegraph operations we have proceeded to the operation of troposcatter systems and in the near future to satellite systems.

In reviewing the past use of HF radio, the most noticeable point is the unplanned proliferation of many systems, of varying degrees of technical excellence, and the variety of both private and public systems. The justification of these systems ranged from the defence of our country to the guidance of a sportsman. HF communications have been used where no other radio communication system has been used, where no other radio communication system has been possible from either a technical or an economic viewpoint.

Where one or two communications channels are all that is required, over route distances of one hundred miles or greater, it has not been feasible to consider any alternate to HF radio. Certainly where the numbers of channels required reach the 50-60 range, other modes of operation such as troposcatter and line-of-sight radio relay would be considered. With the advent of satellite systems, the availability of multi-channel multi-point facilities will be increased.

If we consider that multi-channel systems will be required between some main locations, then we could assume the HF radio will provide the communications between these main and lesser locations and that many locations can be served. The important point here, is that even though there is a need for the multi-channel system, it will not reduce the future use of HF for the smaller localities.

How the increase in northern communications is carried out can bear heavily on how well we can employ HF communications regardless of the introduction of new multi-channel technology. This must be on the basis of using the best technique in each case based on economics, technology and the social needs of the area.

Equipment

The newer generation of solid state apparatus will provide reliability which is at least one order of magnitude better than the general run of equipment now in service. Maintenance of apparatus has and will always be a problem where skilled personnel are scarce and can not be readily transported. Fewer adjustments of this new equipment are required, and as a consequence few control knobs, etc. appear on new apparatus. This reduces illicit adjustment by untrained operating personnel.

The new equipment has a lower prime power requirement which permits its use in many locations where power may be a scarce item. In fact, emergency operation from batteries could be considered where the prime power source has failed.

For remote station operation, the radio equipment, switching and power equipment will require improvement in reliability. Power is the most difficult to improve. Traditional diesel generators are not the most reliable devices in the hands of inexperienced people. Consideration of fuel cells or other more sophisticated power sources could provide greater reliability. Back up emergency power should be considered where possible.

Main locations will usually employ higher power transmitters and on-site maintenance personnel would be available. For this reason the power supply is not as great a problem as it would be at remote low powered stations.

Wherever possible directional antennas should be used to increase circuit reliability and reduce interference. The use of non-directional antennas should be limited to low power stations.

Frequency Stability

The frequency stability of radio apparatus will require improvement if the trend is towards unattended operation. If Lincompex equipment is to be considered, the overall stability of HF radio systems will have to approach an error figure of one cycle in 10^7 (assuming a 12-15 MHz upper limit). This could be overcome by a synchronizing scheme employing the received signal as the reference. Perhaps common calling channels could be used to transmit a reference signal from a common source. If Lincompex is not used then an error of one cycle in 10^6 would suffice for unattended operation of SSB equipment. This assumes an acceptable level of demodulation with an error not greater than 10 cycles, for telephone communication and data transmission, up to 1200 bps.

Transmission Considerations

If we assume that in the end public communications in Canada will require interconnection, then to serve the total public sector serious consideration must be given to the problems of compatibility. Development of communications in Canada's North which require conversion of transmission or signalling features should be minimized.

An example is the very likely use of accoustical telephone couplers for the transmission of data. Although present couplers are normally used for low speed data (100 wpm) there is no serious technical reason for this limit. If Lincompex equipped HF trunks are part of the network and are switched in tandem the data user would obtain an inferior graded service when compared to normal telephone facilities, even though from a speech point of view the facilities would be accpetable. The noise levels may be excessive for greater percentages of time for even low speed data and for speeds in the order of 1200 bps the bandwidth and delay characteristics would limit the performance. It would seem likely that special techniques for data may be required to provide an acceptable performance level.

Today's manually switched or operated HF circuits allow for human monitoring of the circuit condition. The proposal for automatic unattended switching poses a real problem. Serious consideration must be given to the avoidance of unacceptable switching and supervisory failures on HF circuits. The using public will not understand why the failure has occurred - just that his service is not available or at least unsatisfactory.

Where possible, full-duplex trunks should be considered. Although the push-to-talk operation is understood and accepted by the remote user, on an interconnected call, the other user will be unfamiliar with the one-way operation. The resulting confusion is a frustrating experience.

Present day HF circuits are usually operated with an arbitrary net loss. The ability of future apparatus to operate with sufficient loss stability and to maintain echo and singing margins is not yet determined. The trunk loss should be kept as low as practical considering the design of the trunk, the echo tolerance of the user and the singing margin. Echo suppressors will be required if the round trip delay time exceeds about 45 milliseconds. Note the round trip delay of an HF trunk with Lincompex is at least 16 milliseconds. Two HF trunks in tandem plus a wire line facility at one end would likely be marginal and may require echo suppression or the increase of the design net loss of one or both trunks. As a comparison, the Lincompex equipment alone equals the delay in about 1,000 miles of microwave system.

With any system where delays of this order are possible, switching should be carried out on a 4 wire basis and strict attention to terminations at 2 wire points. Care must be exercised to maintain good impedance matching to avoid reflections and consequent echo.

HF Propagation Predictions

In the past very little operational use has been made of the scientific predictions of the maximum useable frequency (MUF) or the optimum working frequency. These predictions are available and with improved computer service the Department of Communications could render the user the guidance necessary to more efficient spectrum useage.

Accurate predictions could allow a more accurate determination of geographical separation of stations assigned to the same frequency. This, along with a proper appraisal of the users operating hours, would allow optimal sharing of the radio spectrum.

An additional benefit derived from accurate and frequent predictions would be the better choice of frequency for the varying nature of HF propagation. This would permit the assignment, on a short term basis, of frequencies which are close to the optimum working frequency for that period. Note that day and night frequencies will change diurnally, seasonally and over the sun spot cycle.

Regulatory Matters

New tools such as accurate propagation predictions and computer filed assignment information should make it possible to plan the improved use of the HF radio spectrum. Before these tools can be employed to their fullest extent the following refinements are suggested:

(1) Publication of guidelines and procedures for the HF bands, similar to those for the microwave bands.

(2) An investigation of the spectrum occupancy using new monitoring techniques. This will establish the necessary geographic separation of stations.

(3) The improved classification of users.

(4) The possibility of frequency assignments for shorter periods of time.

(5) Consideration of the licensing for specific hours of operation.

(6) Making available optimum working frequency maps to users of multifrequency systems.

(7) Re-evaluation of frequencies assigned large users on a traditional basis.

Radio Relay and Tropospheric Scatter Systems

The role that radio relay systems have, and will have, in the development of communications to the North and in the North is discussed below.

Requirements

1. Quality

The quality of a circuit is completely defined by two things:

- how much does it garble the message (fidelity)

- how often is it available (reliability).

Ultimately, there is no difference between the transmission requirements for the Northern part of Canada, and the Southern part. Psychologically the Vancouver business man will soon become intolerant of noisy and unreliable calls to Frobisher Bay; and the Eskimo will quickly recognize that the Prime Minister's face is not magenta. Technically, and possibly more important though, will be the enormous quantities of data that must go rapidly and accurately between the small "on site" computer of a northern mining operation and the main computer, snugly housed in its rarified, air-conditioned room at the company's headquarters. Psychologically or technically, Northern circuits carry information in the same form and at the same rate as Southern circuits and, ultimately, have the same quality requirements.

The word "ultimately" keeps cropping up because there is a catch to all of this. The better and more reliable a circuit is, the more it costs. Somebody has to pay.

2. Quantity

Here is where the big difference comes. The more circuits between any two places, the less each circuit costs. If

Pond Inlet, and every other small, northern community, had a real economic requirement for a thousand circuits, or even a few hundred, there would be no point in writing this report. Heavy route microwave and complex satellite systems would today bind together the North into one massive communications web, and north-south communications would be as reliable and inexpensive as southern ones.

Pond Inlet, however, does not have a real economic requirement for a thousand circuits. In fact, as a typical small isolated northern community it cannot economically justify even one circuit of a quality equal to those of the south. (Whether or not it should have one, good quality, circuit is not discussed in this section). At the moment, Pond Inlet has a single voice communication link that is operational about eighty percent of the time and requires frequent repetition of messages. This represents the low end of the communication spectrum, both in terms of quality and cost, and follows the philosophy that 'any communication is better than none at all'.

Thus development of northern communications involves the combining and balancing of two fundamentally contradictory requirements:

- good fidelity, reliable circuits, but

- relatively few to any geographical point.

Present Situation

Historically, and in order of importance, northern communications have developed using three main types of radio: (1) High Frequency (HF), (2) Tropospheric Scatter, and (3) Point-to-point radio systems.

(1) High Frequency radio was and is still almost always the first form of communication to a northern community. HF radio requires high power, is fairly unreliable, and carries a maximum of one or two poor quality circuits. On the other hand, HF radio can span thousands of miles in one jump and is inexpensive both to buy and maintain. Such systems have had, and will continue to have, an important role in northern communications

(2) Troposcatter Systems

Troposcatter radio systems provide reasonably good quality circuits with cross-sections to 120 voice

channels or more. They are much superior to HF circuits, but fall short of the standards normally associated with communications in the south. They are also much more expensive and are usually heavily supported by large government contracts. Nevertheless, when reasonable communication facilities were required in the North, troposcatter systems were, and in many cases still are, the only method of achieving them.

(3) Point-to-Point Systems

Point-to-point systems, up until now, provided the ultimate in good quality, long distance communications, and still carry the majority of east-west traffic. (Coaxial cable systems are just now becoming a reasonable supplement). However, such systems require a repeater about every 30 to 40 miles and, therefore, were prohibitively expensive to install and maintain in areas where there are no transportation facilities. For this reason, northern use of point-to-point radio has been almost entirely restricted to the north-west.

Future Trends

(1) HF Radio Systems

Satellite systems are similar to HF systems in that they can cover thousands of miles in one jump (to the satellite and back). It is expected too that they will be comparably priced. There the similarity ends, for it is expected that satellite systems will provide circuit quality equivalent to that available in the southern part of Canada. With a few exceptions, therefore, satellite communications will probably eclipse HF radio where the northern point of contact is geographically fixed.

(2) Troposcatter Systems

The same holds true for Troposcatter systems as they are presently used, ie very high power, brute force equipment. The 'scatter' mode of propogation, however, will likely still be used but in a more elegant and less expensive way.

(3) Satellite Systems

Satellite communication, as it is now envisaged, seems to be one very promising way of achieving good quality circuits without paying too high a price for them. Although, ultimately, the satellite will probably be used for as few as one or two channels to a community, it should initially

start as a group of channels (say 24) beamed to some central northern community, with ground facilities radiating from there to the smaller communities. A few years ago, these ground links would have been served by HF radio or conventional Troposcatter, despite the inherent problems of high power and low reliability. Even now, HF radio will often be the most practical way of providing this form of communication.

(4) Point-to-Point Systems

As mentioned earlier, conventional point-to-point systems require good transportation facilities. The newer, fully solid-state equipment has changed all that. Now it is possible to enclose ultra-reliable radio equipment, together with ultra-reliable, low-cost power equipment, in a single weather-proof container that can be transported bodily to just about any place in Canada. Strings of these repeaters can be used to join smaller centres to the satellite ground stations or, in some cases, avoid the need for a ground station and supply interconnection direct to the southern part of the country. This second application may be used for economic reasons, or as an alternative to using the limited spectrum available to a satellite. It is the purpose here to describe the factors involved in the design of light and medium capacity using such isolated repeaters.

Design Considerations

The key factor in developing this Isolated Repeater System approach is based upon a significant reduction in the installation and operating costs of the radio relay repeaters.

(1) Housings

Repeater housings must be inexpensive yet suitable to provide acceptable internal environmental control.

(2) Power

Where commercial power is not available, power sources, such as air depolarized batteries, thermal generators, thermoelectric converters, etc., are integrated into the basic housing design.

(3) Installation

In the majority of cases, equipment installation is completed at a central location in transportable repeater housings prior to the installation of the unit in the field. This greatly reduces the high engineering and installation charges often associated with radio repeaters.

(4) Maintenance

Reliability and stability of the complete isolated repeater allows operation for long periods of time without interruption of service and requires only one or, at the most, two scheduled maintenance visits per year. The exact timing of these visits is not critical.

(5) Site Selection

The design engineer has almost complete freedom in selecting his sites. In topographical areas characterized by low rolling hills or flat plains, repeater sites tend to be relatively closely spaced but use short towers and may be located close to the means of transportation, such as existing roads or winter roads, lakes or river chains, or any suitable point where site access is as economical as possible. In mountainous areas, through the use of helicopters, repeaters can be located in extremely high and remote locations. In this way, repeater spacing can be greatly increased with a subsequent decrease in overall system cost.

(6) Radio Frequency Bands and Propagation

Repeater spacing is directly dependent upon the propagation characteristics of the radio frequency band utilized. Since frequency congestion is generally not a problem in the North, it is practical to take advantage of the radio propagation characteristics of the lower frequency bands to either extend repeater spacing or minimize tower heights.

Conclusions

Radio Relay systems will be utilized in the development of the North, particularly to interconnect locations with a significant common interest, and also to extend systems connecting with the southern telecommunications networks. They will be used in combination with HF, Troposcatter and Satellite systems, depending on the relative cost and type of fidelity and reliability required.

Through careful engineering, light and medium route systems can be designed specifically adapted to the special Northern conditions at substantially reduced initial and operating costs, compared to systems that have been installed in the past.

Low Frequency (LF) Communication in the North

1. Introduction

Radio communications began at low frequencies, and if it were not for the limited bandwidth available, the intensity of atmospheric noise at these frequencies (particularly at low geographic latitudes), as well as certain practical limitations, further discussed below, much more extensive use would be made today of frequencies below about 300 kHz.

Because of the stability of propagation, frequencies in this range are useful not only for communications, but also for standard frequency and time broadcasts, as well as navigation systems employing pulse (Loran C at 100 kHz) or CW (Decca 70-130 kHz) or Omega (10-14 kHz), phase comparison or direction-finding techniques. In particular, it has been found that the stability of transmission permits frequency comparison to within a few parts in 10^{12} which is some four orders of magnitude better than is possible at high frequencies; thus making possible long range radio navigation utilizing phase comparison between spaced atomic frequency controlled or phase-locked transmissions. At frequencies above about 100 kHz, where it becomes practical to isolate, in some circumstances, the ground-and-sky waves by pulse and sampling techniques, highly accurate time systems can be devised. Marine communications use low and very low frequencies, which are also used for point-to-point communications at times of severe ionospheric disturbances (particularly at high latitudes) that disrupt high frequency circuits. Communication to points under the sea, beneath the ground, or below the polar ice cap can be achieved on these frequencies.

VLF frequencies (<30kHz) are normally employed for very long distance (world-wide) communications, and communication to submarines, and LF (frequencies <300 kHz down to a lower frequency limit of about 60 kHz) are most useful for transmission to distances <3000 km or so. The frequency range 30-60 kHz is useful for distances between these two extremes, but little current use is made of this frequency band.

The principal use of low frequencies (70-350 kHz) in Canada is for reliable communications in the Canadian North, particularly by the Department of Transport, for communication between shore-and-ship, for communication between ground-to-air airborne equipment (for routine weather information and back up to high frequency circuits), and for radio navigation (in

particular systems employing simple radio direction location methods for air navigation in the North). The many radio beacons in the Canadian North are, in an increasing number, being used as well for radio teletype transmissions over medium range links, which provide primary or back up service. A number of these circuits use error correction techniques, which improve tremendously the reliability of the transmission (noise at LF is impulsive in nature since individual lightning strokes propagate to the receiver with small frequency dispersion). Frequencies up to at least 350 kHz are not adversely affected at times of severe auroral or polar cap disturbances, in fact the signal strength is often enhanced at times of particularly intense daytime disturbances, disturbances that completely disrupt HF radio communication (black out). The atmospheric noise level is also very low in the Canadian North.

Frequencies below about 70 kHz are not used to any extent by Canadian communicators; there appear to be no Canadian based transmitters operating in the VLF frequency range.

A useful summary of low and very low frequency propagation has been given (Belrose, 1968); and some details concerning the engineering of communications systems for low and very low frequencies is given by Belrose, et al. (1950) and Watt (1967).

2. Some practical Considerations of LF Communications

Radio operators avoid using low radio frequencies if they can. The antenna systems employed are either of such large physical size that construction and maintenance costs are high; or they are so short with respect to the wavelength that radiation efficiencies are low, and the input impedance is very reactive (capacitive) with such low resistance that the band width of the antenna system is small, and the voltages on the antenna large for even moderate transmitter powers. A large tuning coil and a fairly extensive ground system must be employed. Changing weather condition results in some detuning of the antenna; in the extreme, freezing rain prevents operation entirely unless antenna sleet and ice melting circuitry is available. Automatic antenna tuning circuitry should be employed in a sophisticated system operating on more than one frequency; the returning of an LF antenna is a tedious time-consuming task. While such equipments are available they are not in use in Canada. Volume 5 of the Telecommission Study describes, as an example, the LF transmitting system employed at CRC for propagation Studies.

The receiving equipment should comprise a small electrostatically shielded loop antenna, 1 metre diameter, which should be located in an open field several hundred feet from the building housing the receiver and terminal equipment. The receiver should be transistorized, temperature stable, and should employ optimum bandwidth for the particular mode of operation. The receiver should employ impulse noise suppression before the bandwidth is narrowed. Mimumum shift FSK is the most efficient mode of operation at these frequencies, employing simplex or time-division multiplex, and error detection codes.

A closed loop error correction system should be employed, particularly for the southern end of a north-south link because of the higher levels at the more southerly location of atmospheric and man-made noise.

Detailed propagation considerations are beyond the scope of this brief report, but a few general comments follow. In general the longer the circuit the lower should be the operating frequency. The antennas should be so sited that sky wave is launched (and received) over sea water or ground of good conductivity, this is near grazing incidence. For example at 100 kHz over a 1500 km circuit that radiated (and received) field strength for a given transmitter power for the cases where the antenna foreground is sea water, rocky soil, arctic land and glacial ice would be reduced by factors of 0.86, 0.52, 0.3 and 0.09 over that for transmission (and reception) over a perfectly conducting flat earth. Since these factors apply at both the transmitter and receiver combined effect on the received field strength is the product of the antenna factors, i.e. in the above example a circuit where the antenna foreground is arctic land would require a transmitter power about 20 db greater than a circuit where the antenna foreground is sea water, for the same received field strength.

The poorly conducting terrain of the Canadian North also affects the phase of the wave, and hence the positional accuracy of a radio navigation system which depends on the phase of the received wave (Bourne, et al. 1968).

3. Present and Future Use of LF in Northern Canada

The use of LF communications in Canada has been briefly mentioned in the introduction of this report. These are

a) Radio beacons (200 - 350 kHz)
b) Communications (FSK, CW) over medium to long distances, either as primary or back up circuits.

c) Reception of time and frequency broadcast signals
d) Long Range navigation (Omega system 10 - 14 kHz)
e) Short to medium range navigation (and time) (Decca (70 - 130 kHz) and Loran C (100 kHz).

The many radio beacons in the Canadian North are in an increasing number being adapted as well for LF communications (i.e. combining (a) and (b) above). The present use of LF by the Ministry of Transport, the principal user of LF in Canada, is likely to continue, and to expand as the North is developed, even with the advent of communication satellites, and with the addition of new microwave links and land lines.

LF radio waves are not extensively used for navigation in the Canadian North, although the Ministry of Transport has some experience in the use of the Omega navigation system, but with the increasing need for reliable navigation systems (requirements for example to oversee Canadian sovereignty in Arctic waters and oil tankers using the Northwest Passage), there is an increasing need for navigation systems. The installation and maintenance of such systems as Loran C in the Canadian North would be very high. The most practical method for navigation in the Arctic would seem to utilize the Omega (10 - 14 kHz) radio navigation system of the US Navy. The accuracy of Omega navigation systems is not very high, being 1 - 3 miles under ideal propagation conditions; probably much worse in Arctic regions due in part to more frequent radio disturbances, and in part because of the poor conductivity of the land. An adaptation of the Omega system, not yet tried is Differential-Omega which would certainly work. In this method Omega monitor receivers would be located at all sites of the Ministry of Transport where HF and preferably LF communication is available, and updated corrections would be broadcast by radio to users of the system. The differential-Omega navigation method is being considered by the Ministry of Transport.

The development of transistors and integrated circuits has resulted in considerable improvement in the reliability of communication equipments, particularly in regard to receivers and associated terminal equipment. Solid state LF transmitters have been developed commercially, and Communications Research Centre, Department of Communications, have developed a solid state LF transceiver (500 watts) for reliable LF communications over short distances, distances of the order of 250 miles, employing an easily erected horizontal half-wave dipole antenna (about 2,000 feet tip-to-tip) laid on the surface of the ground (or preferably suspended a few feet off the ground) has been demonstrated, (Evans, 1970), which makes possible reliable communication from temporary or semi-permanent locations. The

requirement for a LG communication system could meet military and government needs where reliability is a principal requirement.

In conclusion LF radio communication has been and is being used for reliable communication in the North, and even with the advent of sophisticated satellite communication systems, with the installation of microwave links and land lines, LF radio is likely to continue to be used, either as a back up for these other systems, or a back up to HF radio at places where other reliable communication systems are not available.

CHAPTER VII

Communication Satellite Options

for

Northern Communications

CHAPTER VII

Communication Satellite Options for Northern Communications

A special project team was established to look into the feasibility of using communication satellites to realize substantial improvements in telecommunications service to the Canadian North. It consisted of representatives of the Trans Canada Telephone System, Telesat Canada, and the Department of Communications. The decision was made that two approaches would be taken to investigate the feasibility of communication satellite options for the North. The first approach would be to investigate what could be done using the first series of satellites planned for the Canadian Domestic System. This would provide communications at the earliest moment. The second approach would be to investigate what might be done in the future if a system were developed which was specially designed for this type of service, perhaps operating in a different frequency band.

At the present time in the Eastern Arctic, Nouveau Quebec and the Coast of Labrador, communities are dependent upon HF radio links provided by private users or by Bell Canada and by leased circuits on Military Tropospheric Scatter systems. The same general situation applies in the Western Arctic except that the leased circuits are provided in terrestrial facilities and open wire lines.

The mode of operation of the HF radio links (simplex operation) makes this type of service marginal at best, especially when the problems generated by limited hours of availability are coupled with poor transmission performance and heavy utilization. The access to existing military systems is limited and the capacity available for message traffic restricted.

An additional factor to be considered is the fluid nature of the population centres. It is expected that there will be a migration from outlying centres to larger centres like Frobisher Bay stimulated by government policy, economics and natural evolution. This would mean that small centres could disappear in the next ten years. Any expenditures for communication systems must take these factors into consideration.

A review of the communication requirements in the Canadian North related to the early plans for the Canadian Domestic Satellite System revealed that the initial application was for those population centres generating requirements for approximately twelve intertoll trunks. On the basis of one RF channel providing this type of service, up to seven of these stations might be used before the RF channel is fully loaded. The exact number of stations will depend on the quality of service required. Additional locations could be served if more RF channels were assigned to this service.

Partly as a result of the Telecommission Studies there is work now in progress by Telesat Canada for thin route service in the far North. This system is being designed for locations requiring 1 to 6 message (telephone or data) services. A characteristic of the thin route system is that the overall cost per circuit will be a minimum from 1 to 6 circuits per location as compared with the initial configuration with minimum system costs per location of 12 to 60 channels.

There are many small communities in the Canadian Arctic which at present have no service or very limited service using high frequency communications. These could conceivably be much better cared for if an arrangement could be found to provide them with one near commercial grade telephone channel on a 24 hour basis along the lines considered for the thin route system.

An analysis of the situation indicates that there is a large number of such locations. Some of these locations could conceivably have a requirement for two voice channels. The others would be adequately served by a single voice channel. Also there appears to be a requirement for a single teletype or telex channel at some of these locations.

In searching for a good technical solution to this problem it was natural to examine the use of communication satellites. Their ability to provide direct high quality communication channels to locations without consideration of the intervening terrestrial barriers make them a most attractive solution to this problem. The nature of the Canadian Arctic is such that it does not appear that it will ever be possible to provide an acceptable service to most of these locations using microwave, open-wire, or high frequency communications.

The first communication satellites had extremely limited effective radiated powers. Consequently their first application was in the international service where through international agreement the cost of channels is heavily inflated and through the construction of extremely large sensitive earth stations it appeared possible to produce a system which might be economically attractive. As technology advanced, the launchers became more powerful, the satellites could become larger, which in turn made it possible to increase their effective radiated power and the use of small earth

stations to provide a limited number of voice channels became more attractive. At the present time experiments are under way in this area in at least two countries (Australia and the United States). While it does not appear that these services could be economically viable because of technical limitations associated with sharing the operating frequencies with line-of-sight microwave systems the possibility of providing services in areas where this is the only potential technology could make the question of economics of lesser importance.

In order to estimate the cost of providing service into Northern Canada using the first series of satellites in the Canadian Domestic System, the working group developed a model on which the estimate would be based. Appendix 2 to this Chapter is the specification for the model.

The model on which the estimate is based provides only for service between the isolated areas and the earth station connecting the service into the existing national telecommunications network. This means that communications between two isolated areas may use a double hop in the communication satellite. The abnormal transmission delay experienced from this type of operation is considered to be objectionable by a large percentage of the telecommunications industry. However, some work has been done in evaluating the user objections to this type of service, and there is reason to believe that the users in isolated areas would accept this type of service. The contribution by Telesat Canada in Appendix I recognized this concern and has shown system characteristics and costs for both direct intra-northern communications and double hop communications via a southern earth station.

The use of a communications satellite to provide service to individual subscribers in isolated areas carries with it a number of problems which will require considerable effort before satisfactory solutions can be worked out. New and sometimes unique solutions will have to be obtained to the problems of operating, signalling, billing, numbering, switching, supervision, local distribution, interfacing between the common carriers and Telesat, if the medium is to be exploited.

For instance there is a problem of providing bilingual operators for this type of service. In order to provide bilingual service it is necessary to backhaul all of the circuits to the Montreal area. So the cost of integrating the service into the domestic network becomes a significant item in the total cost of the service. Furthermore the proposed technique of providing the service is not compatible with the present arrangement between Telesat and the common carriers for the interface between their facilities.

Another problem is related to the reluctance on the part of the telecommunication common carriers to provide facilities which cannot be easily expanded in the future. If through the provision of a new type of service there is an abnormal increase in the use of the facility, it must be expanded. It turns out that there are significant incremental increases in system costs when the amount of service being provided is increased and there is always a danger that the facility originally installed in the isolated area may rapidly become obsolete.

Another item which can be significant in the cost of implementing the service is the local distribution system in the area to be served.

The present arrangement for billing the customer is to charge in terms of who made what call and where to. A new and radical billing system may be needed before the facility is placed in operation.

Another problem which must be solved relates to the location of the master station providing the connection into the domestic system. It may be more appropriate to terminate circuits from the western sector of the Arctic at a station on the West Coast, depending on traffic flow patterns.

On the basis of the work which has been done it is easy to conclude that economics alone will not bring communications to Northern Canada.

In Table 1 of the contribution to Telesat Canada the cost of providing the service in the form of one dedicated voice channel per community is estimated to be $88,000 annually. The annual cost to the common carriers to link the service to the customer and provide the necessary toll centres has been estimated to be $600,000 for 50 sites. This breaks down to $12,000 per year per voice channel. The total annual cost, therefore, of providing one dedicated voice channel per community in lots of 50 communities is estimated to be $100,000 per year.

A contribution from the Communications Research Centre estimates the annual cost per community to provide one voice channel in a UHF satellite communication system, specifically tailored for this type of service, is estimated to be between $13,000 and $37,000 per circuit for systems of 100 terminals. This assumes a non-profit operation. For a larger number of terminals the cost per circuit decreases because of the lower cost of ground stations.

ANNEX 1 TO CHAPTER VII

Utilization of the ANIK Satellite

by

Telesat Canada

1. INTRODUCTION

This brief provides a survey of the various system concepts that may be applied to the provision of telecommunication services to the Canadian Far North utilizing the first generation of Telesat Canada satellites.

Planning for the initial domestic satellite system has been based on the provision of six satellite RF channels, allocated to potential users as follows:

1. - CBC, French Language Television.
2. - CBC, English Language Television.
3. - CBC, English Language Television.
4. - CN/CP and TCTS, Toronto-Vancouver Telephone Message Traffic.
5. - TCTS, Telephone Message Traffic to the North.
6. - Bell Canada, Experimental Use.

The satellite channel assigned to Northern telephone service is expected to initially provide circuits to Frobisher Bay and Resolute. This application will utilize about 30 of the 130 2-way circuit capacity of this RF channel in the FDM/FM frequency division multiple-access mode. The remaining capacity will be available for growth and if warranted the experimental RF channel could also provide further expansion of this service. In addition, alternative satellite designs are presently under evaluation which, if implemented, could provide additional flexibility and growth potential.

Television network service will be available to some 25 communities throughout the North initially by the provision of "Remote T.V. Receive-Only" earth stations. These stations will require a 25 foot diameter antenna ($G/T \simeq 25.5$ dB) and will have the capability to accept additional equipment for telephone

message service if this is required. Since the satellite has full country-wide coverage, the television service may be extended to any location by the simple addition of an earth station where required.

Unlike the television service in which each television channel utilizes a full satellite RF channel, many telephone message circuits may be derived from one satellite RF channel in numerous ways, with each transmission method displaying its own cost and performance characteristics. The remainder of this brief is devoted to an examination of these methods for providing telephone message circuits to the North.

Early studies in the application of a Canadian satellite system for telephony to the North suggested it would find its primary use in serving communities requiring a minimum of 6 - 12 telephone trunks. The early studies also proposed that the most economic way of serving the smaller communities having even smaller requirements in the order of 1 or 2 circuits, would continue to be HF radio, either directly to the South or indirectly through the satellite earth stations located in the North. The Frobisher Bay and Resolute service mentioned earlier are a result of this planning.

Although early studies were correct in assuming that HF radio provided the lowest cost means of serving the smaller communities requiring only one circuit, it did not take into account the growing demand from these communities for a reliability and grade of service better than that available with HF radio. The Department of Communications has indicated strong interest in determining the extent to which economic support of this demand might be required, and as a result, Telesat Canada is currently undertaking an extensive evaluation of the technical means which could be used to provide one or two telephone or data channels to such locations in addition to providing trunk facilities to the large centres such as Frobisher Bay and Resolute. The objective is to select the most economic system which could be implemented within the first few years of operation of the Telesat satellite system. This brief provides an interim view of the work undertaken to date by Telesat Canada in this field.

2. THE PLANNING PHILOSOPHY

In the planning of improved telecommunications to the North, Telesat Canada has considered it important that the approach used be one that recognizes and takes into account the

long term implications of providing this service. For example, when a new service is provided by an operating agency, that agency assumes a responsibility to the populace concerned to continue the service and to reasonably meet growth demands over the years. To do so effectively, the source of revenue to meet these commitments must be established. Since telecommunication services to the North are unlikely to be commercially viable for some years, a realistic economic analysis and evaluation will provide an equitable basis for any assistance that may be agreed upon.

This approach underlines the need for decision making based on total annual charges taken over a planning period extending over seven to ten years. Total annual charges would include the major factors of return on investment, depreciation based on expected plant retirement from service, and operating and maintenance expenses as well as the other miscellaneous economic factors. These annual charge factors should be assessed based on provision of the total service, that is, Telesat's satellite link and the Common Carrier or telephone company's associated facilities and services. The long term view recommended here should also take into account the economic effects of early equipment retirements resulting from possible proposals to introduce new techniques.

The pertinent planning factors of traffic forecasts, service quality, cost and capacity of various system choices are discussed in the following paragraphs and appendices attached to this brief.

3. FORECAST OF TRAFFIC REQUIREMENTS

The preparation of a forecast of traffic requirements in the North is a pre-requisite to the choice by Telesat Canada of a suitable communication satellite system configuration to meet them. It is recognized that the forecast of requirements for the North is a difficult process and is affected by many factors including the cost of the service. Telesat Canada is sufficiently advanced in the study of alternative systems to be able to discuss the relationship between the costs, circuit quantities, traffic routing and growth capability. Furthermore, traffic forecasts should be established in consultations between the Department of Communications, the Common Carriers and Telesat Canada and planning or action should be implemented on the basis of such forecasts in consultation with all parties concerned.

Some of the major factors affecting the system design include the potential growth of telephone traffic over the initial 5 and 10 year period and the likelihood of the need of television in the future to these small communities. In the Appendix, systems are shown with capacities of from 15 to 400 two-way voice circuits per satellite channel according to the modulation scheme and type of earth station utilized.

Clearly, the numbers of circuits per location, numbers of locations, the need for inter-Arctic communications and forecasted growth should be carefully assessed if wasteful or inadequate designs are to be avoided.

4. QUALITY OF SERVICE

The systems for the North described in the Appendix are capable of a wide range of performance, ranging from that usual in Southern Canada to lower grade systems. The choice of the noise performance of a telephone circuit affects the satellite channel capacity and therefore has a direct bearing on the cost to customers. Results are shown in the Appendix of the variation of capacity with noise performance. This is intended to assist potential customers in making a choice between grade of service and costs. For example, one system (FDM/DM/FDMA) using 15 ft. diameter antennas and an uncooled receiver can provide 12 voice circuits to each of 10 locations with a noise performance of 38 dBrnc0 or to each of 20 locations with a noise performance of 44 dBrnc0. The noise of 38 dBrnc0 is typical of 2000 mile link in southern Canada whereas a lower performance of 44 dBrnc0 is typical of present tropospheric scatter systems to the North. A similar change in noise performance for a one voice channel per location system (FM/FDMA, voice activated) using the same earth station design would increase the number of remote communities served from 40 to 65.

Service availability, that is the percentage of the time the facility is working satisfactorily, is another quality factor directly affecting the cost of service to remote Northern locations. Service availability is directly dependent on the maintenance effort expended at earth stations, the logistics of spare parts, and the built-in equipment redundancy. All these factors affect the operating cost. For example, one of the stations whose costs are provided in the Appendix, has an estimated availability of 98.2% or an estimated outage of 160 hours per year for unattended operation. The cost to reduce this outage to 3 hours per year would require an increase of 30 - 40% of the station first cost by providing equipment

redundancy. Alternatively, a similar improvement may be achieved through having selected on site spares and having available a trained technician on site. Therefore, considerable care must be exercised in developing a scheme to ensure that both the quality of service is acceptable to the users and the costs are reasonable.

5. INTEGRATION WITH THE TELEPHONE NETWORK

Planning of a communication satellite system to serve the Far North requires that proper consideration be given to the technical integration with existing communication facilities. In addition, the cost of a service to the end user must take account of the cost of both the satellite and terrestrial services. To this end Telesat Canada is in regular consultation with the Common Carriers with the objective of providing a good and cost effective overall system design.

6. ALTERNATIVE SYSTEM PLANS

Telesat Canada has examined some five alternative modulation and multiple-access systems for serving the Canadian North. Three of the most attractive systems are reported on in the Appendix* including FDM/FM/FDMA, FM/FDMA and PCM/PSK/FDMA systems. This includes several variants of these basic systems, including pre-assigned, and demand-assigned systems. All of these systems are compatible with the initial satellite design.

The systems described in the Appendix were studied in detail with respect to their suitability for meeting the telecommunications needs of the North. These studies have included the relative cost advantages of the systems in meeting different assumed traffic requirements and growth rates, traffic routing flexibility, system operation and maintenance. Other systems which are being examined are a Delta modulation scheme and a PCM/PSK/TDMA system. However, these are not considered to be strong contenders for an initial system.

7. ANNUAL COSTS

Preliminary annual charge studies have been undertaken to determine the order of magnitude of the annual costs for the satellite system portion of various alternatives. The space segment portion of the satellite system costs may vary widely over approximately $1 million to $3 million per year per RF channel depending on the satellite design chosen, the procurement policies followed and the commercial agreements negotiated, all of which, at this time of writing, are under review. The per channel cost of an expansion of the initial satellite system could be substantially lower than those for the initial system.

* Telecommission Study 8(c) - Volume 6.

TABLE I

TYPICAL SYSTEM ANNUAL COSTS

	System A[1] x $1,000	System B[2] x $1,000	System C[3] x $1,000
Number of communities served	26	26	65
Number of circuits/community	1	shared[4]	4
Total circuits through one RF channel	26	26	260
First Costs (earth segment)	$ 2,100	$ 2,600	$26,000
Annual cost (earth segment)[5]	$ 700	$ 900	$ 8,700
Total annual cost (assuming $3 m/year/satellite RF channel)	$ 3,700	$ 1,900	$11,700
Total annual cost/community	$ 142	$ 73	$ 180
Total cost/circuit	$ 142	-	$ 45

NOTES:

(1) System A is a voice activated, single voice channel per carrier FM system with 10 ft. diameter earth station antennas and G/T = 16 dB.

(2) System B is similar to A except that improved circuit utilization is achieved through the use of a simple demand assigned system.

(3) System C is a modified Spade System with 30 ft. diameter antennas and G/T = 26 dB.

TABLE I (Contd.)

(4) Eight circuits through the satellite channel are shared between all stations.

(5) The factors that have been assumed in computing annual costs are for illustration purposes only. For example, depreciation rate is based on an assumed life of 10 years for earth stations and capital expenditures all occur at the same time. Maintenance expense is assumed to be 10% of first costs rather than a figure arrived at by assessing maintenance problems in the far North, etc. The study will be refined in future weeks as the necessary data is developed.

To illustrate the relationships between annual cost, service provided and system design examples typical of a small size station design are shown in Table 1.

The examples quoted here demonstrate the normally expected lower cost per circuit when a larger antenna (higher G/T value) is used. However, to realize fully this economic advantage, the circuit capability associated with the large antenna must approximate the traffic requirements forecast.

It should be realized that the larger system "C" may also be instituted utilizing only a portion of a satellite RF channel and serving a corresponding fewer communities and requiring a lower initial capital expenditure.

It is also of interest to note that the larger antenna, used in the example, is about the smallest size suitable for T.V. reception. This offers the possibility for reduction in charges by sharing of certain costs between the telephone and T.V. services. The Appendix provides preliminary data and costs on a wide range of other system designs.

8. TIMING OF INITIAL SERVICE

Telesat Canada can provide service to remote locations in the North during the first year of operation of the domestic satellite system. This timing is dependent on potential customers identifying their forecasted requirements by the end of 1970.

9. SUMMARY

(i) All agencies concerned have agreed upon plans for the provision of network television distribution and telephone trunk requirements (minimum 6-12 circuits) to the far North utilizing Telesat's initial satellite.

(ii) A plan to utilize the satellite system for improving telecommunications to very small communities in the far North has not yet been agreed upon.

(iii) This brief provides preliminary information on the satellite link planning factors necessary to the formulation of an acceptable plan.

(iv) Annual charge information provided here is for illustration purposes only since determination of

space segment charges must await a decision on satellite procurement policy and total charges must await formation of a commercial policy.

(v) The initial satellite system is capable of providing in a variety of ways a significant and expanding "small community" telecommunication service to the North.

(vi) Formulation and implementation of a sound plan can best be achieved through realistic and practical long range economic comparison studies of the various alternatives.

(vii) Telesat Canada recognizes the special importance of satellite communication techniques in the North and is prepared to cooperate fully with all agencies in the formulation and implementation of a suitable plan.

ADDENDUM TO ANNEX I

UPDATED INFORMATION

Utilization of the ANIK Satellite

by

Telesat Canada

TABLE I

TYPICAL SYSTEM ANNUAL COSTS

- ONE DEDICATED VOICE CHANNEL PER COMMUNITY
- CALLS ROUTED BY AN OPERATOR IN SOUTHERN CANADA

Number of communities	50	100	200	400
First Costs Earth Segment average $120 K/Northern Station (1)	$ 6.0 m	$12.0 m	$24.00 m	$48.0 m
Annual Cost Earth Segment (2)	$ 2.0 m	$ 4.0 m	$ 8.0 m	$16.0 m
Satellite RF Channels required	1.2	2.4	4.8	9.7
Space Segment Annual Cost (4) (assuming $2 M/year/Satellite RF Channel)	$ 2.4 m	$ 4.8 m	$ 9.6 m	$19.4 m
Total Annual Cost	$ 4.4 m	$ 8.8 m	$17.6 m	$35.4 m
Total Annual Cost/Community	$88 k	$88 k	$88 k	$88 k

(1) Stations will cost in the range of $90 - 150K, depending on the location involved. Some of the factors causing this variation are items such as installation, shipping costs, Provincial Sales Tax and civil engineering works. The total cost also includes allowance for the cost expended at the southern earth station.

(2) The factors that have been assumed in computing annual costs are for illustration purposes only. For example, the depreciation is assumed to be linear over a 10 year life with no salvage. Capital expenditures are assumed all to occur at the same time. Maintenance is assumed to be 10% of the first cost rather than a figure arrived at through assessing maintenance requirements in detail.

TABLE I (Cont.)

(3) All calls between Northern locations are routed via the Allan Park earth station to enable them to be handled by operators in Southern Canada. This requires two satellite hops for calls between the North and therefore introduces round trip delays of 1200 milliseconds. The quality of such calls with this delay are likely to be unacceptable to users unless 4 wire telephone sets are used in the Northern communities. The use of 4 wire telephone sets would incur an additional cost.

(4) The space segment portion of the satellite system may vary over approximately $1 - $3 million per year per RF channel depending on the procurement policies followed and commercial agreements negotiated.

(5) The costs quoted exclude those which would be incurred by the Common Carriers.

TABLE II

TYPICAL SYSTEM ANNUAL COSTS

- ONE DEDICATED VOICE CHANNEL PER COMMUNITY

- CALLS AUTOMATICALLY SWITCHED BETWEEN NORTHERN COMMUNITIES (3)

Number of Communities	50	100	200	400
First Costs Earth Segment Average $155 K/Station (1)	$ 8.2 m	$ 15.5 m	$ 31.0 m	$ 62.0 m
Annual Cost Earth Segment (2)	$ 2.7 m	$ 5.2 m	$ 10.3 m	$ 20.7 m
Satellite RF Channels required	0.7 m	1.4	2.8	5.6
Space Segment Annual Cost (5) (assuming $2.0 M/year/Satellite RF channel)	$ 1.4 m	$ 2.8 m	$ 5.6 m	$ 11.2 m
TOTAL annual cost	$ 4.1 m	$ 8.0 m	$ 15.9 m	$ 31.9 m
TOTAL annual cost/community	$80. k	$ 80 k	$ 80 k	$ 80 k

(1) Stations will cost in the range of $130 - 180 k, depending on the location involved. Some of the factors causing this variation are items such as installation, shipping costs, Provincial Sales Tax, and civil engineering works. The total cost also includes an allowance for the cost expended at the southern earth station.

(2) The factors that have been assumed in computing annual costs are for illustration purposes only. For example, the depreciation is assumed to be linear over a 10-year life with no salvage. Capital expenditures are assumed all to occur at the same time. Maintenance is assumed to be 10% of the first cost rather than a figure arrived at through assessing maintenance requirements in detail.

TABLE II (Cont.)

(3) The costs include the provision for forwarding information to Southern Canada concerning calls originated, duration of calls, etc., but not the recording and processing of such information.

(4) Calls between Northern locations require one satellite hop. The feasibility of achieving this is dependent on suitable coordination between users of the orbit of interest to Canada in order to reduce adjacent system interference.

(5) The space segment portion of the satellite system may vary over approximately $1 - $3 million per year per RF channel depending on the procurement policies followed and commercial agreements negotiated.

(6) The costs quoted here exclude those which would be incurred by the Common Carriers.

(7) The system considered here uses some demand assigned features. It is to be recognized therefore that although communities are shown to have the capability of receiving one dedicated voice channel per location there would in fact be an improvement in the use of RF channels which is not reflected in the space segment costs here.

TABLE III

TYPICAL SYSTEM ANNUAL COSTS

- 20 COMMUNITIES WITH ONE DEDICATED VOICE AND TELETYPE CIRCUIT EACH
- REMAINING COMMUNITIES SHARING VOICE CIRCUITS IN THE PROPORTION 1:4
- CALLS ROUTED BY AN OPERATOR IN SOUTHERN CANADA

Number of Communities	50	100	200	400
First costs Earth Segment Average $120K/station (1).	$ 6.0 m	$ 12.0 m	$24.0 m	$ 48.0 m
Annual Cost Earth Segment	$ 2.0 m	$ 4.0 m	$ 8.0 m	$ 16.0 m
Satellite RF Channels Required	0.7	1.0	1.6	2.8
Space Segment Annual Cost (assuming $2.0 m/year/satellite RF channel)	$ 1.4 m	$ 2.0 m	$ 3.2 m	$ 5.6 m
TOTAL annual cost	$ 3.4 m	$ 6.0 m	$11.2 m	$ 21.6 m
TOTAL annual cost/community	$68. k	$ 60 k	$56 k	$ 54 k

(1) Stations will cost in the range of $130 - 180K depending on the location involved. Some of the factors causing this variation are items such as installation, shipping costs, Provincial Sales Tax, and civil engineering works. The total cost also includes an allowance for the cost expended at the Southern earth station.

(2) The factors that have been assumed in computing annual costs are for illustration purposes only. For example, the depreciation is assumed to be linear over a 10 year life with no salvage. Capital expenditures are assumed all to occur at the same time. Maintenance is assumed to be 10% of the first cost rather than a figure arrived at through assessing maintenance requirements in detail.

TABLE III (Cont.)

(3) All calls between Northern locations are routed via the Allan Park earth station to enable them to be handled by operators in Southern Canada. This requires two satellite hops and therefore introduces round trip delays of 1200 milliseconds. The quality of such calls with this delay are likely to be unacceptable to users unless 4 wire telephone sets are used in Northern communities. The use of 4 wire telephone sets would incur an additional cost.

(4) The space segment portion of the satellite system may vary over approximately $1 - $3 million per RF channel depending on the procurement policies followed and commercial agreements negotiated.

(5) The costs quoted exclude those which would be incurred by the Common Carriers.

TABLE IV

- 20 COMMUNITIES WITH ONE DEDICATED VOICE AND TELETYPE CIRCUIT EACH
- REMAINING COMMUNITIES SHARING VOICE CIRCUITS IN THE PROPORTION 1:4
- CALLS AUTOMATICALLY SWITCHED BETWEEN NORTHERN COMMUNITIES (3)

Number of communities	50	100	200	400
First costs of earth segment (Average $155k/station (1)	$ 8.2 m	$ 15.5 m	$ 31.0 m	62.0 m
Annual cost earth segment (2)	$ 2.7 m	$ 5.2 m	$ 10.3 m	$ 20.7 m
Satellite RF channels required	0.4	0.6	0.9	1.6
Space segment annual cost (assuming $2.0 m/year/satellite RF channel)	$ 0.8 m	$ 1.2 m	$ 1.8 m	$ 3.2 m
TOTAL annual cost	$ 3.5 m	$ 6.4 m	$ 12.1 m	$ 23.9 m
TOTAL annual cost/community	$70 k	$ 64 k	$ 60 k	$ 60 k

(1) Stations will cost in the range of $130 - 180k depending on the location involved. Some of the factors causing this variation are items such as installation, shipping costs, Provincial Sales Tax, and civil engineering works. The total cost also includes an allowance for the cost expended at the southern earth station.

(2) The factors that have been assumed in computing annual costs are for illustration purposes only. For example, the depreciation is assumed to be linear over a 10-year life with no salvage. Capital expenditures are assumed all to occur at the same time. Maintenance is assumed to be 10% of the first cost rather than a figure arrived at through assessing maintenance requirements in detail.

TABLE IV (Cont.)

(3) The costs include the provision for forwarding information to Southern Canada concerning calls originated, duration of calls, etc., but not the processing of such information.

(4) Calls between Northern locations require one satellite hop. The feasibility of achieving this is dependent on suitable coordination between users of the orbit of interest to Canada in order to avoid adjacent system interference.

(5) The space segment portion of the satellite system may vary over approximately $1 - 3 million per RF channel depending on the procurement policies followed and commercial agreements negotiated.

(6) The costs quoted here exclude those which would be incurred by the Common Carrier.

(7) The system considered here uses some demand assigned features. It is to be recognized therefore that although communities are shown to have the capability of receiving one dedicated voice channel per location there would be in fact an improvement in the use of RF channels which is not reflected in the space segment costs here.

ANNEX 2 TO CHAPTER VII

SYSTEM MODEL

Satellite Communications into Northern Canada

At a meeting held with representatives of TCTS and Telesat it was agreed that the estimates for the cost of a system would be based on the following model.

Number of subscribers - 50, 100, 200, 400

One estimate will be prepared on the basis that there is one dedicated channel to each subscriber.

Another estimate would be based on the assumption that there would in each case be 20 subscribers each with a dedicated channel. The remaining subscribers would share a pool of channels in the ratio of four subscribers per channel.

In other words - the total number of channels in the system would be $20 + (\frac{N - 20}{4})$ where N = the number of subscribers.

All channels would operate between the northern stations and the domestic network - channels between northern points would use double hops over the satellite.

75% of the traffic would be within any particular region.

25% of the traffic would be between any subscriber within a region and the domestic network.

Performance between the domestic system and the North would be 44 dBrnCo.

Performance from the North into the domestic network would be 37.5 dBrnCo.

Each remote earth station would have two transmitters and receivers.

The maximum acceptable outage is two to three days twice per year.

The 20 dedicated channels would each carry one full-time teletype channel.

The system would be managed by an operator where it connects into the domestic system.

CHAPTER VIII

Northern Coordination and Planning

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Northern Coordination and Planning

> "The challenge therefore is to develop a national consensus not only on goals but on the institutional innovations required to meet the emerging objectives."

In this study of communications in "the North" there have been estimates of the economic prospects and the social needs of residents. Suggestions have been offered regarding the ways in which communications can be developed to foster the growth of the economy and stabilize the settlement of people.

Two facts emerge at this point: for communication the north cannot be defined as territory lying above the 60 degree parallel; and the scale of funding to bring the level of services to southern standards may require a cooperative approach on the part of many authorities and agencies active in the north.

There are many telecommunication common carriers serving the north. CN Telecommunication operate in the Yukon, the MacKenzie and Great Slave area of the N.W.T., and Northern British Columbia: Bell Canada provide service to the Central and Eastern Arctic, and northern Ontario, Quebec, and Newfoundland (Labrador); British Columbia Telephone Company, Alberta Government Telephone Company, Saskatchewan Telephones, and the Manitoba Telephone System operate in the western Provinces. Ontario Northland Transportation Commission and Quebec Telephone serve northern Ontario and Quebec.

A study by the Province of Manitoba Royal Commission enquiry into Northern Transportation (the MAURO Report) commented at page 192 on transportation and communication facilities in northern Manitoba. Its findings could be applied with validity to the situation in northern Saskatchewan, Ontario, Quebec, and the Northwest Territories . . .

> "Communications is itself a form of transportation although limited to the movement of intangibles. The availability of adequate communication facilities is as necessary as transport if acceptable standards are to be achieved. In many cases telegraph and postal service throughout the study area

> do not meet minimum modern requirements. We define such minimum standards as the availability of voice communication on an uninterrupted basis, at reasonable cost. We do not suggest that every resident in the province or in a given area of the province be offered telephone service, but it is our view that in every community of over fifty persons there should be available facilities for voice communication not subject to vagaries of weather or atmosphere conditions."

> ". . . The state has an obligation to provide transportation and communication at minimum standards regardless of cost-benefit considerations. Provision of transportation above minimum standard must be considered in terms of contribution to the economic development of the region."

In some places, as in the outports of Labrador, there is official encouragement to leave settlements and concentrate in urban centres. From the point of view of a commercial carrier, the development and maintenance of communications in such diminishing areas is not justified without government encouragement. Even the most socially-oriented boardroom would find it difficult to vote the large sums necessary to give these places the amenity features of southern communications. The provision of reliable all-weather links, however, should not be beyond the range of a carrier if enough time is allowed. An accelerated demand, prompted by resource developments or because of social and political pressures, would strain the resources of the carrier.

A Trans-Canada Telephone System brief makes the following points:

> "The telecommunications carriers regard it as essential to the success of any development that the government accept a leadership role in defining the needs and objectives, and take immediate steps to establish the necessary policies. The carriers are ready and willing, now as in the past, to cooperate with the government by providing and operating those telecommunications facilities. There is no doubt that financial participation by the government is required to ensure the rapid implementation of the development program."

It seems that there is a legitimate role for the federal government as co-ordinator and catalyst for action and this was foreseen by Parliament when it established the Department of Communications.

Section 4 of the Act provides:

"The duties, powers and functions of the Minister of Communications extend to and include all matters over which the Parliament of Canada has jurisdiction, not by law assigned to any other department, branch or agency of the Government of Canada, relating to:

(a) telecommunications; and

(b) the development and utilization generally of communication undertakings, facilities, systems and services for Canada.

Section 5 provides:

The Minister of Communications, in exercising his powers and carrying out his duties and functions under section 4, shall:

(a) coordinate, promote and recommend national policies and programs with respect to communication services for Canada, including the Canada Post Office;

(b) promote the establishment, development and efficiency of communication systems and facilities for Canada;

(c) assist Canadian communication systems and facilities to adjust to changing domestic and international conditions;

(d) plan and coordinate telecommunication services for departments, branches and agences of the Government of Canada;

(e) compile and keep up to date detailed information in respect of communication systems and facilities and of trends and developments in Canada and abroad relating to communication matters; and

(f) take such action as may be necessary to secure, by international regulation or otherwise, the rights of Canada in communication matters.

The inadequacy of communication service in many communities in the northern parts of the provinces suggests that a joint federal-provincial approach is essential. The case for the participatory form is based on the recommendations of the MAURO Report (Province of Manitoba Royal Commission Inquiry into Northern Transportation), the Carrothers Report, the Political Economy of the Canadian North by Professor K.J. Rea.

The subject of federal-provincial consultations must be a matter of deep concern to all Canadians and it is interesting to note that in a report on the Intergovernmental Machinery by Queen's University an Appendix showed the many different interfaces where contact exists. The list may not represent an up-to-date statement of the position in 1971 but is believed to be a good starting point for a general enquiry. One notable lacuna is the virtually complete absence of machinery for development of communications and although the report was primarily concerned with economic liaison it must be conceded that the communications field had not developed a specific mechanism for consultation.

One approach that has been suggested would be to devise a plenary consultative committee body consisting of appointees representing all governmental authorities and carriers with a northern interest and with members reflecting consumer views and offering a participatory function for ethnic groups. They would be charged with preparing two five year plans for a coordinated northern program. The financing of regionally desirable schemes would be agreed upon on a contributory basis related to the population being served and the estimated benefits. No rigid pre-formulation would be written in. If a provincial authority wished to embark on schemes outside the main plans it would do so at its own cost but it would be expected not to lessen its input to the main effort. The ownership of the facilities thus created would be vested in the political authority for the geographical area concerned. Ownership would cease at boundaries. A commercial carrier, wishing to retain control of equipment could build or buy in areas where there is no provincial government agency. Thus Bell could develop in the eastern North but could not expand in, say Alberta.

One obvious difficulty is the size of the organization of the governing body, and the point has been well made by Professor Rea who traced some of the practical difficulties of coordination. He found it difficult to imagine so broadly based an agency having much more than an advisory function. He felt it could have little to do with the actual undertaking of particular projects and the administration

of a program of development in any detail. He noted, however, that the advantage of such a broadly based agency would be that it would not only create a more natural area for planning but ideally it would make possible a much more economical allocation of national resources to the purpose of northern development.

At a later point he wrote:

> ". . . when modern techniques of communication are taken into account, it would appear to be both economically desirable and physically feasible to plan future development of all the Arctic and sub-Arctic regions as a whole."

He suggested that an agency be so organized as to give representation to all the important specialized agencies, private and public, involved in the economic life of the area. And at page 378 he added:

> ". . . because the fundamental purpose of establishing a regional development agency would be to realize the economies to be gained from coordinating all such activities, the structure of the agency would necessarily have to incorporate those involved in its activities.

Perhaps at this point reference can be made to a report submitted on the Third Northern Research Conference held May the 27th to 29th, 1970, at Poste-de-la-baleine which brought together directors of most of the research institutes in Canadian universities.

> "The tone of the conference was that the research in the North was reaching a juncture point. Few of the institutes are considered major activities by their universities and in the last seven years much of their financing has been funded by a grant programme sponsored by IAND.
>
> . . . There is a sense of frustration among a good number of academics who pointed out that at a time when Canadian interest in the North has reached a new peak; when there was an awareness that a number of basic questions about the North remained to be answered; and that a growing shortage of trained scientists to work in the Canadian Arctic is making itself apparent, research programmes were being cut back.

> . . . In reviewing the programmes of the various institutes, it is evident that much of the research work that has been going on in the North in the past years has been concentrated on a very narrow range of physical sciences; for the most part geophysical and other earth sciences, zoological and entomological. Research groups tend to be small, very poorly integrated and in most universities the institutes are really only shelters for small groups for particular professors who have a specialized interest in their subject as it relates to the North. There has been very little done in the way of coordination of programmes and almost nothing with respect to multi-disciplinary or inter-disciplinary research work. Even less attention has been paid to the social sciences."

A great deal can be done to weld these various research and academic units into an effective, co-ordinated programme working on a financial basis which would not be susceptible to change. A cohesive programme would do away with narrowly oriented, poorly integrated task forces.

What other approaches can be suggested? What measures can be employed? How far, for instance, can a rate increase or a reduction be used to stimulate or retard communication development? When used to carry out provincial and federal policy special rate structures for the north might have merit. How much can a carrier direct from distributable revenue to develop commercially unprofitable networks?

If rates are not a complete policy, then how about taxes? Can special tax write-offs and other preferential devices be used to encourage carriers to develop in named areas? Would the governments concerned forego sales taxes or excise levies in order to encourage specific projects? So far the federal government has resisted any suggestion of preferential tax schedules to compensate the northern resident for the cost of living.

While the example of rates, subsidies and tax preferences might not be too persuasive, they are not the only devices to be examined. An alternative might be a form of investment insurance scheme designed

to encourage carrier investment. If, for instance, a carrier was reluctant to commit itself to a major investment in a high risk undertaking such as a service to an isolated mining community, some guarantee formula might be offered. Thus, if the mine development was closed out prematurely, the carrier would be protected against loss of unamortized capital. Yet another approach could be for oil and gas companies to obtain obsolescence allowances for their communications equipment on the same basis as their depletion allowances for mining equipment.

Another approach which may appeal is the Trans-Canada Highway method. It has a record of success and a whole generation of administrative know-how has been accumulated. Subject to including the Territories in the definition of "Provinces" and changing the Ministerial reference, the form of the Trans-Canada Highway Act offers a strong flexible base for a 'Skyway to the North'. Section 3 could be easily adapted:

> "3. (1) With the approval of the Governor in Council the Minister may enter into an agreement with any province providing for the payment by Canada to the province of contributions in respect of the cost within the province as part of a Trans-Canada Highway.
>
> (2) An agreement made under subsection (1) shall prescribe the location, standards and the time and method of the construction of the highway and shall include terms and conditions for
>
> (a) the calling of tenders and the review by the Minister of tenders and specifications,
>
> (b) the inspection by the Minister of the highway during construction,
>
> (c) the method of determining the cost of construction,
>
> (d) the examination, inspection and audit of all construction costs and accounts, and
>
> (e) such other terms and conditions as the Minister may consider necessary or desirable."

It has been argued by some that the role of the Department of Communications would have to be modified to make it a funding or operational department and that the legislation would have to be changed if it engaged in functions similar to construction and operation of airports by the Ministry of Transport.

But perhaps before the apostles of change dismember the existing structures and substitute some bright new mechanism we should note that Canada has achieved more in meeting its legitimate communication needs than many better endowed countries serving greater populations in countries with less formidable geography. The countries with state owned facilities do not approach the Canadian standards, the countries with ownership of communication in private hands do not offer better service. It is unarguable that there is room for improvement, but nowhere has the state of things in Canada suggested we must move from evolution to revolution. The case for more provincial control over tariffs having a direct impact on provincial residents and businesses is being pressed with vigour by the provinces; but recognition must be given to the virtual impossibility of reconciling local demands for tariff relief with the national need for sustained improvement. Experience suggests the presence of a federal balance wheel is needed to damp out possible provincial disharmonies. Perhaps what we are viewing is a peak or crisis of short duration heightened by a phase of intense technological change and heavy investment. The arrival of satellites, computers, lasers, improved switching, microwave systems, multi-channel cables, cable networks means a frantic scramble for operating capital either from investors or taxpayers. It is imperative that unless chaos is to follow there must be an agreed programme of priorities to marshall the competing demands for manpower, money and materials. As a first step each authority having a northern communications interest should consider developing a small group with a specifically northern commitment. One would expect to find attached to the group men and women who have experience in the North and who are qualified in engineering, economics or sociology. Supporting them would be the normal general administrative pattern from which the group is recruited. These groups would be the idea-people and the feasibility-people. They would develop recommendations on priorities. This form of small group planning would be pragmatic and lower key. Each problem would be taken in its turn instead of being slotted into a fixed schedule. Outwardly the scheme of things would not change, but internally each concerned authority would be identifying northern needs and giving them an individual focus.

Whatever suggestions the federal government heeds to there seems

to be no reason why Canada and the provinces cannot continue to draw upon the investment of administrative experience and goodwill that the Trans-Canada Highway Act provided. The suggestions are not definitive and anyone who examines the schedules of corporations in the Financial Administration Act will realize that Canadian ingenuity and energy has responded successfully to a variety of challenges. There is no reason to think that the challenge of the North will find Canadians deficient in effective ideas and resolution of purpose.