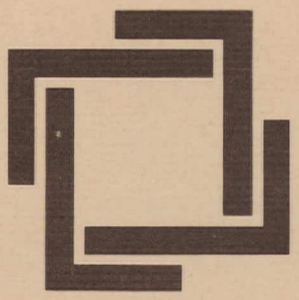
# STUDY INTO THE EFFICIENT USE OF SPECTRUM FOR BROADCAST DELIVERY SYSTEMS



Philip A. Lapp Limited

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A Study Conducted for the

Department of Communications



Philip A. Lapp Ltd.

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# STUDY INTO THE EFFICIENT USE OF SPECTRUM

# FOR BROADCAST DELIVERY SYSTEMS

## 1.0 INTRODUCTION

To assist in developing plans for the formulation and evolution of spectrum policy, the Department of Communications (DOC) commissioned this study to elicit views from those who presently or potentially affect broadcasting through their use of the electromagnetic spectrum. The study is exploratory in nature, and uses the process of personal interview to draw out information, plans and attitudes that would not necessarily be found in written briefs, reports and formal testimony on the principal issues. While no broadcast service is excluded specifically, the study was to concentrate on areas of immediate concern, primarily congestion in urban centres and in the VHF/UHF portion of the spectrum. A "Statement of Work" appears as Appendix 1.

A major issue stems from the increasing demand for commercial land mobile radio services (transportation, utilities, police, telephone, etc.) which could saturate existing spectrum allocations by the 1980's, and thereafter encroach on spectrum currently allocated to television broadcasting which already has depleted most of the available VHF and UHF channels in the major urban centres particularly in Southern Ontario. Other issues relate to the use of UHF and microwave spectrum for the distribution of broadcast signals, the impact of fixed and broadcast satellite services and the use of cable facilities as an alternative to broadcasting in urban areas.

The purpose of the interviews was to obtain the views of broadcasters, cable operators, common carriers, utilities, governments and regulatory agencies on the most effective and efficient ways of meeting demands for spectrum to distribute and deliver broadcast signals. A set of guidelines was developed to assist in the interview process. Appearing as Appendix 2, they were not intended to form a questionnaire, but rather to illustrate the kind of questions to be borne in mind throughout informal discussions.

Most of the persons interviewed were from organizations that responded to the formal invitation from DOC for submissions concerning spectrum allocations in the 406 to 960 MHz. frequency band appearing in the Canada Gazette dated August 21st, 1976. While it was expected that the persons interviewed would repeat or confirm the content of briefs already submitted to DOC, the objective of the interview was to go beyond the formal submissions and draw out deeply-rooted feelings and beliefs - in short, to find out what the person <u>really</u> thinks. Nevertheless, in what is to follow, it has been impossible to avoid repeating some of what already appears in the formal, written submissions to DOC.

The study was conducted in two phases: a first phase in which most of the interviews were conducted, and a second phase of supplementary interviews and analysis. This report attempts to present the findings in such a way as to identify the factors, trends and even prejudices which influence the demand for spectrum and the efficiency of its use for the distribution and delivery of broadcast services.

A total of 64 interviews were conducted over the period January 21, 1977 to August 12, 1977. They are tabulated in Appendix 3 which lists the date, visitor, organization, name and title of persons interviewed. The list covers representatives from the major groups involved, including broadcasters, cable operators,

common carriers, utilities, ministries of communication and representatives of the major relevant Associations. In most cases a pattern emerged in the thought processes and attitudes of the principal players. These patterns are described, but it was an understanding with each of the persons interviewed that in the report they would not be identified individually with particular views. With one or two exceptions, such views and opinions are presented in an aggregated form to preserve the anonymity of the individuals expressing their opinion.

The present and potential demands on the broadcast spectrum as learned through the interviews are presented for each of the major user groups contacted. Then the impact of non-broadcasting spectral demands are covered. A section on the efficiency of broadcast service delivery follows which deals with spectral, economic and geographical considerations including the evolution of non-spectral delivery methods such as cable, video disc and VTR. Finally, conclusions are presented on the principal issues that have been identified in the course of the study.

## 2.0 PRESENT AND POTENTIAL DEMANDS ON THE SPECTRUM

The basic issue giving rise to the study and to the need for spectrum conservation is the unrelenting and inexorable demand for radio frequency assignments from an increasingly wide range of users. Since the spectrum is a finite resource, such users ultimately must come into conflict and compete for whatever spectral resources can be made available. The following paragraphs recount statements made by the users interviewed as to their present use of and future requirements for spectrum, grouped into major user categories.

### 2.1 Broadcasters

Broadcasters use spectrum for two major purposes - distribution and delivery. In terms of the broadcasters' concerns, the issues differed in emphasis depending on the type of broadcaster. While government, and government-related enterprises such as the CBC and educational television agencies were most concerned about available frequencies for programme delivery, private broadcasters currently serving the major designated market areas were more preoccupied with problems related to distribution. The discussions focused on television rather than radio broadcasting because many of the current issues relate to the parts of the spectrum allocated to this service.

Considering first the problems associated with delivery assignments, the CBC lists eleven potential services that could be delivered at any location, but particularly in the larger cities:

1. CBC English TV
2. CBC French TV
3. CTA English TV
4. TVA French TV
5. Third Service English TV
6. Third Service French TV
7. Educational English TV
8. Educational French TV
9. Multicultural/ethnic TV
10. Independent TV (either majority language)
11. Off-air encoded Pay TV (either or both majority languages)

In view of available channels in the larger cities, and depending on the various social and cultural factors which combine to give a particular location its character, the CBC concludes that at least eight channels would be a reasonable requirement for any one location. CBC is deeply concerned that frequency assignments for eight services be preserved in as many locations as possible, and not be given away to non-broadcast users - essentially the land mobile interests.

The concern expressed by the CBC was shared by the other broadcasters interviewed in the educational television groups. OECA, for example, has very ambitious plans for future expansion beyond the six locations now covered by UHF (Toronto, Ottawa, Kitchener, London, Chatham, and Windsor). Immediate plans include Sudbury (UHF) and Thunder Bay (VHF), the next in line will be Peterborough, Belleville, Kingston, Brockville and Sarnia. Longer-term plans include 24 more locations including such places as Timmins, North Bay, Sault

Ste. Marie, Kirkland Lake, Kenora, Ft. Francis, Dryden, Grey-Bruce, Huntsville, Kincardine, Bancroft, Pembroke, etc. Educational TV organizations, which are generally non-commercial and supported by provincial governments are concerned about the availability of assignments at all locations within their respective provinces. They strongly resist the idea of yielding any part of the band to other claimants such as land mobile.

In contrast to the concerns of CBC and the educational TV groups, private broadcasters with assignments already in the major market areas expressed little concern over the future availability of TV channels. In fact some indicated they would be quite happy if no assignments were available since they have already been forced by the CRTC to service smaller, outlying communities as part of the price to retain their licence in a major market area. The impact of an added viewing population on their rate card in no way justifies the capital expense of serving such communities. Moreover, they say that expenditures on expanding services to thinly-populated areas have diverted funds from investment in Canadian programs of high quality, thus inhibiting broadcasters from following CRTC guidelines in this regard. Furthermore existing commercial broadcasters take exception to the large number of services at any location suggested by CBC, arguing that the resulting fragmentation of the market is likely to render all commercial broadcasting unattractive from a business or return-on-investment point of view.

Such attitudes were not unexpected from commercial broadcasters who, once established in major market areas, are not likely to look kindly at any imposed change that would reduce either their return on investment, or their potential market. What was surprising, however, was the attitude by

some that it was just a matter of time before the government takes over all communications including broadcasting. They point to rulings by the CRTC which take out of their hands many of the business decisions normally made by managements of successful business such as capital investments, make/buy decisions, acquisitions and mergers. Owners claim that the regulatory environment is too uncertain to permit the normal type of corporate planning. The result appears to be little in the form of long-range planning, and commercial broadcasters seem to lack much of a flair for imaginative new ideas in broadcasting. It is possible, of course, that because the study was being done for DOC, broadcasters were trying to make a point - but the feeling certainly persisted among all of those interviewed that insofar as the future is concerned, commercial broadcasters were not a happy lot.

Some commercial broadcasters even suggested that the shortage of UHF spectrum was being created by the CRTC through their insistence on the provision of broadcast services in locations already served by local private broadcasters. To add insult to injury, the incoming broadcaster is required to compensate the local broadcaster for loss in revenues due to the competition being created.

Regionally, it became very apparent that in terms of demand for broadcast delivery spectrum, broadcasters in the maritimes and the prairies did not foresee a shortage of UHF assignments with the exception of one or two locations in the U.S./Canada coordination zone such as at Yarmouth, N.S. It is well known that the main problems are in the major cities and in southwestern Ontario. Broadcasters from the maritimes and the west urged that DOC recognize regional differences insofar as spectrum policy is concerned and not apply nationally policies designed to cure problems arising from "Central Canada". A plea for the consideration of spectrum demands on a regional basis recurred throughout the study.

Radical views were expressed by some of the consultants to the broadcasting industry, and some of the senior government officials interviewed. Such views focussed on the encroachment of land mobile spectrum users on the 470-890 MHz. band, and the pressures from the U.S. for Canada to release certain UHF channels for land mobile use. Some advocate that all VHF spectrum should be re-allocated to land mobile, and all television broadcasting should be UHF, as in Europe. Others would first clear the UHF band, leaving VHF to serve principally rural areas as the urban areas move solely to cable. There was no consistency in the opinions expressed by the consultants and government persons interviewed, each with his own private agenda of objectives underlying the basis for his views.

Advocates for clearing the VHF of TV assignments argue that VHF is better for land mobile (although it is claimed that UHF is superior for certain urban applications by some land mobile users interviewed). Those wishing to free UHF of TV assignments point to the inefficiencies of use in the band as a result of taboos caused by the technical inadequacies of TV receivers. The latter - i.e. freeing the band - also would be consistent with what the U.S. have elected to do by releasing channels 70-83, and sharing channels 14-20 with land mobile.

Broadcasters still interested in new assignments, and those with current assignments in Channels 14-20 and 70-83, are concerned that we do not give in to U.S. pressures. From talking to government people (mainly DOC), they fear that under pressures both from the U.S. Government and Canadian land mobile interests, Canada is about to succumb and yield to their requests. If we do so, one consultant advocates that we "horse-trade" border VHF television channels for the release of UHF allocations. (CITY - TV would be very happy to give up channel 79 for channel 7!)

The educational broadcasters supported the CRTPB brief calling for regulations requiring improved UHF receiver tuners so as to eliminate some of the major taboos, but the channels so released should be used to augment available UHF TV assignments, not re-allocated to land mobile. One major study purports to show that the congestion of the UHF spectrum would not be relieved greatly even if taboos were mitigated. Many individual broadcasters feel that the discussion of receiver improvement is academic, on the argument that, by the time improved receivers were in the majority of homes, events (e.g. the introduction of fibre optics) would have passed them by.

a point to be dealt with - perhaps supportive of the approach for a range of allocations to maintain or increase the no of "effective" allocations

It was surprising that few of the broadcasters interviewed had thought through the implications of the growth of cable, fibre optics and the possibility that some day the cities and later both urban and rural areas would be fully cabled. Most believed that cable saturation in the 75-80% range of all potential viewers meant that there still would be room for broadcasters in the urban areas.

By and large it appears that broadcasters are most reluctant to give up their direct access to the home and would wish to cling to the last 10-15% of their off-air clients, even in areas of spectral congestion which are largely served by cable. They still see cable as an adjunct to broadcasting, not as a substitute. The alternative scenario (i.e. 100% cable) implies a considerable readjustment of roles which is perhaps not palatable for quite explicable reasons. The broadcasters presently have two main functions: program production and delivery. While there is as yet little question that the first of these functions belongs to the broadcasters, conditions

True, but not necessarily inserms of Keys paper

in the urban areas are causing increasing pressure on the second. No broadcaster wishes to be denied the possibility of delivering signal in the urban areas (that pay) while being left with delivery to sparsely populated areas that he did not wish to serve in the first place.

On the question of Pay TV, none of the broadcasters interviewed admitted to any plans in that direction nor, indeed to much interest in it, nor to a belief in the feasibility of delivering Pay TV signals by broadcast means. Most see it as a cable activity, and so foresee no spectral implications for broadcasting, only for cable distribution.

As a final note before turning from the issues raised in broadcast delivery to the issues raised in the distribution of broadcast signals, it is worth recording a statement made by one of the senior consultants in the industry. "At many times in the past, it was thought that there was more-than-enough spectrum to meet requirements and then some in AM, FM and more recently VHF television. Yet today virtually all available assignments in these regions of the spectrum are gone. The applications in broadcasting never seem to saturate, and the eight services per location suggested by the CBC in retrospect may seem small in number at some time in the not too distant future, say 15 years."

The issues concerning distribution centre around the deep feeling of resentment toward the monopolistic practices of the common carriers. By and large, small broadcasters (and cable operators) are encouraged and often are forced by DOC to use existing common carrier services rather than establishing their own facilities. Exceptions apparently are granted

deep seated concern - could be alleviated if some sort of an option or deliver.

when cost differences override spectrum efficiency and management considerations. Nevertheless, small broadcasters feel that DOC favours the common carriers, and that the rates charged by the carriers are exorbitant.

The small radio and TV network operators harbour a similar resentment of the carrier monopoly and are busy with plans to avoid as far as possible the rental of carrier facilities. These attitudes are much less evident in the large network operators and it is clear that the CBC generally works very closely with the common carriers.

There was evidence that in some parts of Canada, broadcasters and cable operators may band together to create their own distribution system, hoping to prove they can do it far cheaper than the common carriers. As long as the carriers have a monopoly, broadcasters claim they will resist using them if they see any other possible alternative such as operating their own distribution system.

For this reason, broadcasters oppose the proposed Telesat TCTS merger, because they see the satellite as available no longer as an alternative to terrestrial microwave. (Yet with the exception of CBC, the broadcasters did not use Telesat in any event). The high cost of renting Anik channels also was resented by broadcasters.

There was a strong feeling expressed that the cost of satellite channels would only be reduced to competitive levels under conditions of maximum flexibility in which a wide variety of users were encouraged to take advantage of the satellite system, as in the U.S. The TCTS-Telesat merger, in the eyes of many

potential users would militate against flexibility, and discourage the many users who insist that their only viable course would be to own their own earth station.

Some small broadcasters contacted were not aware of the distribution possibilities in the 11 - 14 GHz band, but when the potential was described, they reacted enthusiastically - again, because they saw it as an alternative to the present common carrier monopoly. In fact, Switzer already has proposed a "National satellite broadcasting system" using the SHF band to free the industry from the "legal and technical complications of dealing with Telesat". Such a system would service both the broadcasting and the cable industries. The CBC also sees its future additional needs for satellite channels being fulfilled by satellites in the "broadcast" rather than the "fixed" mode.

While it was a finding that few of the broadcasters contacted showed much imagination in terms of future innovation either in delivery or in distribution, the cable industry was not much better in terms of the oppression it believes it endures under the twin yokes of CRTC and DOC. It must be born in mind, of course, that private broadcasters and cable operators are businessmen responsible to their shareholders to achieve an adequate return on invested capital. Governmental regulations often are seen as an impediment to that objective, and so it is natural to expect the reactions found in these industries. We turn now to the present and potential demands for spectrum by the cable industry.

## 2.2 Cable Operators

Cable operators use spectrum to distribute broadcast signals, from gathering-points near the U.S. border to cable head ends in urban centres and surrounding communities. For long-haul routes, common carriers are generally used, but for short-haul some cable operators would prefer to operate their own microwave systems because they believe they could do so at a lower cost than renting facilities from the common carriers. For single hops, such as those which feed district cable head-ends from a single distribution point, some cable operators use or plan to use their own 12 GHz VHCM facilities and are thus concerned about the recent DOC ruling concerning that band. The implications of that ruling and the relationship between cable operators and common carriers were two of the major issues rasied in discussion.

The relationship between the common carriers and the cable operators is even more strained than in the case of the broadcasters. For purposes of distribution, it is common for cable companies to form into consortia; and in one notable case in the maritimes where the carrier provides both long- and short-haul services, the 15-year contracts are all planned to expire in the same year - 1987. By that time the consortium expects to have completed arrangements for its own distribution system, possibly using satellite. Thus the monopolistic position of the common carriers is leading in some cases, to the planning of duplicate facilities by cable consortia which would result in less efficient use of the spectrum. The proposed Telesat - TCTS merger appears likely to result in an accentuation of this trend.

An extreme situation of this nature exists in Manitoba where there is a direct conflict between the common carrier, Manitoba Telephone System (MTS), and the Greater Winnipeg Cablevision (GWC). The dispute is over rates for leasing channels on the carrier-owned cable, and the allocation of cable channels. The result is that GWC are planning an alternative independent distribution system obviating the use of MTS trunks, poles, cables, amplifiers, etc. It would use microwave distribution to several local cable distribution centres within Winnipeg from a new distribution point within line-of-sight of the centres. Ultimately, GWC foresee the satellite as an ideal medium for distributing broadcast signals for cable.

Timing? - was this before or after Con/Mon Agreement?

In Newfoundland, the situation differs significantly. There, two common carriers - Newfoundland Tel. and CN Tel. - compete over the same routes. Recently, a consortium of six Newfoundland cable operators asked each carrier to bid on a microwave feed from the Chamcook Mt. headend in New Brunswick via Sydney bringing in two U.S. channels (NBC and ABC) to St. John's.

CN Tel. bid 50% lower and won the contract; and according to the Newfoundland Government, the cable operators appear to be satisfied because there clearly is an alternative in that province between two carriers.

In general, cable operators claim they do not require the very high level of availability of signals provided by the common carriers and are therefore reluctant to pay the extra premium that goes with the provision of the necessary diversity and redundancy in the system. The common carriers

talk of an availability of 99.98 to 99.99% while the cable operators generally use a figure of 99.6%. The latter argue that they can install and operate their own distribution systems to this standard much more cheaply than leasing channels from a common carrier.

As to spectrum conservation, the Cablesat consortium - Canadian Cablesystems Ltd. (CCL) and Agra Industries Ltd. - argue that satellite distribution of U.S. signals to cable headends would be more efficient than the current use of terrestrial microwave for this purpose. Also planned for Cablesat is the future distribution of Pay TV. Since they have not had a positive response to the Cablesat proposal, CCL are proceeding with alternative plans.

The proposed Telesat - TCTS merger worries the cable industry because "anyone wishing to make use of the satellite facilities will be forced to deal with the telephone monopoly".

On the question of Pay TV distribution, CCL are about to question whether or not it is possible to re-allocate the 2.5 GHz band currently allocated elsewhere but apparently not being used. In the meantime, the current CCL plan is to apply for a longhaul system operated by a common carrier linking Ontario communities together for Pay TV.

The DOC ruling (1976) that VHCM systems operating in the 12.7 - 12.95 GHz band must vacate the band by the mid-1980's with no new licences to be issued after January 1978, has caused a great amount of concern among cable operators for two major reasons: no alternative equipment yet exists in the newly-designated 14.5 - 15.35 GHz band for VHCM,

and existing rate bases for cable operators now using recently installed 12 GHz VHCM are based on 15-year amortizations. There are evidently in excess of 20 VHCM systems licenced or under application by cable operators across Canada, and more are being planned. For example, in the planning stages in the Atlantic region are CATV-owned VHCM links from Amherst to Sackville and Springhill, and between St. John's and Bell Island. In Alberta, Capital TV is planning AGT-owned VHCM links to contiguous communities as is OCTV. (One or two long-haul AGT channels will be required in Alberta between Edmonton and Calgary, according to QCTV, for future CATV exchange of signals). Premier Cablevision in Vancouver plan VHCM links from the lower mainland cable consortium master headend in Burnaby to a number of local hubs in greater Vancouver.

The need to vacate the 12.7 - 12.95 GHz band in order to accommodate the common carrier's digital system merely exacerbates the current friction between the carriers and cable operators. While the band is fulfilling a specific, immediate need for the cable companies, the latter sense that the carriers' plans to use the band are indefinite and, at the best, very long term. The carriers do not seem to be prepared to go out of their way to destroy the impression that they are "hedging their bets". The fact that the Canadian market for new 14 GHz VHCM equipment is very small so that unit development costs will be high will undoubtedly increase the financial pressures on cable companies. The issue would be defused to some extent if the expiry date for 12 GHz VHCM were relaxed by a few years according to most cable operators contacted.

On the subject of fibre optics, the cable operators and the common carriers also are on a collision course. The larger cable operators contacted see the telephone companies as providing all the services now offered by CATV, and are beginning to take the U.S. line by advocating two fibre strands into the home - one for TV, the other for telephone. The BCN group are about to start experimenting with fibres as a visible means of laying claim to the field and the technology.

While the cable operators and broadcasters have problems in obtaining spectrum for distribution and delivery, the common carriers appear to have it all their own way. The following section examines the spectrum requirements of the carriers insofar as they affect broadcasting.

## 2.3 Common Carriers

There are three ways in which the demands for spectrum by the common carriers affect broadcasting: the first is growth of the mobile telephone service calling for increasing portions of UHF spectrum, the second is the need for microwave spectrum to provide distribution services for broadcasters and cable operators, and the third is the pre-empting of the 12 GHz VHCM band for long-haul digital services. While the microwave requirements, particularly VHCM, have significant short-term implications, the long-term threat to conventional broadcasting is in the UHF encroachment by land mobile.

Canadian mobile telephone services have been in place since 1948, but VHF facilities have become saturated in recent

years causing telephone companies such and Bell and B.C. Tel. to move into the UHF band. Bell's Automated Mobile Telephone Service (AMTS) is being introduced into Toronto and Montreal this year, a comparable experimental system has been operating in Vancouver since last December. Presently 12 Channels should serve Toronto until mid-1978, working on the basis of 25% blocking (one call in four will not get throught); Bell plans to request 40 Toronto channels for the longer term which they claim will handle 1700 subscribers. Such capacity should carry through until the early 1980's when the high-capacity cellular systems will be introduced if the 825-845 and 870-890 MHz bands are re-allocated from TV to public mobile telephone service.

From the interviews with Bell and the other telephone companies, it was apparent that an aggressive marketing campaign was being launched for AMTS-type services with the expectation that public demand will generate sufficient pressure on the government to release the necessary frequencies from the upper UHF TV band. To the telephone utilities contacted, it was inevitable that Channels 70-83 would be re-allocated to land mobile. (In fact, some harboured the view that by the year 2000, all frequencies below 1 GHz will be used for mobile applications, all broadcasting both rural and urban having ben converted to optical fibre).

The telephone companies pointed out that as people and businesses increasingly rely on mobile telephone, there can be no turning back. Moreover, development work is being conducted right now in Chicago on 850 MHz equipment and systems that will accommodate the expected large demands in the spectrally-congested urban areas. Telephone companies

argue that neither they in particular, nor Canadians in general, can afford the high development costs associated with a new and different frequency band for high capacity cellular mobile telephone. Thus, according to them, there is no alternative but to follow the U.S. lead in reallocating space in the 850 MHz band. The CTCA position paper on the 406-960 MHz band outlines their requirements in detail for both UHF assignments for AMTS-type services, and for 850 MHz cellular systems.

The telephone companies urged regulation on a regional basis if necessary in order to allow shared use to TV bands which were not in demand for TV broadcasting in the given region.

With regard to the distribution of broadcast signals they expressed the view that the time for small "independent" microwave links is over. The carriers do not see the rates they charge as being high enough to force broadcasters and cable operators into competition. (This is contrary to the view of some broadcasters and cable operators).

The carriers see domestic needs in the future served by a single cable into the home, with the common carrier renting both the trunk and the drop to the companies providing the service. They appear to be strongly opposed to the idea of two or more cable systems in the home, one for TV and one for other, possibly two-way services.

Long term issues focus on the growth of land mobile, and whether or not some of the currently allocated UHF TV spectrum should be turned over to land mobile use. The following sections deal principally with the plans and programs of major land mobile users.

## 2.4 Utilities

Aside from telephone companies, utilities make extensive use of spectrum; these include the power companies, gas and oil pipelines and distributors, public transit operations and the railroads. Representative organizations from each of these classes of utility were interviewed.

Power companies use spectrum for protection, telemetry and supervisory controls. Their most critical need is for protection. For example if a main 240 KV line short occurs, say due to lightning, the maximum time before the breakers must open on any section of the grid is 50-70 milliseconds in order not to lose synchronism. Typically, the budget is 15 msecs. to detect the fault, 5-10 msecs. to transmit the information, and 30-40 msecs. to operate the 240 KV breakers. If synchronism is lost on the grid, the entire grid goes down - a major catastrophe. Thus, the power utilities view their communications - particularly their portection systems - as much a part of their system as the turbines. (It is evident that the delay created by a satellite system would be unacceptable).

Power utilities therefore own and operate their own communications systems, and the utilities contacted all would resist vehemently any move to force them to use a common carrier. While it is the protection system that is most critical for the reasons given, supervisory controls and all other forms of communications fall within the same organizational and operational framework of most utilities. For technical reasons, the power companies prefer 7-8 GHz for their protection systems, but most other telemetry and supervisory controls operate in the UHF and VHF bands.

The utility kind of thinking which dictates that they operate their own communications system has resulted in a significant amount of duplication of communications plant across Canada. For example, B.C. Rail's microwave system is paralleled by B.C. Hydro's system in the province, and CN/CP at one time wanted to add a third! Another more recent example is the major battle just lost by Maritime Tel and Tel to provide the 1.4 GHz Telecontrol network for Nova Scotia Power Corporation. Even the Nova Scotia government wanted MIT to provide the service, but the Power Corporation won its battle.

Electric utilities are major users of UHF spectrum both for fixed and mobile services. Their continuing independence from the common carriers likely will result in a one-to-one growth in UHF requirements with generating capacity. Traditionally, this growth rate has been about 7% per year, or a doubling approximately every 10 years which is unlikely to change, even with current energy conservation programs.

In recent years, power companies have been experimenting with various means of distribution load control. At peak load periods, there is a requirement in some urban locations to cut off major appliances in the home such as hot water heaters and clothese dryers. Of the alternative schemes tried, such as the use of telephone lines and ripple control (where a signal is sent out on the power line), UHF and VHF radio apparently turns out to be the lowest cost in terms of dollar, if not in terms of spectrum. Thus as load control grows in Canada, increasing demands can be expected in the urban areas for UHF spectrum, although because of the nature of the signal the bandwidth required can be kept very small.

However, Ontario Hydro is in the process of replacing four VHF control links by power-line carrier control, in the 50-200 KHz band. It is, however, concerned that the extension of the AM broadcast band towards these frequencies not result in the proliferation of high-power long-wave (100-300 KHz) broadcast transmitters which could interfere seriously with the power-line carrier system.

On the other hand, if progress in penetration and alternative uses of cable TV continues as expected by the Cable TV companies, the latter believe that cable could become the least expensive method of load control in the future as well as the one which removes this demand from the spectrum.

Oil and gas utilities do not have the same stringent time delay requirements as the power companies, and some appear to be more relaxed about using the common carriers for their supervisory controls. However, there is a strong feeling against the use of common carriers for certain of their communications needs where security and flexibility are prime considerations. Thus, there is some duplication of facilities with the common carriers as is the case with Canadian Western Natural Gas, for example, which operates its own 960 MHz backbone and UHF distribution system. In contrast Westcoast Transmission uses B.C. Rail's microwave system as its backbone. Canadian Arctic Gas intend to use a satellite for all of their supervisory control with terrestrial facilities as a backup.

Since many oil and gas utilities are small in comparison to some of the major common carrier customers, the utilities

claim that the carriers tend to be unresponsive to their needs. When safety and security were at stake, they have been driven into the decision to build and operate their own communication system. Thus oil and gas utilities, like the power companies, duplicate the use of UHF and microwave spectrum. However, with their small size and growth rate, the corresponding demand for spectrum is relatively small in comparison.

The oil and gas industry is anxious to provide TV entertainment for their men working in the frontier areas of Canada - mainly the Beaufort Sea and MacKenzie delta regions. They plan a TV repeater at Inuvik to retransmit CBC signals to Gulf, Imperial and Shell crews in the area. They also wish to pick up and retransmit U.S. television signals, and are about to examine the possibility of establishing a Satcom earth station in the region for the purpose. Thus there are pressures from industries as well as the public concerning the distribution of TV signals and, ironically, the use of a U.S. satellite would appear to satisfy Canadian demands for spectrum conservation, albeit while raising many other kinds of problems.

Public transit vehicles are becoming major users of UHF land mobile spectrum, again mainly in the urban areas. The purpose is to improve operations and scheduling, and to enhance safety of operator and passengers particularly at night. In Toronto, the TTC are testing a digital polling system using 6 pairs of frequencies - 5 digital, 1 voice on each vehicle. The first phase of the project using 10 vehicles has been completed, and the second phase using 100 vehicles is now in progress. Comparable systems are being planned in other cities.

Finally, the railroads already are large users of VHF spectrum, and will become major UHF users in future. The growth in use arises for three reasons: progressive modernization of facilities involves the increased use of mobile communications in the yard, end-to-end on the train, for security and for maintenance purposes. The growth of traffic and the extension of track mileage tends to produce a proportionate increase in spectrum demands. The railroads understand the spectrum shortage and are planning digital communications in future to conserve spectrum. Thus, the utilities form a major user group which, for public safety and protection, have legitimate demands on the UHF spectrum - demands that could have a measurable impact on available spectrum for UHF TV. Another group that has strong legitimate demands on UHF spectrum is the provincial governments. They are covered in the following section.

## 2.5 Provincial Governments

In most provinces, it is the provincial government and its related agencies that are the largest users of land mobile services. In the Ontario government, major users are the Ministry of Transportation and Communications (mainly highways), the Ontario Provincial Police, the Ambulance Service of the Ministry of Health and the Ministry of Natural Resources (mainly the forestry branch). In other provinces, much the same pattern exists with the important users being the departments associated with highways and forestry, and law enforcement and emergency organizations. The growth of spectrum demand for such provincial government services will parallel the growth of government, its capital facili-

ties and the population. Probably the closest indicator to use would be the real growth in Gross Provincial Product which, of course, varies from province-to-province. Thus as might be expected, the most rapid growth of provincially-owned mobile communication facilities is in Ontario, Alberta and British Columbia.

In Alberta, the government-owned Alberta Government Telephones is very active and aggressive in the land mobile area. They foresee major growth in the demand for land mobile spectrum and fully expect to acquire the 470-512 MHz band (TV channels 14-20). It was pointed out that in the U.S. this band is shared with broadcasters. AGT see no reason why this need happen in Alberta, where there are to date no UHF/TV assignments.

In Nova Scotia, provincial and federal government agencies are served by two ageing backbone systems now in place: a 50 MHz system for Lands and Forests, and a 140 MHz RCMP system. In addition, other departments such as highways, the ambulance service and N.S. Power Corporation operate their own mobile systems. The provincial government presently is planning a province-wide, fully-integrated land mobile system to replace the existing, spectrally inefficient mixture of mobile services. It will be described in a later section.

Thus while growth of mobile spectrum demand by provincial governments can be expected to be steady and somewhat predictable, there is some hope that through integrated management action by each government, improved efficiencies might reduce not only mobile communications costs, but also the otherwise inexorable demand for more spectrum.

We turn finally to other users of land mobile, and attempt to estimate their present and potential demands for spectrum.

## 2.6 Other Land Mobile Users

The other major user of land mobile frequencies interviewed was the paging industry. The largest paging operation in Canada probably is MacLean Hunter Communications which now has 6500 individual customers in southern Ontario, as compared to 2000 in 1973. In contrast, the company also leases mobile repeaters - 900 customers in 1973, 840 today. Thus, paging appears to be having some effect on curbing the growth of two-way mobile radio.

The company has 13 duplex channels assigned - 10 VHF, 3 UHF; but future growth will be UHF. A total of 1500 - 1700 voice pagers can be accommodated on one channel, but using 5-tone sequential signals, one channel can handle 50,000 tone pagers. The company covers southern Ontario from Windsor to Oshawa, with plans to extend to Ottawa and Kingston. Typical voice pager rates are $29.16 per month for metro Toronto (Hamilton-Oshawa), $39.65 per month from Oshawa to Windsor. Wide area tone pagers cost $24.16 per month.

Some paging advocates believe that paging can substitute for mobile telephone and many other land mobile applications and thus conserve spectrum, or lessen the growth in demand for spectrum. The telephone companies paint a different scenario. They see paging as part of the evolution toward the

personal mobile telephone. Their sequence go as follows:

1. Paging - as is, using voice
2. Paging - using digital signals and tones providing simple pre-arranged messages.
3. Paging - involving more complex one-way messages such as status reports using digital methods and a printer for recording the message.
4. Personal telephone - providing two-way voice facilities to a sophisticated pocket radio.

These advocates see an enormous increase in the demand for personal telephones once they are detached from a vehicle. They see an aggressive marketing campaign for a "pocket communicator" which would produce a boom in sales which they say will compare with the CB boom of recent years.

On the other hand many take the more conventional view that sees the personal telephone coming very gradually as an extension of cellular land mobile systems. They are sceptical regarding the availability of the sophisticated technology which will be necessary for these advances and some foresee years of gradual systems and equipment development before the "pocket communicator" becomes a reality.

It is well known that as part of the transportation sector, the trucking industry is a major user of land mobile. The brief submitted by the Canadian Trucking Association shows a 10-fold increase in the growth of mobile radio for trucking between 1962 and 1975 in the major urban areas of Toronto, Montreal and Vancouver. Another growth area for mobile communications is boating - particularly pleasure craft on inland waters, but statistics were not obtained on the extent of the growth.

In order to gain a better understanding of the growth of land mobile, the DOC office in Toronto arranged to provide some computer runs on assignments in the Ontario region. A wealth of material was produced, and only a sampling analysis was possible during this study. In a very aggregated fashion, the 1976/77 assignments for Toronto by business sector were as follows:

| | | |
|---|---|---|
| 1. | Agriculture | 162 |
| 2. | Forestry | 145 |
| 3. | Mining and Quarrying | 74 |
| 4. | Manufacturing | 445 |
| 5. | Transportation and Storage | 977 |
| 6. | Communications | 507 |
| 7. | Public Utilities | 514 |
| 8. | Construction | 666 |
| 9. | Trade | 538 |
| 10. | Finance, Insurance and Real Estate | 65 |
| 11. | Services | 637 |
| 12. | Federal Admin. | 73 |
| 13. | Provincial Admin. | 79 |
| 14. | Local Admin. | 807 |
| Total | | 5,689 assignments |

From the list, transportation and storage, and local administration account for over 31% of the assignments. The data provided included the SIC number associated with each assignment and so it would be possible to break down in much greater detail who uses land mobile. Also provided was a time history covering the 14 years from 1963 to 1976 for each sector listed above, and so it would be possible to conduct a trend analysis to show which users are expanding their use of land mobile

most rapidly. Such analyses will be useful in evaluating the relative merits of alternate strategies of any future re-allocation policies relative to the UHF band.

## 3.0 EFFICIENCY IN THE DISTRIBUTION AND DELIVERY OF BROADCAST SERVICES

During the interviews, in recognizing the problem of crowded spectrum, approaches were evolved that could be applied to conserve spectrum and thus improve the spectral efficiency in the distribution and delivery of broadcast services. The following paragraphs describe such approaches and their implications.

### 3.1 Distribution of Broadcast Signals

The OECA and the CBC French service in southwestern Ontario make extensive use of the off-air repeater which they regard as economical of spectrum and as avoiding the use of common-carrier facilities. One of the largest operators of off-air repeaters, who obviously regards the technique as the most effective one for transmission for short distances over favourable terrain, nevertheless said they experienced some fading at sunrise and sunset due to temperature gradients.

The communications satellite, as an alternative and/or supplement to terrestrial microwave for long-haul distribution has a potential effect on spectrum utilization. Telesat Canada points out that the avoidance of back-haul at 6 GHz in future satellite systems operating in the 12 and 14 GHz bands will reduce the pressure on the 6 GHz band which is currently shared with terrestrial microwave. Similarly broadcast satellites, which are capable of delivering sufficient power to individual TV repeaters or cable head-ends, can be used to reduce spectrum demands, provided the expansion of terrestrial systems is controlled accordingly.

In some locations, it was learned that there is a shortage of spectrum for Studio Transmitter Links (STLs). Some broadcasters are planning to replace existing STL links with cable. In fact, Capital TV in Edmonton are planning to use an optical fibre link - a 2000 ft. cable from a high-rise building to the cable head-end.

An interesting suggestion was made by a person in Manitoba that spectrum economy might be achieved by analysing the U.S. networks for significant content not already carried by CBC or CTV. A composite of these programs then could be compiled on a simple channel thereby eliminating the duplication of delivering the same U.S. program on several cable channels. It is understood that some cable companies are studying the feasibility of such a package, although they recognize enormous legislative and institutional obstacles to implementation.

The monopolistic attitude of the common carriers, as perceived by some broadcasters and most cable operators is said to be one of the main reasons for what users regard as high carrier rates. These same users said that the high rates are causing them to seek alternative means of distribution which as they are well aware, usually involve a greater use of the spectrum. The carriers see the solution to this problem as enforcement of the use of a common carrier. The users say they cannot accept such enforcement unless it is accompanied by strict regulation of the carriers to ensure that broadcasters and carriers are being charged fairly. Where there is competition between carriers and spectrum congestion is not a problem, as in Newfoundland, the carriers seem to satisfy the cable and broadcasting communities.

The proposed merger of Telesat with TCTS is looked upon by Telesat as a means of reducing prices by equalizing costs over the entire combined system. In the process, however, it appears to potential users to close off a competitive option thereby leaving users entirely at the mercy of the telephone company - a situation that makes them most uncomfortable as indicated by the very large number of intervenors in the current CRTC hearings. These hearings will determine the final outcome.*

## 3.2 Delivery of Broadcast Signals

According to the Cable TV industry the relief of spectral congestion in the urban areas can be accomplished most efficiently by connecting every TV receiver to cable, and eliminating off-air broadcasting entirely. Other things being equal a mature, well-run cable system expects a penetration of over 80%. The CCTA cites the Canadian experience that up to 20% of viewers whose homes are passed by cable never connect for a variety of reasons, mainly economic. They say that while it might be socially unjust to cut such viewers off, in the end there may be no alternative as spectrum demands reach crisis proportions.

Optical fibres are being pursued aggressively both by the telephone companies and by the major cable operators. They believe that the present decade will see optical fibres being used for trunking purposes; and that by the mid-1980's, fibre will be used in the feeder field, from which it will expand into distribution before the end of that decade. Home installations for telephone service should be well

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* The CRTC has recently ruled that the merger should not take place and Telesat is appealing the ruling to Cabinet.

underway by 1990.

Meanwhile, a consortium of cable operators and Canada Wire and Cable with DOC support, have organized a new company, BCN Fibre Optics Ltd., to perform research and development on the use of optical fibres for cable television, initially for an 8 Km, 14 TV channel, 12 FM channel trunk in London, Ontario.

Beyond conventional TV signal delivery, the telephone companies are beginning to conduct serious research into various forms of service that could be provided through interactive modes with the subscriber - initially by telephone, and later through return data channels on the cable. Linking of the telephone to the TV set is stated by Bell Canada as a probability for the mid-to late-1980's. Such an arrangement could transmit slow-scan TV to a video recorder overnight for regular viewing at a later time.

At the same time the Canadian Cable Television Association is actively working towards the use of its members' coaxial cable for a large number of new services including as possibilities frame-grabbing, meter reading, security services, information services and tele-shopping, as well as Pay and Educational TV. Most of these are also interactive services but as CCTA see them do not call for a switched network in the conventional sense.

As such new technology is developed and introduced, the relative roles of broadcasters, broadcast networks, cable operators and telephone companies will continue to change.

In the course of interviews a number of scenarios were discussed but always in a highly speculative manner. The scenarios included the extremes in which broadcasters created programmes but were only peripherally involved in their delivery, at least in metropolitan areas, and common carriers had the monopoly of delivering all cable services to the home. In this extreme, the cable companies see themselves as threatened and make it clear that they are fighting to retain a role by creating programs on the one hand and by insisting on the right to retain access to the home in a way that is, as far as possible, independent of the telephone company.

Even if urban areas are fully "fibred", and off-air broadcasting in the cities ceases, there still will be a need for broadcasting in rural regions where spectrum congestion will not be as severe. Sooner or later, however, the carriers believe it will be economical to provide any rural telephone subscriber with cable TV once the price of copper wire surpasses the cost of installed optical fibre - a possibility by 1990 according to one of the telephone companies interviewed. However this view does not seem to be supported by the cable companies or their Association.

Meanwhile it is the view of the broadcasters that off-air broadcasting will remain in place for at least the next 10-15 years even in the metropolitan areas which are already largely served by cable. According to their argument there is still an urgent need to make available as many channels as possible to accommodate the eight services projected by the CBC. Thus, they feel, there

is every reason to take action on the CRTPB recommendation to determine the feasibility of improving the design of TV receivers which would allow the reduction of taboos thereby freeing more UHF channels.

## 3.3 Land Mobile

If the UHF spectrum currently allocated to land mobile were used more efficiently it would defer the time when additional spectrum allocations for land mobiles would be necessary and might, in particular, reduce the pressures on the UHF/TV band. Several methods of reducing spectrum use were uncovered from those interviewed. The first is paging which is argued as being a substitute for mobile telephone in some cases. It was mentioned earlier that paging could backfire and help to arouse peoples interest in the personal telephone. A second approach to conserving land mobile spectrum involves the use of digital signals to take the place of regular voice, where routine questions, reports and acknowledgements can be coded and operated at very narrow bandwidths.

Present usage of some land mobile assignments is said by the telephone companies to be relatively inefficient. That is, the amount of actual time being used on-the-air for many assignments is said to be quite small. The suggestion has been made by telephone companies that such users should be obliged to rent the service from the telephone company which would operate computer-controlled, shared channels enabling more customers to be served with less spectrum usage.

In Nova Scotia, a system having a channel-sharing arrangement of this kind is being designed at the present time for the Nova Scotia government. Today, there are a number of departmental mobile systems in operation by such departments as Lands and Forests, Highways, Ambulance Service, RCMP, etc. A province-wide, fully integrated land mobile system is being considered to replace the current ageing systems now in place. The purpose is to reduce costs of future expansion and current operations and to provide for better spectrum management and conservation.

The present assignments to such federal, provincial and municipal agencies are in the high and low-band VHF, including a few mobile assignments. As noted in Section 2.5, there are two backbone systems now in place: a 50 MHz system for Lands and Forests and a 140 MHz RCMP system. The plan is to develop a higher-capacity 960 MHz (or 2 GHz) single backbone and give up the present 50 MHz and 140 MHz assignments thus permitting any agency's mobile to communicate with the nearest of about 30 strategically-placed base station sites containing dispatch centres for entrance and exit from the backbone.

In planning new assignments, the service could be left as it is with additions as necessary, or present assignments could be released and a public service block of frequencies obtained. Apparently, the latter may still be feasible in Nova Scotia. There are 300 mobile assignments now among the agencies involved, and total investment is approximately $ 7 million. The major obstacles to implementing the scheme centre around the coordination

of all user agencies who agree with the concept, but are not willing to pay for their portion. Total cost of the new system and conversion is estimated at $2 million for all agencies combined.

The Nova Scotia plan could be a blueprint for other provinces to follow. It is particularly significant since governments (federal, provincial and local) are the major users of land mobile, and under some form of central management, it should be possible to effect the necessary action to conserve spectrum. Moreover, if government cannot set the example, it becomes increasingly difficult to convince industry and the general public that they should take spectrum conservation seriously.

## 4.0 CONCLUSIONS

It must be re-emphasized at this point that the conclusions of the present report have been drawn by consultants who are independent of all the sectors in which interviews have been held. The conclusions are based on a perception of the problem areas which has resulted from hearing, as far as possible, the views of all the protagonists. While the conclusions do not relate to the details of spectrum usage in particular situations, they summarize the general nature of the problems revealed in the course of the study. Some options for the future approach to efficient use of the spectrum for broadcast purposes are suggested, and it is urged that criteria be developed on which claims for spectrum can be judged consistently in the future in a manner that is visible to all users.

### 4.1 The UHF Television Band

There is congestion in this band which is principally confined to south western Ontario and three major cities: Toronto, Montreal and Vancouver. There is little or no pressure on it elsewhere at the present time.

It is difficult in the light of all the evidence not to regard the use of the UHF band for television broadcasting as a wasteful use of a valuable part of the spectrum. The existence of taboos necessitated by the shortcomings of most domestic TV receivers results in the wide spacing of TV channels in a given region and the loss of intervening frequencies.

Moreover, in congested areas, where the problems are most acute, the great majority of viewers are served by cable and the UHF band on most TV receivers remains unused as far as off-air reception is concerned.

In our view the long-term scenario sees the delivery of broadcast signals directly to cable head-ends either by VHCM, cable, fibre optics or satellite, according to the program source. To pursue the course of reducing taboos by the improvement of future generations of TV receiver front-ends would appear to fly in the face of the national trend which is the decline in the use of the UHF band for TV broadcast purposes.

why? still necessary to effective use of spectrum?

We are conscious of the social and political problems involved in enforcing 100% cable in heavily-populated areas. Nevertheless this is probably the only way of freeing a significant part of the UHF band for other purposes such as land mobile. Consequently it is in our view these political and social problems which government and regulating bodies should face, rather than continue indefinitely with a compromise that is less than satisfactory to broadcasters, cable operators and users alike.

would this not inevitably be held to a monopoly approval - no guarantee not.

There will be particular difficulties in areas such as the Toronto Windsor corridor and in BC with the social and economic cost of removing UHF/TV broadcasting and this should be the subject of a special study.

In areas where there is currently little or no use of the UHF/TV band, consideration should be given to a decision that no assignments will be made, except perhaps on a band-sharing basis.

How are we addressing the regional issue?

Consideration should therefore be given, as an interim measure, to regulation on a regional basis which would permit sharing the UHF band between TV and other users wherever the pattern of present assignments makes it feasible, as discussed for example in the following section.

## 4.2 The Pressure of Land Mobile

The main pressure on the UHF/TV band comes from demands for new allocations for land mobile.

Throughout the study an effort has been made on the part of the consultants to remain neutral on the question of television versus land mobile. The argument that eight television services are needed at any point in Canada is just as valid to the broadcasters as the land mobile argument to mobile users concerning their claim on the band and the economic benefits to be derived from it. Since the two issues are incommensurate, there is no logical way to resolve the dispute, and the final decision becomes political. However, it should be possible to take advantage of Canada's vast geography and localize the issues rather than apply any politically-inspired remedy coast-to-coast.

We have seen that the congestion is primarily confined to southwestern Ontario and the three major cities - Toronto, Montreal and Vancouver. There does not appear to be any reason why solutions found for these "pressure points" should be imposed elsewhere, and so it can be concluded that the television/land mobile issue is a regional,

not a national one. It is true that Canada is under pressure from the U.S. to make changes along the U.S./Canada coordination zone, but the final decision there should follow the pattern of solution for the Canadian pressure points, and maximum advantage needs to be taken of the Canadian geography.

At the pressure points, it would appear inevitable that ultimately some form of sharing be arranged in the bands spanning Channels 14-20, and Channels 70-83. Where sharing has been in use in U.S. cities, we were told that there has not been a single complaint of interference to TV by land mobile users. Quoting from "Industrial Communications" March 25th, 1977, concerning the question of sharing UHF channels:

"When Commissioner Lee asked about possible interference in TV use of the frequencies in other cities, Mr. Petrutsas (Safety and Facilities Division Chief, FCC) pointed out that the land mobile services have been sharing the frequencies for some years now, and the Commission has not received a single interference complaint". New York has 208 channels assigned to land mobile, San Francisco 122, Los Angeles 191, Boston 109, etc. and the FCC plan to assign a lot more.

However, there is some evidence that land mobile users are at least as guilty as broadcasters of using their existing bands inefficiently. We heard references to cases in which assigned frequencies were in use as little as 5% of the working day. While this is justified for emergency services it is hard to justify for commercial operations.

It seems clear that a significant increase in efficiency of spectrum use will mainly be achieved by the substitution of

non-spectrum techniques or by frequency- or time-sharing methods along the lines being planned in Nova Scotia and by other provincial bodies.

Even if these steps towards spectrum conservation are taken, it is likely that the needs for land mobile allocations will steadily increase. Indeed there is logic in the argument which advocates the increasing use of the spectrum below 1 GHz for mobile applications and the use of microwave relay, fibre optics or satellites for all fixed point-to-point applications (including broadcast) in the longer term.

## 4.3 Cable TV

There are increasing demands by CATV operators (and some broadcasters) for VHCM channels to by-pass services now provided by the common carriers. These are caused by rates, which many users regard as excessive, combined with regulations with regard to the ownership of cables and amplifiers and the use of poles which CATV operators view as restrictive - inhibiting flexibility and enterprise.

Whatever the validity of the views of the two sides of this conflict a change of outlook is necessary if unnecessary demands on the spectrum in order to by-pass common carriers are to be avoided.

Some cable companies and broadcasters feel that they are at the mercy of a carrier monopoly which has the unequivocal support of the Government. Steps to be taken to correct this impression could include:

a) The development of more flexible formulae for the relationships between the cable companies and carriers such as those in effect in Newfoundland.

b) The development of ways to ensure that cable companies, broadcasters, carriers and the public understand the criteria against which applications are judged and regulations applied. It is important that an atmosphere of secrecy is avoided and that rulings are not only fair but perceived by all parties to be fair.

c) A statement of policy with regard to spectrum conservation (see below).

d) The demonstration of an understanding of problems of all parties in a disputed area. The shift of VHCM from the 12 GHz to the 15 GHz band is an example of an issue which has exacerbated relationships. The CATV operators feel, rightly or wrongly, that the shift was ordered in response to a whim of the carriers with regard to long-term needs, without adequate consideration of the immediate needs of CATV. This is the type of problem in which greater compromise in terms of more flexible timing, consideration of the issue on a regional basis and acceptance of the possibility of a lengthy period of band-sharing might produce a solution acceptable to all without compromising the long-term future.

## 4.4 Pay TV

There seems to be virtual unanimity that Pay TV, if it comes, need not and should not place demands on the broadcast spectrum. It is one potential demand on the spectrum that can be readily avoided.

## 4.5 Satellites

The economies of spectrum to be achieved by the use of satellites as a replacement for or an adjunct to terrestrial microwave can only be assessed by a detailed study of the whole system of distribution of broadcast signals. However, some of the directions in which economies might be achieved include: -

a) Distribution by satellite network programmes to broadcast transmitters and cable head-ends. Much of the advantage of satellites as regards spectrum economy is lost if back-haul from a ground station is necessary.

b) Similarly the strong demand for nation-wide broadcasting of US network programs could be satisfied by distributing the three principal US network programs by satellite to cable head-ends throughout the country, thus replacing a multiplicity of terrestrial feeds from border antenna farms. The political and commercial implications of such a move are enormous and far-reaching. Nevertheless it is one which should receive serious study from the point of view of spectrum conservation as long as the current policy of universal access to US networks continues.

c) Truly national broadcasts of Canadian material constitute only a relatively small fraction of all TV and radio transmissions. Regional programs are important in practical, political and, possibly, economic terms. Some broadcasters feel that the distribution of regional programs is accomplished

> most flexibly by terrestrial means. However, the plans for new satellites include the means of effecting regional distribution by satellite. Thus the possibility arises of using narrowly-beamed satellite transmissions to cable head-ends where distances within a region are currently regarded as too long for cable trunks. The implications on spectrum use of introducing regional distribution by satellite are far from obvious and there will not be a significant net economy of spectrum use unless terrestrial microwave channels can be released as a result.

The rates charged by Telesat Canada are evidently a deterrent to some potential users. Should the proposed merger of Telesat with TCTS, the main purpose of which is to finance a greater number of channels and thus achieve economy of scale, go through, it might well, because of its monopolistic aspects, drive some users to seek alternative channels on satellites operating in a broadcast mode. Thus there is the risk of creating still another situation in which users seek additional spectrum in order to avoid using the common carrier. Some believe that such pressures might result in the establishment of more satellite channels than the Canadian market could absorb.

The spectrum economy achieved by the use of satellites for the regional and national distribution of broadcast signals depends critically on the place of satellites in the overall system. It is therefore suggested that a number of alternative scenarios which are credible from a technical, economic, and operational point of view, be assessed for the potential net saving of spectrum they might achieve.

## 4.6 The Role of Technology in Spectrum Conservation

It appears from the limited range of interviews carried out in the course of the study that there is often little incentive

to the user of the spectrum to seek alternative technologies for the purpose of spectrum economy.

Some of the principal opportunities to save spectrum by the use of alternative technologies are:

1) Distribution of television signals by fibre optics.

2) Frequency-sharing and time-sharing techniques for land mobile.

3) Optical transmissions (lasers, infra-red) for a limited number of short-range line-of-sight applications, point to point.

All these techniques are in a state of development where early applications are quite feasible. The rate of achievement of spectrum economy by these means will therefore depend more on economic factors and in particular to the incentives apparent to carriers, broadcasters, cable and land mobile operators to take decisions which lead to spectrum economy. Consideration should be given urgently to the use of regulatory powers, and if necessary, financial incentives to hasten the introduction of non-spectrum methods of distribution during the next few years when the situation is particularly fluid.

## 4.7 Implications for Policy-Making and Regulatory Bodies

While there are policy and regulatory implications in many of the above conclusions, a few significant comments are offered on the policy-making and regulatory climate as a whole:

a) Should spectrum be allocated purely on the basis of response to various demands or should there be criteria against which conflicting demands, which differ widely in their social and economic implications, could be judged?

b) The interaction between demands on the various parts of the spectrum is so great that decisions are likely to be wrong unless they are made after the analysis of a comprehensive set of data which, in view of many, does not yet exist. Policy makers are accused of asking the opinions of users instead of accumulating objective data. Yielding to pressure by re-allocating a part of the spectrum merely shifts the problem, but does not solve it.

c) In particular little seems to be known about the loading of certain bands, particularly land mobile. It is said that frequencies are allocated to users who only use them once or twice a day but no hard evidence is available. There is a call for tighter regulations both in the technological sense and in the efficiency of usage of allocated channels.

d) In the alleged absence of comprehensive data and established criteria as a basis for the regulatory process, regulations are said by some users often to be applied in an arbitrary manner or to be unduly swayed by those (such as the carriers) with powerful vested interests.

e) Broadcast licenses are required to be reviewed from time to time. Some broadcasters suggest that the same rigorous standards of review are not applied to the common carriers.

f) The development of social criteria is vitally important. What, for instance, are the social arguments for an against CB or for or against flooding the country with satellite broadcasts of US network programs? What are the social arguments relating to a transition to 100% cable in heavily-populated areas in order to free the UHF/TV band? These questions have significant implications for the future use of the spectrum and plans for spectrum economy cannot be made in the absence of answers.

g) The proposed TCT-Telesat merger raises questions of a tighter monopoly on communications between fixed points. Is there going to be only one

electronic highway? Does this result in a net saving of spectrum? Is it reasonable for satellite rates to be based on distance, like terrestrial microwave? Is a fixed satellite service flexible enough to attract the majority of potential users? These are important questions which are being asked. Only an integral policy is likely to satisfy the various players in the broadcasting game.

# APPENDIX 1

## "STATEMENT OF WORK"

1. TYPE OF STUDY

The study will be exploratory, providing principally non-quantitative information on:

a) spectrum use for broadcasting and other services
b) further areas for study.

2. USE OF RESULTS

a) Immediate application in the development of spectrum policy.
b) Results will be of direct use to the proposed Spectrum Coordinating Committee in examining new ways of managing the spectrum, e.g. will assess the viability of permanent industry/government working groups for spectrum management.

3. STATEMENT OF WORK

Recognizing that both radio frequencies and capital are limited resources:

a) To identify and examine the nature of the present and potential demands on the relevant portions of the radio spectrum by various methods of delivery of broadcasting-type services such as radio, television, pay television, etc., to the general public. Methods of delivery may range in extent from national, to regional to sub-regional and may include terrestrial microwave links, off-air broadcasting, coaxial cable, satellites in the fixed-satellite or broad-cast satellite services, etc. The study will concentrate on areas of immediate concern (congestion in urban centres and in the VHF/UHF portion of the spectrum).

b) To assess the extent to which the transmission of broadcast-type signals from an origination point to the individual member of the public is or could be done in the most economical means possible in terms of minimizing the financial and spectrum requirements of such delivery methods.

c) To consider the extent to which geographical considerations are or would be used with a view to increasing the efficiency of spectrum usage.

d) To consider the impact of demands on the radio spectrum for other purposes (e.g. data transmission, telephony, etc.) which might compete for spectrum and financial resources for the above services, particularly where these other purposes are closely identified with service to the general public.

4. METHOD

a) Interview, in the public and private sectors, present and prospective suppliers and users of the above services and delivery methods with regard to their present and projected operations.

b) Interview senior federal and provincial government staff with regard to their views on the above subject matter.

c) Analyze the information obtained in (a) & (b) and present in a written summary identifying factors and trends which lead to inefficiencies in terms of economic and spectrum considerations. Identify the present and anticipated extent and impact of non-spectrum methods of delivery, e.g., coaxial cable, video disc systems, etc.

d) Propose ways in which more efficient methods of delivery (in spectrum and economic terms) of broadcasting-type services might be implemented in Canada.

# APPENDIX 2

# GUIDELINES FOR INTERVIEWS

# ON THE

# EFFICIENT USE OF THE SPECTRUM

## Guidelines for Interviews on the Efficient Use of the Spectrum

Although the following guidelines are phrased as questions, they are not intended for form a questionnaire, nor to be used directly during interviews. They illustrate the kinds of question the interviewer will have in mind - a mental check-list - during informal conversations with interviewees. The presentation of the questions directly would, in most cases, elicit formal replies of the kind which are already in the hands of DOC.

### 1. Statement of Objectives

To obtain the views of broadcasters, carriers, CATV, governments and regulatory agencies on the most effective and efficient ways of meeting demands for the use of the spectrum for the distribution and delivery of broadcast signals.

### 2. Principal Frequency Bands of Interest

See Annex

## 3. Guideline Questions to Broadcasters

3.1 What do you see as your future needs for spectrum usage for the delivery of broadcast signals, including UHF/VHF television channels, terrestrial microwave, satellite channels, studio-transmitter links, mobile, etc.

3.2 To what extent and at what rate do you see off-air broadcasting being replaced by non-spectrum methods of delivery such as cable, fibre optics, tape, etc., a) in rural areas, b) in urban areas.

3.3 If there is a trend towards the relief of spectrum congestion by the use of non-spectrum methods of delivery, what will be the timing of this relief in various areas?

3.4 Recognizing the difference between remote rural and large urban areas as the two extremes, to what level of population density will non-spectral methods have any impact on spectrum relief?

3.5 What will be the economic and financial implications?

3.6 How will social pressures affect the decisions with regard to relieving spectrum congestion?

3.7 What will be the impact of the development or use of new parts of the spectrum to relieve the congestion of existing bands?

3.8 Is there any new technology which will have a beneficial impact on spectrum use?

4. Guideline Questions to CATV

4.1 What are your present and projected uses of the spectrum for the delivery of broadcast signals? How do you see your needs being satisfied in terms of allocation?

4.2 What will be the demands generated by new services such as Pay TV home information services, computer-aided instruction, TV games, etc.? Will there be demands for 2-way cable? What will be the impact on spectrum use?

4.3 To what extent and at what rate do you see off-air broadcasting being replaced by by non-spectrum methods of delivery a) in rural areas, b) in urban areas. What methods will be used where? What will be the timing?

4.4 To what levels of population density will non-spectrum methods penetrate? What are the economic and financial implications? What are the social factors?

4.5 What will be the impact and timing of fibre optics on the relief of spectrum use?

4.6 Are there other technologies which will have a beneficial effect?

5. Guideline Questions to Carriers

5.1 What are your present and projected requirements for spectrum use for the delivery of broadcast signals.

5.2 What areas of conflict with other services do you see?

5.3 Where and when will fibre optics or other new technologies have an impact on relieving spectrum congestion?

5.4 What services other than telephone and TV do you see delivered to the homes in the future? What demands if any will they make on the spectrum?

6. Guideline Questions to Utilities, Industries, etc.

6.1 What requirements do you have or foresee for the use of the spectrum for the delivery of broadcast signals? For what purposes?

6.2 How do these fit in a conflict with spectrum use by other services in the same region?

7. Guidelines to General Questions (to all categories)

7.1 What will be the impact of Pay TV and the growth of after, new services to the home on the organizational structure of the communications and broadcasting industry?

7.2 What do you see as the relative roles in the future of carriers, broadcasters and CATV operators. How will various scenarios affect the use of the spectrum for the delivery of broadcast signals?

7.3 To what extent will legislation or regulation be required to relieve spectrum congestion? Federal or provincial? What kind of legislation or regulation would you like to see?

7.4 What effect will the TCTS - Telesat amalgamation have on spectrum usage?

7.5 What special problems do you see at locations within range of the US border? How do they impact on Canadian Spectrum use?

# ANNEX

## Broadcast Delivery Methods

### Distribution

#### A. SPECTRAL

| | |
|---|---|
| 942 - 960 MHz | S.T.L. |
| 2500 - 2690 MHz | Broadcasting satellite |
| 2548 - 2690 MHz | I.T.F.S. |
| 3700 - 4200 MHz | Analogue terrestrial |
| 5925 - 6425 MHz | Anik Satellites |
| 6590 - 6770 MHz | Short-haul |
| 6930 - 7125 MHz | " |
| 7125 - 7725 MHz | Low-capacity analogue and digital systems |
| 7725 - 8275 MHz | Medium-capacity digital systems |
| 8275 - 8500 MHz | 1-way video |
| 11.7 - 12.2 GHz | Satellite dist'n |
| 12.7 - 12.95 GHz | Short-haul |
| 14.5 - 15.35 GHz | " " |
| 17.7 - 19.7 GHz | Fixed Satellite |
| 19.7 - 21.2 GHz | Fixed Satellite |

#### B. NON-SPECTRAL

Bicycling

Wire Lines

### Final Delivery

#### A. SPECTRAL

| | |
|---|---|
| 535 - 1605 KHz | AM |
| 2.3 - 26.1 MHz | HF Broadcasting |
| 88.1 - 107 MHz | FM |
| 54 - 216 MHz | VHF TV |
| 470 - 890 MHz | UHF TV |
| 2548 -2690 MHz | ITV |
| 11.7 -12.2 GHz | Broadcast Satellite |
| 12.2 -12.5 GHz | Broadcasting |

#### B. NON-SPECTRAL

Cable

VTR

Video Disc.

# APPENDIX 3

## List of Visits

NEWFOUNDLAND

| Date | Visitor | Organization | Persons Interviewed |
|---|---|---|---|
| May 2/77 | P. A. Lapp | Newfoundland Department of Transportation and Communications | Dr. Tom Grandy<br>Director of Communications |
| May 2/77 | P. A. Lapp | Newfoundland Broadcasting Company<br>Station CJON<br>(CTV affiliate) | Mr. Jack Heany<br>Chief Engineer<br>Mr. Austin Greene |
| May 2/77 | P. A. Lapp | Newfoundland Telephone | Mr. Don Nickerson<br>Chief Engineer<br>Mr. Bill Newman<br>Mr. Arch Jollymore |
| May 2/77 | P. A. Lapp | CN Telecommunications | Mr. R. F. Symonds<br>Plant Maintenance Superintendent<br>Mr. Cyril Abbott, Engineer |

NOVA SCOTIA

| Date | Visitor | Organization | Persons Interviewed |
|---|---|---|---|
| May 3/77 | P. A. Lapp | Nova Scotia Department of Highways | Mr. David Colville<br>Office of Communications Policy<br>Mr. Eamonn Oldham<br>Consultec Canada Ltd. |
| May 3/77 | P. A. Lapp | Maritime T & T | Mr. A. J. Pothier<br>Transmission Facilities Engineer<br>Mr. J. F. Sinclair<br>Supervising Engineer Transmission Design<br>Mr. R. D. C. Coles<br>Supervising Engineer Equipment Standards<br>Mr. M. P. Pothier<br>Engineer, Mobile Radio |
| May 3/77 | P. A. Lapp | Halifax Cablevision Limited | Mr. W. C. Sayers, Manager |
| May 3/77 | P. A. Lapp | Atlantic Television System Ltd., Station CJCH, (CTV Affiliate) | Mr. Marvin Nathanson<br>Vice President, Operations<br>Mr. Wally Robert, Dir. of Engineering for ATV |

NEW BRUNSWICK

| Date | Visitor | Organization | Persons Interviewed |
|---|---|---|---|
| May 4/77 | P. A. Lapp | DOC Atlantic Regional Office | Mr. Denis Martin<br>Director, Atlantic Region<br>Mr. Fred Cunningham,<br>Chief Engineer<br>Mr. John Thwaites<br>Socio-Economic Advisor |
| May 4/77 | P. A. Lapp | N.B. Government | Mr. Walter Steeves<br>Communications Advisor<br>(phone contact only) |
| May 4/77 | P. A. Lapp | CBC French Service<br>Atlantic Region | Mr. Guy Theriault<br>Regional Director |

ONTARIO

| Date | Visitor | Organization | Persons Interviewed |
|---|---|---|---|
| March 23/77 | J. R. Whitehead | Canadian Petroleum Association | Mr. Marcel Delisle<br>Imperial Oil Ltd.<br>Chairman, Telecommunications Committee |
| March 23/77 | P. A. Lapp<br>J. R. Whitehead | H. K. Davis & Assoc. Limited<br>(Communications Consultants) | Mr. H. K. Davis, President |
| April 1/77 | P. A. Lapp | Switzer Engineering Services Ltd.<br>(MacLean-Hunter Broadcasting) | Mr. I. (Sruki) Switzer<br>President |
| April 1/77 | P. A. Lapp | CN Telecommunications | Mr. A. Piechota, General Radio Engineer<br>Mr. John Ormiston<br>Mobile Radio |
| April 4/77 | P. A. Lapp | Canadian Radio Technical Planning Board | Mr. J. C. R. Punchard<br>Secretary and Chairman<br>406-960 Committee |

ONTARIO (Cont'd)

| Date | Visitor | Organization | Persons Interviewed |
|---|---|---|---|
| April 8/77 & April 17/77 | P. A. Lapp | Ontario Educational Communications Authority | Mr. Peter Bowers<br>General Manager |
| April 11/77 & April 22/77 | P. A. Lapp | Bell Canada | Mr. John Worrall,<br>Chief Engineer, Toronto Area<br>Mr. Ron Cross<br>Land Mobile<br>Mr. Pana Burman<br>Headquarter, Tech. Dev.<br>Mr. John Hill<br>Headquarters, Tech. Dev.<br>Mr. Des Dwyer<br>Ontario Tech. Dev. |
| April 11/77 | P. A. Lapp | Canadian Cablesystems Limited | Mr. Ted Jarmain<br>Executive Vice President<br>Mr. Nick Hamilton-Piercy<br>Vice President, Engineering |
| April 21/77 | P. A. Lapp | DOC Toronto Regional Office | Mr. Dave Lyons<br>Regional Director<br>Mr. Bill Stone<br>Supervisor of Authorization & Licencing |

ONTARIO (Cont'd)

| Date | Visitor | Organization | Persons Interviewed |
|---|---|---|---|
| July 29/77 | J. R. Whitehead | Ontario Ministry of Transportation and Communications | Mr. Dave Hobbs<br>Executive Director<br>Mr. Norman Spector<br>Manager, Policy Analysis and Coordination Office<br>Mr. Pierre Vidal<br>Research Officer |
| July 29/77 | J. R. Whitehead | CTV | Mr. Donald W. Coyle<br>Executive V.P.<br>Mr. John T. Coleman<br>Director, Government and Industry Liaison |
| July 28/77 | J. R. Whitehead | OECA | Mr. Ray Carnovale<br>Assistant Director<br>Maintenance Services Branch |
| July 29/77 | J. R. Whitehead | Ontario Hydro | Mr. R. G. Elliot<br>Senior Communications Engineer<br>Mr. Don F. Mittle<br>Telecommunications Engineer<br>Mr. N. Alchuk<br>Project Officer |

OTTAWA

| Date | Visitor | Organization | Persons Interviewed |
|---|---|---|---|
| Jan 21/77 | J. R. Whitehead | Dept. of Communications (DOC) | Mr. T. Rochefort, DOC Project Officer on Spectrum Study<br>Mr. R. Bowen, Chief Satellite Requirements Planning |
| Jan 25/77 | J. R. Whitehead | DOC | Mr. J. Gilbert, Dir. of Industry Structure & Services<br>Mr. G. Courtemarche, Director of Broadcasting Engineering Services<br>Mr. R. Bennett, Director of Network Development<br>Mr. F. Simpson, Director of Research Planning |
| Jan 26/77 | J. R. Whitehead | DOC | Mr. R. Bowen, Chief Satellite Requirements Planning<br>Mr. C. Billowes, Directorate of Rural Communications<br>Mr. J. Silkans, Director of Social Programs<br>Mr. J. Gilbert, Director of Industry Structure & Services |
| Jan 26/77 | J. R. Whitehead | DOC | Mr. J. R. Marchand, Director of Rural Communications Project |

OTTAWA (Cont'd)

| Date | Visitor | Organization | Persons Interviewed |
|---|---|---|---|
| Feb 7/77 | J. R. Whitehead<br>D. J. Cook | DOC | Mr. J. Halina, Director General Research Policy & Planning<br>Dr. J. deMercado, Director General, Telecomm. Regulatory Service |
| Feb. 16/77 | P. A. Lapp<br>J. R. Whitehead<br>D. J. Cook | DOC | Mr. D. Parkill, Ass't Deputy Minister, Research |
| Feb. 16/77 | J. R. Whitehead | DOC | Mr. N. Ahmed, Director of Planning and Special Projects |
| Feb. 17/77 | D. J. Cook | DOC | Mr. Ken Stein, Director Social Policy & Programs |
| Feb. 17/77 | D. J. Cook | Bushnell Comm. Ltd. CJOH | Mr. Jack Ruttle Executive Vice President |
| Feb. 18/77 | D. J. Cook | CBC | Mr. Norman Moore, Manager Planning & Coordination |
| Mar. 15/77<br>July/77 | J. R. Whitehead | Canadian Cable Television Assoc. | Mr. Ken Hancock Director of Engineering |
| June 1/77 | P. A. Lapp | Consultant to C.A.B. | Mr. A. G. "Sandy" Day |
| July 25/77 | J. R. Whitehead | Telesat Canada | Mr. J. Almond Chief Engineer |
| July 28/77 | J. R. Whitehead | Bell Canada | Mr. J. D. Fahey Vice-President<br>Mr. Daniel A. Smith |

QUEBEC

| Date | Visitor | Organization | Persons Interviewed |
|---|---|---|---|
| July 25/77 | J. R. Whitehead | CBC | Mr. J. Litchfield<br>Supervising Engineer<br>Transmission Systems<br>Dr. C. A. Siocos<br>Chief Consulting Engineer<br>Office of the V.P.<br>Engineering |
| July 26/77 | J. R. Whitehead | Telemedia Communications | Mr. R. Lawson<br>Director of Engineering |

MANITOBA

| Date | Visitor | Organization | Persons Interviewed |
|---|---|---|---|
| Mar. 17/77 | J. R. Whitehead<br>D. J. Cook | Manitoba Telephone System | Mr. Glover Anderson<br>Director, Engineering and Planning<br>Mr. Gordon Hauch<br>Manager, CTCA Relations |
| Mar. 17/77 | J. R. Whitehead<br>D. J. Cook | Allan, Consulting Engineer | Mr. D. E. M. Allan |
| Mar. 17/77 | J. R. Whitehead<br>D. J. Cook | Government of Manitoba Department of Consumer, Corporate and Internal Affairs | Mr. Rick Starr, Director Telecommunications Development<br>Mr. C. Thompson |
| Mar. 18/77 | J. R. Whitehead<br>D. J. Cook | Greater Winnipeg Cablevision (GWC) | Mr. Hugh Comack, President also Vice Chairman Prairie Region of the CCTA. |

ALBERTA

| Date | Visitor | Organization | Persons Interviewed |
|---|---|---|---|
| Mar. 3/77 | P. A. Lapp | Alberta Government and Alberta Gov't Telephones | Mr. Gordon Haase, Consultant to the Deputy Minister of Utilities and Telephones<br>Mr. David Klappstein Marketing, Mobile Comm.<br>Mr. Lorne Willard, Technical, Mobile Comm. |
| Mar. 23/77 | D. J. Cook | Alberta Educational Communications Authority | Mr. Larry Shorter, President<br>Mr. W. Porochnuk, Director Technical and Distribution Superintendent |
| Mar. 23/77 | D. J. Cook | Capital TV Limited | Mr. R. J. McIntyre Assistant General Manager |
| Mar. 24/77 | D. J. Cook | CFRN-TV | Mr. Bruce Allaway |
| Mar. 24/77 | D. J. Cook | Quality Cable TV | Mr. E. J. Polanski, President |
| Mar. 24/77 | D. J. Cook | Alberta Government Telephones | Mr. Mallet-Paret, Vice President<br>Mr. Lorne Willard Technical Mobile Comm. |
| Mar. 24/77 | P. A. Lapp | Canadian Petroleum Association | Mr. Harold Millican, President<br>Mr. Cal Phillips Shell Oil |

ALBERTA (Cont'd)

| Date | Visitor | Organization | Persons Interviewed |
|---|---|---|---|
| Mar. 24/77 | P. A. Lapp | Calgary Power | Mr. Art Davis, Manager Telecontrol |
| Mar. 24/77 | P. A. Lapp | Canadian Western Natural Gas | Mr. Jim Atkinson, Communications Engineer |
| Mar. 24/77 | P. A. Lapp | CFCN Television (CTV affiliate) | Mr. Ted Chapman President<br>Mr. Roger Nordquist Chief Engineer |

BRITISH COLUMBIA

| Date | Visitor | Organization | Persons Interviewed |
|---|---|---|---|
| Mar. 25/77 | P. A. Lapp<br>D. J. Cook | Premier Cablevision Ltd. | Mr. Don Shiel<br>Staff Engineer<br>Mr. Jim McEwen<br>Vice President, Operations<br>Mr. Bob Peake<br>General Manager<br>Vancouver Cablevision<br>Mr. Bud Garrett<br>Vice President<br>Planning & Development |
| Mar. 25/77 | P. A. Lapp<br>D. J. Cook | B.C. Government | Mr. Terry Prentice<br>Comm. Consultant<br>B.C. Department of<br>Trans, Comm. & Energy<br>Mr. D. J. Charlton<br>Superintendent of Comm,<br>B.C. Forest Service<br>Mr. Roy Jarvis<br>B.C. Department of Highways |
| Mar. 28/77 | P. A. Lapp | B. C. Telephone Company | Mr. Bob Eldridge, Radio Services Dev. Eng., also Chairman, CRTPB<br>Mr. Tony Adcock, Radio Special Services Engineer for Land Mobile |

BRITISH COLUMBIA (Con't)

| Date | Visitor | Organization | Persons Interviewed |
|---|---|---|---|
| Mar. 28/77 | P. A. Lapp | Westcoast Transmission Co. Limited | Mr. Terry Lynch<br>Supervisor<br>Technical Services |
| Mar. 28/77 | P. A. Lapp | Mr. Gowan Guest | Vancouver lawyer representing certain broadcast interests in Western Canada. |
| Mar. 28/77 | D. J. Cook | Station CKVU (Independent) | Mr. Daryl Duke, President |
| Mar. 28/77 | P. A. Lapp<br>D. J. Cook | BCTV (CTV Affiliate) | Mr. J. Ray Peters<br>President |

STUDY INTO THE EFFICIENT USE OF SPECTRUM FOR BROADCAST DELIVERY SYSTEMS.