# The utilization of the radio spectrum in the range 0.890–10.68GHz


Government of Canada
Department of Communications

Gouvernement du Canada
Ministère des Communications

# THE UTILIZATION OF THE RADIO SPECTRUM IN THE RANGE 0.890-10.68 GHz

DISCUSSION PAPER

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# EXECUTIVE SUMMARY

## 1. Background

In recent years, the Department of Communications has undertaken a number of spectrum policy and planning initiatives related to this review of spectrum utilization in the 0.890 to 10.68 GHz range. Policies for licensing short-haul, fixed systems in the bands 12.7-12.95 GHz and 14.5-15.35 GHz (Refs. 1 and 2) were intended to accommodate systems that would otherwise likely have had to be fitted into bands below 10 GHz. These policies recognized potential needs of common carriers for long-haul, high-capacity digital systems in the bands 10.7-11.7 GHz and 12.2-13.25 GHz.

The policy and Standard Radio System Plan (SRSP-306) for the band 7725-8275 MHz (Refs. 3 and 4) are intended to meet early carrier needs for medium-capacity, long-haul, digital systems. High-capacity, fixed systems at 10.7 to 13.25 GHz (referred to above) would have to be considered as one of the alternatives for accommodating further growth in long-haul, digital traffic after the band 7725-8275 MHz has been exhausted. The policy and SRSP-305 for the band 7125-7725 MHz (Refs. 3 and 5) provide for the licensing of lower-capacity systems, both analogue and digital, including those systems that might otherwise be licensed in the band 7725-8275 MHz, or that might be displaced from the latter band by the need to accommodate medium-capacity, long-haul systems.

SRSP-303 (Ref. 6) covers licensing of low-capacity radio relay systems, both analogue and digital, in the range 1710-1900 MHz.

SRSP-309 (Ref. 7) treats the licensing of systems in the range 8275-8500 MHz, for transmission of video information with associated audio channels. SRSP-311 is being drafted to cover the range 1427-1525 MHz. It treats mainly low-capacity digital systems and subscriber radio systems for use in sparsely-populated areas, providing for aeronautical mobile telemetry needs.

The department recently issued a policy covering the range 406-960 MHz (Ref. 8). Systems that could be accommodated in those bands, such as fixed and mobile types, would then not have to be taken account of above 960 MHz or elsewhere in the spectrum.

Canadian allocation proposals for the 1979 World Administrative Radio Conference include a number in the 1-10 GHz range. (Details follow in the discussion paper.) These proposals might provide alternatives for provision of service, or change constraints on sharing among services within a band and, therefore, the potential of that band to suppport future service growth.

Finally, preparations for the 1977 WARC on broadcasting satellites, while specifically addressing the band 11.7-12.2 GHz in Region 2, resulted, inevitably, in some examination of planning for the fixed-satellite and broadcasting-satellite services at lower frequencies in the 1-10 GHz range.

This spectrum planning activity has addressed --- directly or indirectly --- a number of important planning issues influencing the effective utilization of the spectrum covered by this review. The results have made a significant contribution to the policy and planning process.

But the implementation process for these policy decisions, coupled with new spectrum issues that have arisen, both underline the need for an overall review of all bands in the general range 1-10 GHz, with special emphasis on those for which allocations include the Fixed service.

Among major issues affecting fixed systems that require early policy and planning decisions are:

..the identification of additional spectrum to be channelized along lines similar to that for the band 7125-7725 MHz, but with possible provision for still smaller capacity systems;

..the accommodation of an increased emphasis on digital techniques for the future, while taking account of the large investments in analogue systems and the extensive use of spectrum by such systems;

..the efficiency of use of the spectrum (e.g., the adoption of more efficient modulation techniques and the use of two-frequency, rather than four-frequency, plans), with due consideration of costs;

..sharing between fixed systems and earth stations;

..the optimum mix of radio and non-radio means of delivery, particularly in areas such as major population centres where spectrum congestion and coordination difficulties most frequently develop.

## 2. Scope and Objectives of the Review

While this review will cover all bands and services in the range 1-10 GHz, there will be special emphasis on the Fixed service because there is an urgent need to make decisions about how best to accommodate the variety of Fixed systems and applications --- both existing and proposed --- of a great diversity of interests and needs.

The review will entail three stages of notification in the Canada Gazette, with intermediate periods for consultation and comment:

1. This paper which, with its associated consultation period, aims at establishing a general understanding of important areas related to the use of this spectrum. (These areas are noted in turn in Section 3 of this summary.) This first stage is very important. It will provide the basis upon which subsequent, specific proposals are to be made. The department wishes to ensure that all important issues are identified, adequately assessed and properly interpreted, and that major requirements for service, their nature and scale are properly understood.

2. A policy paper with specific proposals for utilization of the several bands which include allocations for the fixed service.

3. A final policy paper on these bands.

There would be a corresponding sequence of activities involving the associated SRSPs and technical guidelines.

The overall review, of which this discussion paper thus represents the initial phase, has a number of objectives which will cover both economic and technical issues. The main objectives are:

..To review the present usage, in Canada, of the bands in this range. Two key factors will be the degree to which a band is being utilized and the scale of investment in equipment;

..To identify various needs for services, for which this range of spectrum might be considered appropriate;

..To identify issues that appear to bear most strongly on the development of policies and associated technical standards and channel plans;

..To assess the extent to which the spectrum in this range is adequate to satisfy the needs identified (above) and thus to relate utilization to that of lower and higher frequencies (i.e., to other policies and standards);

..To assess the potential impact on the utilization of this spectrum in Canada of proposals being made in preparation for the 1979 World Administrative Radio Conference (WARC-79).

..To integrate and assess available information that might aid spectrum planning for the 1-10 GHz range, to identify gaps that still exist, and to pose questions, the answers to which would be most likely to provide information still required;

..To identify and assess alternative delivery methods for providing a given service;

..To examine the economic and other bases for projections of growth of services, and the technical and operational factors that might be used to transform these needs into needs for spectrum;

..To identify network issues, and the impact of network policies and configurations on both the needs for spectrum and the sharing constraints for various combinations of services;

..To propose policies and technical standards for the utilization of the spectrum, arrange for appropriate consultation with the public and, as a final product and based on that consultation, to issue policies, technical guidelines, and SRSPs.

## 3. Organization and Content of this Paper

This document examines important subjects relevant to the development of policies and associated SRSPs for the utilization of this range of spectrum. The objectives of the overall review go beyond those summarized in Part 1 of the previous section. While the review will cover all bands and services, major emphasis will be placed on those bands which contain an allocation to the Fixed service, either exclusively or on a shared basis. Section 3, on background, puts the review into perspective with respect to related domestic and international spectrum activities. The former include other policies and SRSPs, either recently issued or in the course of preparation; the latter include WARC-79. The need, in any review of a certain portion of the total spectrum, to relate it to the situation at both lower and higher frequencies just outside the reviewed portion is stressed.

Section 4 examines major areas of Fixed traffic requirements, some of which might be met most appropriately within the range of spectrum under review. They are discussed with relation to several broad headings: Broadcasting, Mobile-support, Protection and Control, Telephone, Video and Data, and CATV.

Requirements are defined and characterized by a number of factors, including system capacity and reliability, direction of traffic flow, type of traffic and system length and network configuration.

More specific reference to requirements is made in Section 6, from the point of view of the suitability of the various bands as alternatives to meet requirements.

Section 5 sets down what have been identified as the main, general issues to be addressed by the review. (Others, specific to particular bands, are discussed in Section 6.) These main issues are felt to be:

..The need for spectrum. It is fundamental to any review of spectrum use to have reliable, quantitative information on this point. Section 4 reviews main areas of requirements for traffic. These needs would have to be transformed into needs for spectrum by application of the appropriate technology-related formula, either available or forecast, and consideration of both hardware and propagation.

..Sharing of spectrum between and among services. Two very important issues involve sharing between analogue and digital Fixed systems, and between Fixed-Satellite and Fixed systems. In the latter case, the number, geographical distribution, and technical parameters of earth stations deployed will be vital issues in the development of the Fixed service.

..Efficiency of use of the spectrum. This can be expressed in different way. Units of information transmitted per Hz of spectrum, either

actually occupied or committed because of factors such as receiver characteristics, the manner in which propagation factors are considered, careful planning for sharing spectrum among different types of systems and the taking into account of other relevant factors will be important. The ensuring of adequate operational reliability with the commitment of the minimum amount of spectrum is the general objective.

..Environmental factors. The principal potential sources of interference are taken to be out-of-band emissions, noise from high-voltage electrical power systems, and scattering from precipitation.

..International coordination. This is a very important factor, given Canada's long border with the U.S. and variations in the different uses to which certain bands are put by the two countries, population distribution in Canada and the special issues raised by the growing role of space systems, with related orbit and spectrum implications.

..Economic factors. The principal ones are the impact of policies and technical standards on development costs, the operation of systems and amortization schedules. Economic tradeoffs are related to alternative methods of delivery, the basis on which service growth forecasts are made, the concept that, for certain types of service (e.g. safety of life), economic factors are important but are often not the overriding ones, and the pros and cons of the concept of "paying for the use of the spectrum."

..Dual standards for conforming systems. Under this concept, standards would be relaxed for remote areas where spectrum congestion would not be likely to occur for some time.

..Reservation of bands of spectrum. The practice in Canada has been to reserve spectrum for classes of system, rather than of user. Issues raised by this practice are discussed, including those related to coordination, both within Canada and on a Canada-U.S. basis.

Time-sharing in Canada of spectrum used for TV portable and temporary operations is a related issue.

Section 6 treats by band, and in some detail, the present utilization and status of spectrum allocated to the Fixed service (including the U.S. and Canadian proposals for the 1979 WARC and issues of a specific nature relating to a particular band), the requirements that, it has been suggested through previous consultation and review, might be met within a particular band, and lists some possible options for future use of each band. It is considered that further information and analysis are necessary to permit making specific proposals for the several bands. This presentation raises by band many of the major issues referred to in Section 5 and, in a complementary way, in Annex III. Lesser reference is also made in Section 7 to those bands not allocated to the Fixed service, primarily in terms of Canadian proposals for WARC-79.

Among specific issues identified in Section 6 and, in some cases, in Annex III, the following may be noted: (a) the relative roles of analogue and digital techniques in the future use of spectrum; (b) sharing between Fixed and Fixed-Satellite systems; (c) the effect of use of four-frequency plans on efficiency of spectrum use; (d) the need for channel plans to accommodate a wider range of channel capacities --- for example, lower capacities in certain ranges of the spectrum, and capacities intermediate between certain of the present standard levels.

..Utilization of bands not yet planned. The main ones are near 2500 MHz, 4500 MHz and 10.6 GHz. A number of options are suggested for approaches to future utilization of such bands for Fixed systems.

Many of these issues emphasize the fact that, as requirements of the spectrum increase in both scale and diversity, questions raised by the increased need for sharing become more important.

Section 8 presents a summary of the present situation on a number of significant issues on which further attention will be focussed, and on which comments are invited. Areas are identified on which opinions on initial conclusions are sought, and on which further questions are posed.

Annexes I, II and III summarize an initial approach to three important questions bearing on the outcome of the review. The present level of investment in equipment, and the anticipated replacement schedule, would be critical issues in any assessment of future use of spectrum. This would be particularly so with respect to any significant reorientation of the use of a band or changes in technical parameters, or standards. The impact of microwave noise from electrical power systems on the operation of microwave systems, and particularly of those used for communications and control related to the power systems, is expected to strongly influence decisions on spectrum for microwave systems operated near power systems. Annex III presents statistics on usage of the spectrum in Canada for fixed systems, with graphs of the number of frequency assignments in each band, by year, since 1970. These statistics suggest certain areas of concern in planning for future use of these bands. The information complements that presented in Section 6 under the individual bands.

## 4. SUMMARY

Reference has already been made to some important issues and spectrum needs identified by the department. These will be covered in greater detail. There may well be other items that parties interested in use of this spectrum would wish to have added to each list. It is hoped they will respond to this paper with information and suggestions that will aid the department in future stages of the planning process.

# DISCUSSION PAPER

## 1. INTRODUCTION

It is hoped this paper will stimulate thinking, discussion and the generation of ideas for future use of the spectrum in the nominal range of 1-10 GHz. It examines a number of important subjects relevant to a review of the utilization of this part of the radio spectrum. This review may result in an amended policy of usage and amended Standard Radio System Plans (SRSPs). It represents a further step in the process of consultation with users of the spectrum, manufacturers of equipment, and others on long term planning for the most equitable use of the 1-10 GHz spectrum, which accommodates most existing microwave systems in Canada. The importance of this review of this entire vital range of frequency spectrum can not be overemphasized.

The objectives of the review go beyond those of this paper. While the review will cover all bands and services in the range of spectrum, major emphasis will be placed on the Fixed service and, therefore, on those bands allocated to it either exclusively or on a shared basis.

Section 3 (background) relates this review to other domestic and international spectrum activities, stressing the need to take account of bands just above and below any range of spectrum under general review.

Section 4 examines Fixed traffic requirements, some of which will need to be accommodated within the range of spectrum under review.

The discussion of Section 5 sets down the main issues to be addressed in the review. As requirements for use of the spectrum increase in both scale and diversity, the questions raised by the increased need for sharing become more important.

Section 6 treats, by band, the present use of those bands of the spectrum allocated to the Fixed service on either an exclusive or a shared basis, and requirements suggested through previous public consultation and internal review which might be met within a particular band. Options for the future use of each band are listed. Further information and analysis are necessary to permit specific proposals for the several bands.

Section 7 discusses briefly, and in the context of proposals being made by Canada for WARC-79, those bands for which there are no allocations to the Fixed service.

Annex I summarizes an initial approach to determining the present level of investment in equipment and the anticipated replacement schedule. These would be critical issues in any assessment of future use of spectrum that might lead to a significant reorientation of the use of a band or changes in technical standards. Annex II discusses the impact of microwave noise from electrical power systems on the operation of microwave systems of power utilities. Annex III presents statistics, by frequency band, on the past use of microwave frequency channels.

## 2. OBJECTIVES

While the review will deal with the frequency spectrum and services in the nominal range 1-10 GHz, there will be a special emphasis on those frequency bands which accommodate the Fixed service, since there is an urgent need to assess potential future developments of usage of the Fixed microwave spectrum to determine how existing departmental policies, channel plans and technical standards might be modified to meet future requirements.

The overall review, of which this paper is the initial phase, has a number of objectives encompassing both economic and technical issues. The main goals are:

..To review present Canadian usage of the frequency bands in this range. Two key factors will be the degree to which a band is being utilized and the scale of investment in equipment;

..To identify needs for various services that could be accommodated in this frequency spectrum;

..To examine the economic and other bases for projections of growth of services and technical and operational factors that might be used to transform these needs into needs for spectrum;

..To identify issues that are relevant to development of policy, channel plans and technical standards;

..To assess the potential impact on utilization of this spectrum in Canada of the decisions of WARC-79;

..To identify and assess alternative methods of delivery for providing a given service;

..To identify available information relevant to this review, spot gaps in this information and pose appropriate questions;

..To determine the impact of network policies and configurations on the need for spectrum;

..To assess the extent to which this spectrum is adequate to satisfy identified needs and, thus, to relate utilization of this range of spectrum to that of lower and higher frequency ranges;

..To propose additional or modified policies, channel plans and technical standards for utilization of the 1-10 GHz spectrum, arrange for appropriate public consultation and finalize it.

## 3. BACKGROUND

The department has undertaken a number of spectrum policy and planning initiatives in recent years that should be taken into account as essential background in any examination of the future use to which the spectrum in the 1-10 GHz range might best be applied. This background is summarized below in order to put the 1-10 GHz review in perspective and to emphasize the close interaction and relationships among different departmental policy actions.

The rationale for policies for licensing short-haul Fixed systems in the bands 12.7-12.95 GHz and 14.5-15.35 GHz (Refs. 1 & 2) catered to systems that would otherwise most likely be fitted into bands below 10 GHz. In addition, recognition was given in the policy for 12.7-12.95 GHz to the possibility that, in the long term, spectrum in the range 10.7-13.25 GHz might be needed for a trans-Canada terrestrial high-capacity, point-to-point digital system. The timetable for the requirement for this type of system is still in question.

Such a process of estimating or forecasting a date or period led inevitably to an examination of the rate at which spectrum below 10 GHz utilized for terrestrial digital systems of medium or large capacities would likely be exhausted. The only such band being considered for this purpose at that time was 7725-8275 MHz, for medium capacity systems. A policy and technical standard (SRSP) covering licensing of medium-capacity digital systems in this band were issued in July, 1977 (Refs. 3 & 4). On the same date, the department issued companion documents covering the band 7125-7725 MHz (Refs. 3 and 5) aimed at accommodating lower-capacity Fixed systems, both analogue and digital. They covered analogue systems that might otherwise be licensed in the band 7725-8275 MHz or that might, in the future, be displaced from that band.

Policies and SRSPs for the spectrum above 10 GHz are thus seen to be directly related to those for below 10 GHz. Thorough reviews of certain bands in the range 1-10 GHz have recently been made.

Technical standards (SRSPs) for other 1-10 GHz bands have been issued recently, or are in an advanced stage of preparation, to cover the licensing of a variety of Fixed systems. Included are SRSP 303 (1710-1900 MHz), for low-capacity systems of both analogue and digital types, issued in June, 1975 (Ref. 6) and SRSP 309 (8275-8500 MHz), for the transmission of video information, with associated audio channels, issued in December, 1978 (Ref. 7). SRSP 311 has been proposed for the band 1427-1525 MHz. It is directed mainly toward the licensing of low-capacity digital systems and subscriber radio systems for use in sparsely populated areas.

The department, over the past several years, reviewed use of the spectrum 406-960 MHz and, in February 1979, issued a policy paper (Ref. 8) outlining new allocations for this band. Decisions for this range of spectrum will impact on spectrum planning above 960 MHz.

Some proposals for modification to the frequency allocations in the range 1-10 GHz are included in the Canadian proposals for WARC-79. Further details are given in Sections 6 and 7. Any reallocations resulting from WARC-79 could impact on provision of spectrum for a given service or might introduce (or alternatively alleviate) frequency sharing constraints.

Finally, preparations for the 1977 WARC on broadcasting satellites, while addressing the band 11.7-12.2 GHz specifically in ITU Region 2, resulted in some examination of planning of the Fixed-Satellite and Broadcasting-Satellite services at lower frequencies in the 1-10 GHz range.

## 4. DEMANDS FOR SERVICE

### 4.1 INTRODUCTION

This section summarizes various demands for service that can be

accommodated by radio systems in the Fixed service. Demands are segregated into requirements to satisfy: (a) existing types of usage; (b) emerging or anticipated types and (c), new services whose demands are now latent.

The requirement, or demand, is defined and characterized by system capacity and reliability, the direction of traffic flow, the type of traffic and the system length and network configuration. The stated requirements are based quantitatively on the forecast growth of existing types of usage and on estimates based on emerging or anticipated types of usage expected to occur in the next 10 to 15 years.

Demands are discussed in relation to several broad headings: Broadcasting, Mobile-support, Protection and Control, Telephone, Video and Data, and CATV.

Major users fall into the classes of carriers, government - both federal and provincial, electric power utilities, broadcasters, and CATV companies.

Brief, specific reference to requirements is made in Section 6, from the point of view of the suitability of various bands to meet requirements.

## 4.2 CATEGORIES OF DEMAND

### 4.2.1 Broadcasting

The three main point-to-point Fixed requirements in support of terrestrial broadcasting are for network distribution, (to be discussed also in Section 4.2.5), studio-to-transmitter links (STLs), and for remote broadcast pick-up. Forecasting of requirements is difficult, because of factors such as the number and form of new services anticipated, institutional factors, and the nature of the future broadcasting network

(e.g., the impact of satellite broadcasting and non-radio modes of delivery).

Forecasting the extent of needs for network distribution of programming by Fixed systems is uncertain; it will undoubtedly be affected by decisions on the use of the satellite alternative for programme delivery under the new liberalized policy for licensing earth stations.

STLs are normally one-hop, one-way systems with lengths up to approximately 10 miles. Specified reliability is very high.

A maximum in the order of 20 to 30 additional STLs by about the year 2,000 has been anticipated for FM and TV in major population centres. These estimates will require further study to identify, assess and minimize major sources of uncertainty. Some of these needs might well be filled by cable and some by spectrum above 10 GHz, in the case of shorter links. It would appear, from discussions with broadcasters, that all audio requirements could be accommodated in spectrum below 1 GHz.

Remote broadcasting pick-ups are high-quality, single-hop links, carrying analogue information from the site of an event or presentation to either a mobile studio or van, or directly to the main studio. In both cases, the direction of traffic flow is one-way from the remote broadcast pickup site to the studio. Distances could be a maximum of the order of one mile for the link from the pick-up site to the mobile studio, and 20 miles for the link from the latter site to the main studio.

Longer systems would require spectrum below 10 GHz; the shorter ones might be operated at higher frequencies (e.g. 15 GHz). For links between the main studios and permanent sites acting as sources of programming (e.g., exhibitions, concert halls and convention centres) non-radio modes might be adopted. Estimates suggest that a maximum of the order of five to seven such systems might be needed in the major metropolitan centres over the next 25 to 30 years.

Introduction of additional TV networks could involve a need for spectrum in the 1-10 GHz range for point-to-point operations, depending on their geographical scale, the nature of developments in off-air vs cable delivery and satellite-broadcasting. The system could be operated by the CBC, commercial interests, or educational TV. The need for further study of potential requirements for service, and therefore for spectrum, also applies here.

4.2.2 Cable TV (CATV)

Cable TV in its present context is closely related to broadcasting and, as such, can impact the off-air broadcasting network and its eventual needs for spectrum. The nature and extent of new services to be provided by the CATV industry and their need for spectrum, including that in the range 1-10 GHz, are still largely unknown factors.

Requirements for service by the CATV industry fall under four main headings:

..A link from a remote head-end to a studio or distribution point (e.g., the input of the cable). Programming will normally involve a minimum of three TV channels plus FM services. System reliability requirements will be of the order of 99%. The system could involve a number of hops, with an overall length of 30-200 miles. Longer systems could thus be considered to comprise a form of networking.

..A link from a local head-end to a studio or distribution point. Except for the distance, normally one hop and less than 30 miles, system parameters are very similar to those above. These operations might well be accommodated, in general, in bands above 10 GHz.

..Links from a local head-end or the main local distribution point to a number of secondary distribution points within the CATV service area. This requirement is similar to that immediately above. It can be met in

bands above 10 GHz. The need is already being met, for the most part, at 12 GHz and, to a lesser extent, at 15 GHz.

..In certain limited areas, radio links permitting interconnection of two or more cable systems, to interchange programming. Alternatives to 1-10 GHz radio that might prove feasible for providing this service would be cable and microwave above 10 GHz. Programming would normally involve a small number of channels and could be two-way. The demand would arise primarily in metropolitan areas which support more than one CATV system. Reliability would probably be of the order of 99%.

Growth of CATV delivery requirements will largely depend on the scale of introduction of new services and the future of satellite operations, of both the Fixed and Broadcasting types, (e.g., Pay-TV and earth-station ownership). The CATV industry has been characterized by high growth since its inception in larger centres 10 to 15 years ago. There are now 351 CATV companies (Aug. 1978) in Canada, providing service to over 2,868,000 subscribing households (Aug. 1976) and achieving a licensed area market penetration of 61.7% nationally. Future growth in new service areas represents a possible expansion of only 10 to 12 %. As a consequence of this, only spectrum for Fixed links might be necessary to permit this expansion. As most of this potential growth will likely occur in rural areas, serious congestion of Fixed microwave spectrum for CATV program transmission would not likely occur. Therefore, it might be concluded that growth of new CATV systems into presently unlicensed service areas could be accommodated in the present Fixed allocations.

### 4.2.3 Demand for Fixed Links in Support of Mobile Radio Services

There are two main types of demands for Fixed links in support of mobile radio services, each with the same types of characteristics.

The first is to permit networking of paging between various repeaters in a coverage area. The capacity of the system is fairly light,

with only a few voice channels required. Traffic is one-way, from the main paging transmitter to the repeaters. Both analogue and digital formats are used. Growth is expected to continue at a substantial level, but mainly in terms of small-area coverage, rather than regionally or nationally.

The second is for networking between mobile radio repeaters. Even with the large consolidated users, system capacity is relatively small, with between one and 12 voice circuits in the networking links. Up to the present, point-to-point links in support of mobile operations have been in the 400 MHz Land Mobile bands or 890-960 MHz Fixed band. In future, as mobile spectrum below 1 GHz becomes more congested, such fixed narrow capacity requirements may by necessity be met above 1 GHz. The demand for fixed narrow band links in support of mobile operations can be expected to grow as more consolidated, spectrum-efficient mobile systems are developed ---probably at a growth rate of a half to a quarter of the present Land-Mobile rate of 12-15% annually.

4.2.4. Demand for Systems for Protection and Control Operations

This section covers the need of a class of users including electrical power utilities, oil and gas pipeline operators, transportation agencies, police and security firms.

Power utilities require links along their electrical networks for communications, protection, control and regulation purposes. System bandwidths presently range from less than 10, to several hundred, equivalent voice circuits. Large utilities use a combination of power line carrier (PLC) systems and microwave facilities. Their microwave networks comprise multi-hop, two-way voice and data systems with very high reliabilities. Links cover the most populous areas of the provinces in which they operate (i.e., the consumption centres), extending towards all large generating sites, including those in remote areas. In some cases reliability is enhanced by use of ring systems in addition to frequency diversity.

Demand for microwave facilities by electrical power utilities results from two main factors. The first is the development of new electrical generation facilities and the second is the replacement or complementing of power line carrier systems with microwave.

New generation facilities will be of two main types---nuclear power stations situated near load centres, and conventional types at remote sites with hydro potential that will of course require longer transmission and communications links.

The second main impetus is replacement of power line carrier communications facilities to improve communication and control capabilities. The power line carrier bands (20-500 KHz) are more intensively used by radio services such as Loran C. (In some cases, it may be decided to retain the carrier systems as a back-up to microwave facilities.)

Another important requirement for fixed point-to-point links is for the control and monitoring of oil and gas pipelines and related communications, primarily in Alberta and Saskatchewan. Light-route, multi-hop systems, are required. Hop lengths are dictated mainly by the location of pumping stations along the pipeline path. Point-to-point networks are often shared along the pipeline right-of-way between the control and monitoring function and mobile repeater service for dispatch of maintenance vehicles. With this additional two-way voice requirement, the number of channels can increase from six or less to a maximum of 24. In such cases, the 900 MHz band has been used extensively. With the 890-960 MHz band totally utilized around Edmonton, and highly utilized throughout the rest of Alberta, continuing demands for this low capacity fixed requirement may need to be accommodated above 1 GHz, or by the common carriers on a consolidated basis. Non-radio facilities should be investigated as another alternative.

The Department of Transport and, to some extent, the Department of National Defence, have a number of fixed requirements that might be met in

the 1-10 GHz range. These include the reliable transmission of video information from unattended radars, and TV surveillance systems (e.g., traffic monitors in harbours and along coastlines, airport runway surveillance TV, and air traffic control radars). System bandwidths are generally in the range 8-15 MHz for high resolution, particularly for marine applications.

Other agencies, such as police and security firms, have stated requirements for TV surveillance systems of the same general class as those discussed above. Distances up to 5-10 km are involved, with the primary need being for analogue systems. Demand for this type of system may be spurred by decreases in costs of TV hardware and growing public concern for security of both person and property.

4.2.5 Common Carrier Demand for Telephone, Video and Data Services

Several general statements on this subject may be made:

..Traffic volume of an interpersonal nature tends to decline with distance.

..Commercial traffic tends to be greatest between metropolitan areas.

..Volumes of all forms of traffic -- particulary commercial -- tend to be sensitive to economic conditions and to growth and shifts of population.

..There is a general trend towards use of digital transmission, on both technical and economic grounds, for voice and data services. A similar trend will likely develop for video.

Long-term growth rates for national toll traffic have been approximately 17% annually. This represents a doubling of required capacity every four and a half years. Growth rates for Trans Canada Telephone System traffic decreased to 10-11% in 1977. But TCTS does not

consider this drop necessarily suggests a general drop in the long-range growth curve. Growth was significantly lower in 1977 in Eastern Canada. But Alberta Government Telephones (AGT), by contrast, experienced a growth of 20-28% in its traffic. It should be noted that traffic to and from Alberta tends to keep other provincial cross sections very high.

There is now a population shift towards the Western provinces and, with this, a shift of traditional economic power centres in Canada. As a result of this shift, telecommunications growth between Manitoba and Ontario and to the west is likely to exceed the national average, while growth between Quebec and the Maritimes will lag.

It is essential to keep in mind the orders of magnitude difference in needs for transmission capacity between broadband video and narrow band voice communications. Since one TV circuit is equivalent to 1,000 telephone circuits, capacity is sensitive to the scale of TV service. (The statement on network programming, given in the second paragraph of Section 4.2.1, is relevant at this point.)

Cross-subsidization policies can exert a strong effect on the distribution of needs for service. Any shift from the cross-subsidization to user-pay concept would have the effect of reducing toll tariffs while increasing basic charges for local service. Assuming no decrease in penetration of basic telephone service, lower toll tariffs would have a tendency to stimulate demand and spectrum requirements for toll traffic.

Overlaid on the domestic demand for telecommunications is international (Canada to the rest of the world) demand. Estimates of the requirements of Canada-U.S. traffic are similar to those for domestic and even higher for certain overseas traffic. This traffic must be taken into account as part of the loading of terrestrial systems, depending on the services and destinations in Canada, and the locations of satellite earth stations.

4.2.6 New Services

The need for new services has to be taken into account by this review.

Data services are of relatively recent origin and, in terms of the large expansion anticipated (and thus of the impact on needs for transmission capacity and spectrum), might well be considered new services. Circuit distances could vary from very short (e.g., inter-building in the same city) to trans-Canada. Shorter circuits, which may well involve the highest data rates in many cases, could more appropriately operate either at frequencies above 10 GHz or by non-radio modes.

An important network concept that has thus far seen very little application in Canada involves communications between a central point and a number of fixed, outlying stations, in either a one-way or a two-way mode. It is normally called a multiple-distribution system (MDS) when one-way, outward transmission is involved. A limiting or extreme variant of the MDS concept is omnidirectional transmission. CATV agencies in Canada are applying the general concept, in the MDS form, in the bands 12.7-12.95 GHz and 14.5-15.35 GHz.

Other potential applications are for central to branch office connections in metropolitan areas, and utility and security-monitoring functions. Information rates could vary over wide ranges. Distances could be single or multi-hop. The overall network could involve space/terrestrial interconnections. Key questions to be answered in this case are the choice of the bands(s) that might be optimum and the probable scale of the requirement.

Any attempt to list, or estimate, the scale of services to be provided by a specific mode of delivery (in this case by point-to-point systems in the frequency range 1-10 GHz) has to consider the important issue of alternative means of delivery. Mention has been made of satellite

broadcasting, which as a new service might be expected to impact on the terrestrial broadcasting and CATV networks, as well as reducing fixed point-to-point needs. But the reverse can be true. As an example, radio may be substituted for wire line services, as in the subscriber radio service at 1500 MHz, thus creating, in effect, a new radio service which would then have to be accommodated in the spectrum.

## 5. DISCUSSION OF THE MAIN ISSUES

The main issues can be conveniently divided into two groups. There are those of a general nature, which apply to more than one frequency band, and specific issues which relate to only one band. The latter group are discussed in Section 6. It is not the intention of the Department of Communications to propose specific methods to resolve these spectrum issues in this initial paper. The department's immediate goal is to stimulate the generation of ideas, suggestions and recommendations which could be beneficial in making better decisions about utilization of the 1-10 GHz spectrum from all interested parties.

### 5.1 GENERAL ISSUES

#### 5.1.1 Needs for Frequency Spectrum

As a fundamental requirement in any spectrum planning one must have reliable, quantitative data on needs for radio telecommunications traffic or services as discussed in Section 4. Those needs must then be translated into needs for spectrum, through an understanding of available technology, or that envisaged as likely to be available within some specified time frame. The cost of providing the radio service with a given degree of spectrum efficiency must be considered. Since bands in the range under consideration are typically shared by services with competing claims, the basis for those claims must be well understood and agreed on. The objective of regulatory policies, sharing and operational criteria, and

technical standards will be to satisfy those competing claims in the most equitable manner. The efficiency with which spectrum will be utilized to satisfy a specific need will be an important factor to be kept in the foreground when formulating policies, technical standards and operational criteria.

Technological developments play a dual role in determining demands for spectrum. On the one hand, technology can make it possible to use spectrum with a higher efficiency. Or it can provide alternative means of delivery (e.g, non-radio systems such as optical fibres) and thus effectively increase available spectrum. On the other hand, as a counteracting effect, technological developments can lead to suggestions for new services, or can demonstrate that services previously considered not feasible can now be undertaken, thus leading to increased demands on the spectrum. One is thus led to ask those engaged in technological research and development to attempt to estimate probable outcomes for specific time frames. (The question of efficiency of spectrum usage is discussed in greater detail in Section 5.1.3.)

Impetus for new services can also come from non-technological areas, such as developments in social and population patterns and in the telecommunications network itself. For example, needs involving Multiple Distribution Systems (MDS) are closely related to developments in cable TV networks.

### 5.1.2 Sharing Frequency Spectrum Between and Among Services

As demands on the spectrum increase, the department must increasingly employ frequency sharing. Sharing between radio services may be necessary, or among different users of the same spectrum in the same radio service. Technical and operational criteria have to be developed for system parameters to permit sharing. A key factor is the arrangement of channel plans and technical standards so spectrum can be used as efficiently as possible by different classes of usage often having large

differences in their technical and operational requirements.

5.1.2.1 Sharing Between Analogue and Digital Fixed Systems, and the Use of Analogue vs Digital.

Several important bands in the frequency range under discussion (e.g., 4 GHz, 6 GHz, upper 6 GHz) have been developed exclusively for analogue systems, as far as the Fixed service is concerned. There is a body of opinion predicting an increase in the transmission of information by digital techniques for both voice and data. In particular, growth traffic in certain applications will tend to be accommodated through digital systems, because of both technical and economic factors. Digital techniques are under study for the transmission of video data, both TV and radar. An important issue will therefore be that of identifying those bands into which digital systems might most appropriately be introduced, to operate on a shared basis with existing analogue systems. Three options would be available for the long term: To have bands for analogue systems exclusively, bands shared between analogue and digital systems, and bands dedicated to digital systems which could involve a gradual phasing out of analogue systems.

Factors to be examined will include: (a) the nature and scale of predicted traffic, (b) the efficiency of use of the spectrum (use of a band for two dissimilar types of modulation introduces additional issues in this regard), (c) the types of channel plans involved, for both analogue and digital systems, (d) the level of capital investment in the different bands and the economic penalties (e.g., the amortization issues) and operational constraints associated with the need to share spectrum, or to dislocate existing systems, (e) the propagation factors, (f) the timing of the introduction of digital operations, and (g) available alternatives to sharing spectrum.

5.1.2.2 Sharing Between Space and Terrestrial Systems and Between Space Systems

Some combinations of services in the present allocation table from 1 to 10 GHz might be considered to be somewhat related, in the context that they might either share facilities or bear some operational similarity, or complement each other in terms of dividing traffic load or achieving a certain operational or scientific objective. There are other combinations of services for which sharing would be difficult, --- for example, between Mobile Satellite and Fixed.

Constraints on sharing between space and fixed operations in a band will depend on two factors: the configuration of both the network of fixed systems and that of the earth stations (e.g. whether or not the earth stations are limited in number), and the technical and operational parameters of both systems (e.g., whether or not the earth stations are transportable or have small antennas with resulting broad beams). The extent to which the shared spectrum is being used, by both the terrestrial and space services, and the growth predicted for that use, will be further critical factors.

5.1.2.3 Restraints on Frequency Sharing

Certain combinations of services have been identified for which sharing with the same allocation status is inefficient and should be avoided if possible. Mobile-Satellite and Fixed have already been mentioned. Other examples include Radio Astronomy and a downlink in a space or aeronautical service, Radiolocation or Radionavigation and Fixed, Broadcasting and other services, two Space Services in the same direction, (unless there is adequate angular separation between the two paths -- e.g., orbital separation in space, or geographical sharing on the ground or in the air), and Fixed and direct-to-home Broadcasting Satellite.

5.1.3 Efficiency of Use of the Frequency Spectrum

Efficiency of use of the frequency spectrum can be viewed and assessed in a number of ways, some amenable to statements in quantitative

terms and others which are not. The first criterion is the extent to which a transmission occupies the channel assigned to it, or conversely, the extent to which the channel plan matches the bandwidth characteristics of the signal. The second criterion is the amount of information transmitted per Hertz of radio frequency bandwidth. The third criterion for efficiency of use can be considered in terms of the difficulty (criteria) of sharing among different services, and also among systems of the same service to reduce the need to seek spectrum elsewhere.

In considering the efficiency of microwave systems it is important to note several other factors. The first, which is difficult to express quantitatively unless perhaps in economic terms, is largely related to propagation. Spectrum congestion is generally found to be greatest at the lower microwave frequencies which have been used for longer periods. This indicates that, at this time at least, frequency spectrum at high microwave frequencies is not as dear as that at lower frequencies and hence a higher degree of spectrum efficiency should be demanded at lower frequencies.

A second factor is the availability required of the radio system, depending on the type of operation. One operation can thus be asked to share spectrum with another one with criteria that may result in interference to one or both of them, as long as the level of availability achieved meets that required.

Third, use of different polarizations offers potential for frequency re-use, and thus, an increase in spectrum efficiency.

Fourth, sharing of the same spectrum among more than one user in a particular geographical area can enhance efficiency.

Finally, there is a trade-off between the degree to which system operational reliability can be shown to be increased and the use of additional spectrum to provide for multiple radio channel protection arrangements, particularly as applying to one-to-one ratios of protection

to working channels. The question can be stated another way: to what degree is multiple protection required in order to achieve a specified operational reliability or availability?

### 5.1.4 Environmental Factors

It is desirable that systems be permitted to operate in a radio environment compatible with the level of sensitivity of receiving equipment. There are a number of sources of noise in the spectrum range 1-10 GHz that need to be considered as potential radio environment problems. They include spurious emissions and spill-over into adjacent channels, spurious emissions of high-power radars, noise from high-voltage electrical power systems and ISM, and energy scattered from precipitation in various states or from irregularities of refractive index in the clear atmosphere. (It can be argued that any intentional radio transmission is a potential source of interference, treated, however, as a frequency co-ordination matter.) It would be expected that, in designing and siting a system, standard precautions would be taken to minimize the possibility of interference. But one has to depend, to a greater extent, on actual measurements of background noise. Data from reliable measurements are not always available. As a general rule, the level of microwave noise from electrical power systems decreases with increasing frequency. (This is discussed in detail in Annex II.)

### 5.1.5 International Co-ordination

It is necessary to co-ordinate spectrum utilization with that of other countries on various levels ---- bilateral, regional and international --- depending on the nature of the service and its use in Canada. Co-ordination on a regional or international basis is necessary for certain services such as space or aeronautical mobile.

No review of the microwave bands in Canada and planning for their use in the future would be complete without also considering the

utilization of these bands in the United States, due to the close proximity of the majority of Canadian microwave systems to U.S. microwave operations and the necessary frequency co-ordination between systems operating in the two countries. There are also advantages, in terms of co-ordination procedures, purchasing economics, marketing of equipment, and support for the Canadian telecommunications manufacturing industry, to having a high degree of compatibility between the types of service and the technical parameters and standards for systems operating in both countries. In the final analysis, however, any decision on planning the utilization of the spectrum has to take into account domestic needs and priorities.

### 5.1.6 Spectrum for Mobile Operations

Spectrum in the range 1-10 GHz is being used for a range of mobile and mobile-type operations, both terrestrial and space. They include aeronautical mobile, aeronautical radionavigation and maritime mobile-satellite. However, there are only a few land mobile operations in Canada in this spectrum. They are experimental. Furthermore, while there are a number of bands allocated internationally to the Mobile service, the only ones for which the service is included in the Canadian table are 1427-1429 MHz and 1429-1525 MHz. In this respect, one has to take into account the fact that, in Canada, transportable terrestrial stations are operated in the Fixed rather than the Mobile Service.

The bands utilized in Canada for the Land Mobile Service are becoming seriously congested, mostly in certain large, metropolitan areas. Consideration will soon have to be given to a possible requirement for spectrum above 1 GHz for this purpose. The recently announced policy for 406-960 MHz is relevant in the context of accommodating perceived future Land Mobile needs.

### 5.1.7 Comparison of the Canadian Domestic and the ITU (Region 2) Allocation Tables

There are a number of instances where the Canadian and Region 2 tables differ. For example, few Region 2 allocations to the Mobile Service have been adopted domestically. In the case of the band 1435-1525 MHz, the allocation to the Fixed service is secondary in Region 2 but primary in Canada. This issue is discussed further in Section 6. Canada has not adopted the Region 2 allocation to the Fixed-Satellite service in the range 3400-3700 MHz. There are footnote allocations in the Region 2 table related only to Canada.

One product of this review will be an examination of the Canadian allocation table, to determine whether or not changes should be proposed.

5.1.8 Economic Issues

Several important economic issues that have to be addressed when planning the use of the spectrum are:

..The economic bases on which projections of service growth and facilities, and corresponding growth of needs for spectrum are made;

..The economic implications of a specific policy and set of technical standards for use of a band for a proposed purpose (e.g., the cost of available equipment and system design, the cost of developing alternative equipment, with possible amortization implications). When new policies or technical standards force existing equipment into non-conforming status, suitable arrangements specifying protection of operations of this equipment, and including amortization schedules, have to be developed;

..The economic tradeoffs associated with alternative methods (radio or non-radio) of delivery for providing a specified service;

..The merits of the concept of "paying for use of the spectrum;"

..The recognition that there are certain uses of the spectrum for which economic factors, while important, may be superseded by operational requirements --- for example, for certain safety-of-life services.

..The impact on the stimulation of Canadian industry, for both domestic and international markets, of domestic spectrum utilization policies and technical standards compared with those of other countries.

5.1.9 Dual Standards for Conforming Systems (Zone Concept)

It is sometimes argued that licensing policies and standards for conforming systems might well be relaxed for areas where it is anticipated that congestion of the microwave spectrum is not likely to occur for some time. It is stated, in counter-argument, that this practice is already being effectively followed, in principle, because systems which do not conform to technical standards are licensed as non-conforming systems. Such licences are issued under certain specified technical and economic constraints that must be accepted to avoid interference with a conforming system. This concept of two levels of technical standards should be examined further.

5.1.10 Reservation of Microwave Bands

In principle, it has not been the practice of the department to reserve bands for specific users, although specific frequency channels are sometimes so reserved (as is discussed in Section 5.1.12). Frequency bands have been planned by type of usage. However, in cases where a single heavy user of spectrum was expected to be the sole user of a particular band for an extended period in a specific area, the practice of coordination of the entire band within Canada could be interpreted as "reserving" the band. From the planning point of view, it might not have been considered economically feasible for the major user to make the financial commitment for a big system, if eventual capacity was to be limited to a few channels.

However, with more users and increased demands for spectrum, one can expect growing needs to share it among users of a given service. Options for a long-term procedure will have to be identified and assessed.

One criterion that might be examined is that the degree of protection of spectrum reservation could relate to the level of investment in the band.

It may be noted that the Canada-U.S. co-ordination agreement does not allow for reservation of frequency spectrum to meet identified future demand.

5.1.11 Utilization of Bands Without Channelling Plans, or Very Lightly Used

Consideration should be given to determining the optimum future utilization of bands now vacant or lightly used. Such bands include 2548-2690 MHz, 4400-4990 MHz and 10.55-10.68 GHz.

If review of statistics of usage indicates certain existing planned microwave bands are not being utilized to their full capacity (e.g., in terms of efficiency of usage), should one concentrate on improving their efficiency, rather than opening up new bands?

If these bands remain in reserve (e.g. in anticipation of new technologies), absence of early utilization near the Canadian border may reduce their availability to Canada in the future.

If a band is opened prematurely, or without adequate planning, this might lead to ineffective usage and preclusion of use for other essential services.

5.1.12 Time Sharing of Spectrum Among Users of Temporary Systems

Most 1-10 GHz assignments now made assume the user requires very high or continuous system availability.

There are uses and users which can operate by time sharing with other users, or with reduced reliability. If such users are identified, it may be possible to find spectrum for them. (Uses of this type already identified include TV portable and temporary links.)

SRSP-308 (6590-6770 and 6930-7125 MHz) reserves specific frequency channels for certain telecommunications organizations, such as the Canadian Broadcasting Corporation, for temporary TV links.

In addition to increased demand for this type of usage, there is also an expressed demand for spectrum for electronic news gathering (ENG), a transportable TV pick-up service.

The resulting competition for service might be alleviated by time sharing of available frequencies on a co-ordinated basis. One possibility is that users of the TV portable pick-up band 6930-7125 MHz might be licensed to employ all 10 available frequencies and be required to co-ordinate amongst themselves to avoid an interference problem for any particular event.

This principle, or an alternative, could apply to any frequency band which, as the result of this review, would be designated as a type of time sharing band.

## 6. A DISCUSSION OF SPECIFIC ISSUES BY FREQUENCY BANDS WHICH INCLUDE FIXED SERVICE ALLOCATIONS

### INTRODUCTION

An examination of present utilization of Fixed service bands in Canada is necessary in this 1-10 GHz review. The use of each band has been examined nation-wide. Microwave route plans, frequency assignment data, the degree of occupancy by RF channels, convergence of routes and frequency use patterns (ie. 4-frequency vs 2-frequency plan) have been analyzed. Problems of frequency conflict or saturation are identified below.

For clarity, the format of this section is that of portraying each band on two facing pages, with a statement on the status of the band in question given on the left hand page.

Current spectrum allocations are shown with ITU Region 2 on the left side of the page and Canada on the right. For the text of footnotes, refer to "Table of Frequency Allocations," issued by DOC Telecommunications Regulatory Service (1979). Summaries of Canadian and U.S. proposals to the 1979 WARC are given, where appropriate.

Statements indicate the extent of usage of a band, showing areas of heavy use, potential for congestion, whether a 2 or 4-frequency plan is used, intra and inter-service sharing problems, if applicable, and any other pertinent information.

On the right hand page are two columns. One is a summary of requirements now identified that might be related to a band. The other suggests possible options to fulfill continuing and new requirements and to resolve problems noted under current status.

Some options have been suggested by operating and manufacturing agencies; others by departmental staff. They should not be considered the only options. In fact, some might be taken to be mutually contradictory, but are presented to stimulate thinking, discussion and possibly the generation of new options.

Reference should be made here to closely-related and complementary sections of the paper.

Major issues considered to be pertinent to the review were discussed in a general sense in Section 5. A more general discussion of identified major demands or requirements for service was presented in Section 4. Finally, analysis and statistics of present usage are presented in ANNEX III.

Some of the bands containing an allocation to the Fixed service have been the subject of recent policy action as discussed in Section 3. No further major action on these bands is contemplated at this time, except to monitor the implementation of policy and associated SRSPs --- including the clarification and interpretation of the documents as issues arise --- and to take account of new sharing situations and issues (e.g., between the Fixed and the Fixed-Satellite services).

The range of spectrum under review has been extended downward to 890 MHz in order to emphasize the relation between the amount of spectrum available for Fixed and Mobile systems near 900 MHz and the need for spectrum for such systems that would otherwise have to be met above 1 GHz.

CURRENT STATUS OF THE 890-960 MHz BAND (SRSP 310, Issue I)

I.

| ITU (Region 2) | Canada | |
|---|---|---|
| 890-942 MHz | 890-902 MHz | 928-942 MHz |
| FIXED | FIXED | FIXED |
| RADIOLOCATION | Radiolocation | Radiolocation |
| 339A, 340 | 339A | 339A |
| 942-960 MHz | 902-928 MHz | 942-960 MHz |
| FIXED | FIXED | FIXED |
| | Radiolocation | |
| 339A | Amateur | 339A |
| | 339A 340 | |

II. This band is heavily used in the Edmonton and Calgary area for control of oil pipelines. In the Edmonton area, it is extremely difficult to select new frequencies for assignment due to spectrum congestion. Other areas which show a rapid increase in spur links and single hop systems are: Saskatchewan, southern B.C. and northern New Brunswick.

III. Fixed links are also employed in support of the Mobile Radio service (low capacity) between control points and associated base stations.

IV. The FM-STL band (956-960 MHz) is congested in certain cities. This band blocks a channel of one of the two multi-hop point-to-point system frequency plans in the 890-960 MHz band.

V. For the past several years the department has cautioned applicants in employing this band in southwestern Ontario (including Toronto), Ottawa, Montreal, Quebec and Vancouver because of its possible future use by the Mobile service. The U.S. proposes to add the Mobile service to this band at the 1979 WARC. Domestically, the U.S. has allocated this band to the mobile service on a reserve basis. Once this reserve is removed and the band is under active mobile assignment, interference to Canadian fixed services in border areas may become a problem.

VI. The FCC may select a section of this band for use by the personal radio service (similar to GRS).

VII. The band is also employed for ISM, and in the U.S. for Radiolocation.

VIII. This band was included in a recent review by DOC of the spectrum from 406-960 MHz. A policy paper was issued in February 1979 (Ref. 8) and the revised Canadian Allocation Table is given above.

IX. Most existing systems covered under III and IV above employ non-standard antennas.

REQUIREMENTS

890-960 MHz

A. There is a demand for additional spectrum for sytems of the type described in II, III and IV.

B. Depending on the outcome of the possible requirement for this band for the mobile service, further restrictions can be envisaged in this band for the fixed service in the intermediate 3-5 years (CB/GRS) and longer term (5-10 years) future (mobile).

POSSIBLE OPTIONS FOR FUTURE USE

890-960 MHz

1. Additional spectrum for low capacity systems (per A.) could be considered in other bands as follows: a) 1427-1525 MHz, b) 2450-2548 MHz, c) 4400-4990 MHz, d) 10.55-10.68 GHz, e) also new mobile bands 406.1-410 and 420-430 MHz.

2. Consideration could be given to not mixing FM STLs with radio relay system assignments as is presently employed in the 890-960 MHz band, to help alleviate the problem mentioned in IV. FM monaural STL's should only be assigned in the 450-451 and 455-456 MHz bands presently used by AM monaural services as outlined in the modified Canadian footnote - C44.

3. The band could be restructured, due to U.S. mobile service usage including C.B., and in the longer term to Canadian GRS and mobile requirements. A caution could be given on future Canadian fixed assignments due to U.S. C.B. expansion which might also follow in Canada. Also in border areas, if the U.S. is successful in adding MOBILE at WARC, there will be a need for sharing arrangements. Due to the very different technical characteristics of mobile and fixed systems and the differing levels of protection required, in the longer run it may prove impossible to prevent interference from mobile to fixed services in border areas with reasonable sharing arrangements.

4. Systems employing non-standard antennas should perhaps be modified to meet the requirements of SRSP 310, in cases where interference could be caused to a proposed standard system or where it would result in improved use of the band.

5. There are no recorded or known cases of ISM interference. Potential fixed users should nevertheless realize that ISM enjoys prime status in this band according to Footnote 340.

CURRENT STATUS AND USAGE OF THE 1427-1525 MHz BAND (SRSP 311)

I.

| ITU (Region 2) | Canada |
|---|---|
| 1427-1429 MHz | 1427-1429 MHz |
| SPACE OPERATION (Telecommand) | SPACE OPERATION (Telecommand) |
| FIXED | FIXED |
| MOBILE (except aeronautical mobile) | MOBILE (except aeronautical mobile) |
| 1429-1435 MHz | 1429-1525 MHz |
| FIXED | FIXED SRSP 311 |
| MOBILE | MOBILE |
| | C 51 |
| 1435-1525 MHz | |
| MOBILE | |
| Fixed | |

Note: The Fixed service is secondary in Region 2 in the 1435-1525 MHz band. A Canadian Proposal for the 1979 WARC would upgrade Fixed to Primary in Region 2. The U.S. is proposing a footnote to give priority to aeronautical telemetering in the Mobile service.

II. The band is now intended primarily for small capacity digital systems and rural telephone distribution systems.

III. In ITU Region 2, the 1435-1525 MHz band is allocated to Mobile primary and Fixed secondary. In the U.S., the 1435-1535 MHz band is used in the Mobile (aeronautical telemetering) service only, while in Canada, Fixed and Mobile are allocated equally as primary services. Consequently, close coordination will be required. In Canada, assignments have been made to the Fixed service as well as to the Mobile service (aeronautical and ground telemetry on an experimental basis). These experimental assignments will be reviewed after WARC 79.

IV. In Nova Scotia, the electrical power utility employs a province-wide low capacity (7 M bits/sec) digital system.

V. Subscriber radio systems (SRS) are employed in a few areas across Canada.

VI. Proposals have been received in the SRS section of the band for other than SRS-type systems, as follows:

a) Supervisory control and monitoring functions of electrical power utility systems.

b) Employment of this band for monitoring and control of pipelines.

c) Data distribution systems.

VII. Draft SRSP 311 restricts all FIXED point-to-point systems to be digital.

VIII. The band is very lightly used in Canada and, therefore, has the potential for greater utilization.

IX. This band is very attractive, due to the low cost of the available digital equipment.

* Please note comments concerning the 1525-1535 MHz band at the end of Section 6.

REQUIREMENTS

1427-1525 MHz

A. Based on the comments in II, there is a need to review the status of existing Fixed systems and the approach to the future licensing of such systems.

B. The availability of SRS equipment has stimulated proposals for the use of this band in non-rural areas for other types of services.

C. The Canadian Radio Technical Planning Board (CRTPB) stated a requirement for low capacity (e.g., 6-300 V.C.) point-to-point analogue systems in this band.

D. There is a requirement for mobile telemetery assignments.

POSSIBLE OPTIONS FOR FUTURE USE

1427-1525 MHz

1. With reference to Canada's proposal to upgrade fixed to primary at the WARC '79, a moratorium could be put on all Fixed systems near the border with the U.S. until the outcome of WARC is known. Another alternative would be to caution proposed users in the Canada/U.S. border areas of the possibility of interference to or from U.S. mobile (aeronautical telemetery) operations.

2. It is felt that the introduction of the non-subscriber type radio systems (listed in VI) could create difficult coordination problems. Therefore, consideration could be given to an alternative band, such as 2450-2548 MHz, for these types of systems.

3. Because of the previously mentioned coordination issues, it is felt that the introduction of analogue systems (of the type mentioned in C) in this band would further compound the problem. An alternative for these systems could be the 2450-2548 MHz band.

4. Consideration could be given to mobile telemetering assignments in the 1525-1535 MHz range. In the meantime, close coordination will be required between the fixed and mobile services in the 1427-1525 MHz band.

CURRENT STATUS AND USAGE OF THE BAND 1710-1900 MHz (SRSP 303)

I.

| ITU (Region 2) | | Canada | |
|---|---|---|---|
| 1710-1770 MHz | | 1710-2290 MHz | |
| FIXED | | FIXED | |
| MOBILE | | | |
| 352K 356A | | | |
| 1770-1790 MHz | | | |
| FIXED | | | |
| MOBILE | 356AA | | SRSP 303 |
| Meteorological Satellite | | | |
| 356A | | | |
| 1790-2290 MHz | | | |
| FIXED | | | |
| MOBILE | | | SRSP 304 |
| | | C53 C71 352K 356A 356AB | |
| 356A 356AB 356ABA | | | |

II. The lower 2 GHz band is heavily used for order wires and spurs by TCTS, railways, and electric power utilities. The band is mainly used for low capacity (channeling plans having a minimum of 6 and 120 V.C.) analogue systems. However, recently, there has been an increase in low capacity (T1-1.544 Mb/s and T2-6.3 Mb/s channelling plans) digital systems.

III. Several non-conforming systems which have RF channels in both the upper and lower 2 GHz bands have blocked proposed standard systems. All of the users involved have given an indication that they would eventually modify their non-standard systems, but have been very slow in doing so. However, one of these licensees has commenced Phase I of the eventual turn-down of its extensive non-conforming system.

IV. The United States is proposing for the 1979 WARC the addition of a number of space allocations throughout this spectrum range -- i.e. space operation, (Earth-to-Space) 1721-1850 MHz, and Fixed Satellite (Space-to-Earth) 1850-2025.

* Please note comments concerning the 1670-1690 and 1700-1710 MHz bands at the end of Section 6.

REQUIREMENTS

1710-1900 MHz

A. There is a demand for additional spectrum for both short and long haul analogue systems with minimum capacities of 6 and 60 V.C. and digital systems with capacities of 1.544 Mb/s and 6.3 Mb/s bit streams per RF channel per polarization.

B. The need for multiple data distribution systems using digital techniques in metropolitan areas has been suggested. The capacities could generally be less than 1.544 Mb/s.

POSSIBLE OPTIONS FOR FUTURE USE

1710-1900 MHz

1. Due to the existing high number of analogue systems already in the band, caution should be employed before any move is made to alter its existing structure or introduce new services.

2. Analogue or digital systems of the type described in A could also be accommodated in the following bands: 7125-7725 MHz, 890-960 MHz, 1427-1525 MHz, 2450-2548 MHz (new usage), 4400-4990 MHz (new usage) 10.55-10.68 GHz (new usage).

3. The requirement for multiple data distribution systems of the type described in B could be handled in the 15 or 18 GHz band for systems with hops less than 30 kilometres, and possibly in the 2450-2548 MHz band for longer systems.

4. Non-conforming systems should be modified to conform to the SRSP in cases where there may be conflicts with proposed conforming systems.

5. As the lower and upper 2 GHz bands are presently employed by the utilities, they could be considered for expansion of their existing systems. The question of microwave noise from electrical power systems is a factor here.

CURRENT STATUS AND USAGE OF THE 1900-2290 MHz BAND (SRSP 304 Issue I) UPPER 2 GHz BAND

| I. ITU (Region 2) | Canada |
|---|---|
| 1900-2290 MHz | 1900-2290 MHz |
| FIXED | |
| MOBILE | FIXED |
| 356A 356AB 356ABA | C53 C71 356A 356AB |

Note: The United States is proposing various space operations and satellite allocations throughout this band; i.e. FIXED SATELLITE (Space-to-Earth), Earth Exploration Satellite and Space Research

II. The channelling plan provides for approximately 1800 telephony channels or equivalent TV on each R.F. channel.

III. There is an extensive upper 2 GHz system throughout Manitoba conveying telephone traffic, circuits for Manitoba Hydro and television for the CBC. Elsewhere in Canada, the band is generally lightly used.

IV. Several old non-standard 2 GHz systems (occupying both the lower and upper 2 GHz bands) have blocked proposed standard 2 GHz systems in the past. All of the users involved have given an indication that they would eventually modify their non-standard system but have been very slow in doing so. However, one licensee has commenced Phase I of the eventual turn-down of an extensive non-conforming 2 GHz system.

V. SRSP 304 allows for the option of a two or four frequency plan. However, in practice it has not been possible to implement a two frequency plan because of the antenna limitations.

VI. The Department has allocated frequencies 2080 and 2100 MHz (in the guard band of the Upper 2 GHz band) for Tv portable camera operations on a coordination basis. These frequencies do actually overlap into the Upper 2 GHz channelling plan and there are an increasing number of frequency coordination problems.

VII. There are two trans-horizon systems in the upper 2 GHz band, one in the Northwest Territories and the other in the Quebec-Labrador area.

* Please note comments concerning the 2290-2300 MHz band at the end of Section 6.

REQUIREMENTS

1900-2290 MHz

A. There is a definite requirement for a long-haul, high capacity (see II) band having the propagation characteristics for long hops (e.g., in the MacKenzie Valley).

B. The DOC has received a proposal and several inquiries for intermediate capacity digital systems (between 10-40 MHz with a minimum efficiency of 1 bit/Sec per Hertz per polarization) in the upper 2 GHz band. Today there is no SRSP for such systems.

POSSIBLE OPTIONS FOR FUTURE USE

1900-2290 MHz

1. Based on A, there appears to be a case for continuing to permit the growth of systems conforming to SRSP 304, and therefore not to make any significant changes to the upper 2 GHz channeling plans.

2. However, based on B, there is also a case for taking advantage of the light use being made of the band, and consequently to introduce new types of systems.

3. Concerning the existing non-standard lower/upper 2 GHz systems, please refer to Item 4 under possible options for 1710-1900 MHz band.

4. Delete the reference to a two frequency plan in the SRSP 304, (See V).

5. Refering to VI, one could consider withdrawing the use of these frequencies for TV portable camera operation. The frequency bands 2450-2548, 6930-7125 MHz and 14.5-15.35 GHz would appear to be more appropriate for TV portable pick-up operations.

6. No new trans-horizon systems would be allowed in the upper 2 GHz band. If the two existing trans-horizon systems should block a standard 2 GHz system, they could be required to make the necessary modification to alleviate the possible interference problem.

7. Please note Item 5 in the lower 2 GHz band as a possible option in the upper 2 GHz band also.

CURRENT STATUS AND USAGE OF THE 2300-2450 MHz BAND (NO SRSP)

I.

| ITU (Region 2) | Canada |
|---|---|
| 2300-2450 MHz | 2300-2450 MHz |
| RADIOLOCATION | RADIOLOCATION |
| Amateur | Amateur |
| Fixed | Fixed |
| Mobile | |
| 357 | 357 |

II. In Canada's proposals to the 1979 WARC, MARITIME RADIONAVIGATION would be added to the 2300-2350 MHz portion of the band with a footnote limiting the new service to shore-based radars. In addition, a new footnote would allow amateur-satellite operations in the 2300-2310 MHz portion of the band. In the U.S., the band is allocated to Government (for all services except amateur) and non-government (amateur service only). The U.S. proposes to upgrade mobile to primary in the 2310-2390 MHz band with a restriction to aeronautical mobile telemetering (similar to present U.S. usage in the 1435-1535 MHz band).

III. The only assignments are to several radar stations operating at the lower end of the band, mostly at remote locations.

IV. Amateurs are allowed to use this band in all amplitude and frequency-modulated emission modes on a basis secondary to RADIOLOCATION and equal in status to Fixed and Mobile as indicated in the above table.

V. ISM operates at $2450 \pm 50$ MHz. Thus communications systems operating in the band 2400-2500 MHz must accept any interference from ISM systems. However, the department is not aware of any reports of interference to communications systems from ISM in this band in North America.

VI. The U.S. is proposing to the 1979 WARC a footnote designating $2450 \pm 10$ MHz for the transmission of large levels of power from space to earth and from space to space. The issues raised by such a proposal will have to be examined carefully.

REQUIREMENTS

2300-2450 MHz

A. There is a demand for one-way systems of varying bandwidths carrying data, video or other kinds of information for which occasional interservice interference is tolerable.

eg. - Multipoint distribution systems (MDS) for television program distribution, paging, data gathering and/or distribution,

- industrial/institutional applications for short-distance video links,

- data transmission systems using low-bit rate digital techniques (less than 6.3 mb/s).

- short range telemetering.

POSSIBLE OPTIONS FOR FUTURE USE

2300-2450 MHz

1. Future frequency assignments could be coordinated but not necessarily protected from radiolocation.

2. To provide for facilities in A, one could do the following:

a) Fixed, mobile and amateur services could share the band on the basis that occasional inter-service interference is tolerable.

OR

b) domestically, divide the 2300-2450 MHz band between the amateur and the fixed and mobile services to avoid inter-service interference.

3. Short range telemetering could be accommodated as in the 1525-1535 MHz band.

CURRENT STATUS AND USAGE OF THE 2450-2548 MHz BAND (NO SRSP)

I.

| ITU (Region 2) | | Canada | |
|---|---|---|---|
| 2450-2500 MHz | | 2450-2500 MHz | |
| FIXED | | FIXED | |
| MOBILE | | RADIOLOCATION | |
| RADIOLOCATION | | | |
| 357 | | C55 357 | |
| 2500-2535 MHz | | 2500-2535 MHz | |
| FIXED | 364C | FIXED | 364E |
| FIXED SATELLITE (Space-to-Earth) | | FIXED SATELLITE (Space-to-Earth) | |
| MOBILE (except aeronautical mobile) | | BROADCASTING SATELLITE | 361B |
| BROADCASTING SATELLITE | 361B | RADIOLOCATION (Canada only) | 361A |
| 361A 364E | | 364E | |
| 2535-2550 MHz | | 2535-2550 MHz | |
| FIXED | 364C | FIXED | |
| MOBILE (except aeronautical mobile) | | BROADCASTING SATELLITE | 361B |
| BROADCASTING SATELLITE | 361B | | |
| 361A | | C53 C54 361A | |

In Canada the band 2500-2550 MHz is allocated by footnote on a primary basis to the radiolocation service.

For WARC-79 both the United States and Canada are considering expansion of the fixed satellite band to be the same as the broadcasting satellite band, to enable the development of new services such as teleconferencing and tele-education by satellite. Canada is also proposing the inclusion of the auxiliary-satellite service* for the provision of feeder links to other narrow-band satellite systems.

II. The ISM band is from 2400-2500 MHz and is used extensively for microwave ovens. Radio-communications services operating within this band must accept any harmful interference that may be experienced from the operation of industrial, scientific and medical equipment.

III. The following existing Canadian assignments are in this band:

a) Radar speed meters on a Canada-wide basis at 2455 MHz,
b) Radio Astronomy assignment at Penticton, B.C. on 2500 MHz.

IV. The United States employs the same radar speed meter frequency, 2455 MHz, as Canada, and also has an ISM band between 2400-2500 MHz. However, FCC has planned the 2450-2500 MHz for the Private Operational Fixed service. The ITV band in the United States is from 2500-2686 MHz whereas in Canada it extends from 2548-2686 MHz. These factors are being pointed out to emphasize that the 2450-2548 MHz band is employed by the FIXED service in the United States while Canada is not making any use of the band for this service.

V. The U.S. is proposing to WARC-79 a footnote designating ($2400 \pm 10$ MHz) for the transmission of large levels of power from space to earth and from space to space. The issues raised by such a proposal will have to be examined carefully.

*For definition of "auxiliary satellite service", please see Section 6, 6425-6590-6770-6930 MHz band.

REQUIREMENTS

2450-2548 MHz

A. The CRTPB sub-committee reviewing the microwave bands (1-10 GHz) has recommended that this band be employed for electronic news gathering/electronic journalism (ENG/EJ).

B. There has been a demand for several years to provide a band for multi-distribution type systems (MDS). These systems could include the following:

i) multi-TV distribution
ii) data distribution (packet broadcasting, etc.)
iii) fixed links for wide-area paging,
iv) multi-distribution for hydro type services

Although these services have been partially satisfied in the 14.5-15.35 GHz band, there also appears to be a demand for them in the 2 GHz portion of the spectrum.

C. There is a demand for light route analogue and digital systems (generally less than 300 voice channels, or less than 6.3 Mb/s).

D. There is a requirement to provide new communications services by satellite for such uses as telemedicine, tele-education and teleconferencing.

POSSIBLE OPTIONS FOR FUTURE USE

2450-2548 MHz

1. Due to requirements for sharing among the various services mentioned in item I of Current status of the 2450-2548 MHz band, it would appear that this band would be ideal for TV portable links such as ENG.

2. Another service which lends itself to this band is the multi-distribution type service as outlined in item B of Requirements.

3. Consideration could be given to light route analogue and digital type systems.

4. Requirement D can be provided with 4/6 GHz systems such as ANIK-A, at 12/14 GHz with ANIK-C, or in the long term with a system using the 2.5 - 2.69 GHz band as a downlink. The corresponding uplink could be either at upper 4 GHz or upper 6 GHz.

CURRENT STATUS OF THE 2548-2686 MHz BAND (SRSP 300)

I.

| ITU (Region 2) | | Canada | |
|---|---|---|---|
| 2550-2655 MHz | | 2550-2655 MHz | |
| FIXED | 364C | FIXED | |
| MOBILE except aeronautical mobile | | BROADCASTING SATELLITE | |
| BROADCASTING SATELLITE | 361B | | |
| | | C53 C54 | |
| 2655-2690 MHz | | 2655-2690 MHz | |
| FIXED | 364C 364D | FIXED | |
| FIXED SATELLITE (Earth-to-Space) | | FIXED SATELLITE (Earth-to-Space) | 364E |
| MOBILE except aeronautical mobile | | BROADCASTING SATELLITE | 361B 364H |
| BROADCASTING SATELLITE | 361B 364H | | |
| 364E 364G | | C53 C54 | |

II. The U.S. and Canada have made proposals to the 1979 WARC involving the FIXED-SATELLITE service (Space-to-Earth) in certain parts of the band. In addition Canada has made a proposal regarding the auxiliary satellite service.

III. The SRSP for this band was issued in 1966.

IV. There is no growth in this band, only 3 ITV systems are presently licensed in Canada. They are located at London and Timmins, Ontario, and Winnipeg, Manitoba.

V. The frequency channeling plan is identical to the United States frequency plan with the exception that the U.S. plan extends down to 2500 MHz.

REQUIREMENTS

2548-2686 MHz

A. Due to the limited use of this band for ITV systems through the years, other applicants have inquired regarding their possible use of the band. The main interest seems to be in point-to-point/multi-point video distribution systems. Provincial educational authorities have objected in the past to the use of this band by other than instructional television service.

B. See requirement D of the 2450-2548 MHz band.

POSSIBLE OPTIONS FOR FUTURE USE

2548-2686 MHz

1. Provincial educational authorities should be contacted to obtain their long range plans for ITV systems. If little growth is expected, one could consider permitting a type of TV distribution service which has the same technical characteristics as ITV systems, so that sharing would be possible. This type of system could be coordinated very easily with ITV systems in Canada and the United States. MDS and cable TV distribution systems may lend themselves to sharing with ITV systems.

2. Another approach is not to permit other services in this band. This band, with its few ITV systems could then be kept fallow, in a sense, for possible future use by new technology.

3. See option 4 for use of the 2450-2548 MHz band. It should be noted that a major user of the new satellite communications services would be the same as those referred to in options 1 and 2 above.

CURRENT STATUS OF THE 3500-4200 MHz BAND (SRSP 302)

I.

| ITU (Region 2) | Canada | |
|---|---|---|
| 3500-3700 MHz | 3500-3700 MHz | |
| FIXED | FIXED | C53 |
| FIXED SATELLITE (Space-to-Earth) | Radiolocation | |
| MOBILE | | |
| RADIOLOCATION | | |
| 3700-4200 MHz | 3700-4200 MHz | |
| FIXED | FIXED | C53 |
| FIXED SATELLITE (Space-to-Earth) | FIXED SATELLITE (Space-to-Earth) | |
| MOBILE | | |

II. Canada has proposed to the 1979 WARC to delete FIXED SATELLITE (3500-3600 MHz); add AUXILIARY SATELLITE (SPACE-EARTH) (3500-3700 MHz); and to downgrade RADIOLOCATION from primary to secondary (3500-3700 MHz). The U.S. proposes to add a footnote that 3500-3700 MHz is also allocated to aeronautical radio-navigation.

III. As this band is shared between the FIXED and SATELLITE service (down-link), close coordination is required between the two services.

IV. The 4 GHz band is becoming filled up on the trans-Canada (TD2) route, particularly in urban areas. This is complicated by the fact that the two major users (TCTS and CN/CP) are sharing this band in the Toronto and Montreal areas. Reference should be made to item 4 under possible options for future use of this band.

V. TCTS is currently studying the future of this band and in particular whether for its future operations it would like to see it analogue or digital, or shared between the two modulation techniques. However, it says this band will be required for analogue transmission of television for some time to come.

VI. The 4 GHz TCTS route is now being overbuilt with an 8 GHz digital radio system. With the exception of television, future growth on this long-haul route will probably generally be accommodated in the 8 GHz digital band.

REQUIREMENTS

3500-4200 MHz

A. There is a continued requirement for the long-haul transmission of television.

B. There is a requirement for digital traffic. (See VI for status).

POSSIBLE OPTIONS FOR FUTURE USE

3500-4200 MHz

1. As existing analogue systems become obsolete and require replacement, they could be replaced by digital radio systems within this band. This of course implies sharing between analogue and digital systems. Considering that long-haul television will probably be preferable in the analogue format in this band, it would remain hybrid in nature for the foreseeable future.

2. Same as above, but also permit digital systems in the band immediately as required on existing or new routes.

3. It has been stated (by CRTPB) that due to technical reasons (e.g., cost of filtering) digital radio may not be as economical as analogue systems in this band. If so, then, as analogue systems vacate the band, for other digital systems (radio, fibre optics etc.), the band could eventually become vacant (possibly with the exception of some TV systems, but even these will, in the long term, probably be carried via satellite). In this case, there is the option of permitting vacated channels to remain unused, in anticipation of the development of new technology and the evolution of new services.

4. The options available for the future development of the fixed network will depend to a great extent on the use of the band for earth stations under the new policy on ownership and licensing of such stations (ref. DOC document "Satellite Earth Station Licensing").

CURRENT STATUS OF THE 4400-4990 MHz BAND (NO SRSP)

I.

| ITU (Region 2) | Canada | |
|---|---|---|
| 4400-4700 MHz | 4400-4700 MHz | |
| FIXED | FIXED | C57 |
| FIXED SATELLITE (Earth-to-Space) | FIXED SATELLITE (Earth-to-Space) | |
| MOBILE | | |
| 4700-4990 MHz | 4700-4990 MHz | |
| FIXED | FIXED | C57 |
| MOBILE | | |
| 233B 382A 382B | 233B 382A 382B | |

II. Canadian F.N. C57 also allocates the band to trans-horizon (troposcatter) systems. However, no such systems are operating in this band in Canada.

Note: The issue of coordination with these possible new services is considered to be eased by the circumstance that only a small number of earth stations or observing stations are currently involved.

III. There are only two fixed line-of-sight assignments in Canada, both to a common carrier in Newfoundland. One is a fixed TV link in St. John's and the other a transportable (TV Auxiliary). The licensee has indicated willingness to give up these assignments if this band is used for other purposes in the area.

IV. Canadian proposals to WARC-79 would extend FIXED up to 5000 MHz and Radio Astronomy (R.A.) down to 4950 MHz. Thus, 4990-5000 MHz exclusive to R.A. would become 4950-5000 MHz shared with FIXED and R.A., with footnote protection for R.A. on 4826.6-6-4832.2 MHz. FIXED satellite would be added 4700 to 4810 and 4850 to 4900 MHz in the direction space-to-earth.

V. In the United States, the band is designatd for use by government. There are two U.S. assignments within the U.S.-Canada coordination zone.

VI. Before new services can be planned for this band, negotiations would have to be carried out with government agencies in Washington.

VII. Radio Astronomy observations, which require protection, are being carried out in Canada in the 4700-4900 MHz segment of the band. Sites are in Algonquin Park, Ont., and Penticton, B.C. This places some constraints on future use.

REQUIREMENTS

4400-4990 MHz

A. These would arise mostly from overflow from other bands and new needs not readily accommodated elsewhere.

B. Radio Astronomy

POSSIBLE OPTIONS FOR FUTURE USE

4400-4990 MHz

1. As the band is nearly vacant of limitations imposed by existing Canadian systems, several new uses can be proposed:

a) Conveyance of video signals --- for example, TV and Radar,

b) Long-haul, high capacity systems;

c) "Catch all" band for various types of systems;

d) High capacity (minimum of 1200 voice channels);

e) Medium capacity (minimum of 300 voice channels);

f) Low capacity (minimum of 6 voice channels).

2. The band could be employed so that operations in other bands could be translated to this band as needs arise.

3. The Canadian footnote allocating the band to trans-horizon systems should be reviewed with regard to the licensing of further systems in the band.

CURRENT STATUS OF THE 5925-6425 MHz BAND (SRSP 301 Issue 2)

I.

| ITU (Region 2) | Canada | |
|---|---|---|
| 5925-6425 MHz | 5925-6425 MHz | |
| FIXED | FIXED | C53 |
| FIXED SATELLITE (Earth-to-Space) | FIXED SATELLITE (Earth-to-Space) | |
| MOBILE | | |

Canada and the U.S. are not proposing any changes in allocation at the 1979 WARC.

II. CNCP Telecommunications employs this band for its trans-Canada route. However, for most of the route, only three of the eight available channels are being employed.

III. CNCPT is currently considering the feasibility of overbuilding its 6 GHz system with 8 GHz digital radio.

IV. CNCPT and TCTS share this band in certain areas. With growth of the CNCPT system, there is a conflict with Quebec Telephone's existing 6 GHz link between Ste-Florence and St.-Alexis, P.Q. There is also heavy utilization of this band in the Vancouver and Halifax areas.

V. The frequency channeling plan in this band is similar to the upper 2 GHz band and is therefore feasible for sharing between analogue and proposed "intermediate capacity" digital systems (between 10 and 40 MHz). We have no band at present to accommodate such systems.

REQUIREMENTS

5925-6425 MHz

A. There is a demand for digital systems in this band to accommodate future expansion for the type of systems described in III.

B. There is a requirement to resolve the type of issue described in V).

POSSIBLE OPTIONS FOR FUTURE USE

5925-6425 MHz

1. The band could be shared between analogue and digital systems of the type described in III and V.

2. One could permit this band to remain analogue, with digital growth being accommodated in the 8 GHz overbuild mode (or other suitable spectrum).

3. In areas of conflict such as item V, possible alternative bands to the 5925-6425 MHz band are:

a) the long-haul 4 GHz band,

b) the upper 2 GHz band,

c) the upper 6 GHz band,

d) The band is shared with a fixed-satellite uplink. Thus flexibility for planning and operation of fixed systems in this band will depend to a large extent on policies regarding the parameters and distribution of earth stations. (Reference item 4 under possible options for future use of the band).

4. In certain geographic areas the introduction of new (2-frequency plan) systems is prevented due to existing 4-frequency plan systems. Here, consideration could be given to having at least those portions of the systems that are preventing the establishment of new ones converted to a 2-frequency plan.

CURRENT STATUS OF THE 6425-6590 6770-6930 MHz BAND (SRSP 307)
Upper 6 GHz band

I.

| ITU (Region 2) | Canada | |
|---|---|---|
| 6425-7250 MHz | 6425-7250 MHz | |
| FIXED | FIXED | C53 C59 |
| MOBILE | | C60 |
| 379A 392AA 392B | | |

Note: a) Canada proposes (1979 WARC) to add in the direction earth-to-space, the following:
6425-6525 MHz - FIXED SATELLITE & AUXILIARY SATELLITE*
6525-6625 MHz - AUXILIARY SATELLITE*
6625-7125 MHz - FIXED SATELLITE

b) Canada is also proposing a footnote for the use of passive sensors for earth exploration in the band 6625-7250 MHz, on a "bear-in-mind" basis. The U.S. has a similar requirement, but covering the band 6425-7125 MHz.

c) The United States has proposed FIXED-SATELLITE (earth-to-space) 6425-7115 MHz to the 1979 WARC.

II. This band is lightly used in Canada. Since the frequencies are not shared between the FIXED and FIXED-SATELLITE service, the band has been ideal for back-haul systems to earth stations. However, most of these back-haul systems required only a few hops. Consequently, no extensive back-haul network has developed across Canada. Due to anticipated heavy use by back-haul systems, other users (e.g., the common carriers) have tended not to employ this band. Therefore, neither back-haul nor common carrier systems have utilized this band to any significant degree. However, higher utilization is found in Toronto (to the Telesat Canada Allan Park earth station) and in Halifax (to Teleglobe Canada's Mill Village earth station).

* Auxiliary-Satellite Service: A radiocommunication service for connection between one or more earth stations at fixed points and one or more satellites used for other than the fixed-satellite service or the broadcasting-satellite service (for example, the mobile-satellite service). Connections between earth stations at fixed points via one or more satellites for communications related to that other service are also permitted. This service is subject to the same regulations as the fixed-satellite service.

Reason: This new service is intended to provide for feeder links associated with the Mobile-Satellite services, the Radio-navigations Satellite Service or any other satellite services which require small bandwidth connections in either direction. This new service should ease the pressure on standard high-capacity fixed-satellite allocations by promoting efficient use of both the geostationary satellite orbit and the radio spectrum.

REQUIREMENTS

6425-6590 MHz
6770-6930 MHz (SRSP-307)

A. Despite relatively low usage of this band, the requirement still exists for back-haul service to earth stations.

B. The utilities consider this band to be an appropriate alternate band for their system requirements.

C. The common carriers also look on this band for conveyance of other than trans-Canada traffic.

D. Regarding Canadian and U.S. space proposals for the 1979 WARC, it is not clear at this time what the level of requirements might be in the long term, or what network of earth stations associated with the Auxiliary Satellite Service might evolve.

POSSIBLE OPTIONS FOR FUTURE USE

6425-6590 MHz
6770-6930 MHz (SRSP-307)

1. Back-haul service to earth stations (separate frequency band for conveyance of traffic between earth stations and terrestrial microwave systems) could continue to be accommodated in this band. However, other alternatives such as cable and spectrum above 10 GHz should also be considered for new systems, for all applications in the metropolitan area, and not only for backhaul.

2. This band could be employed as an alternative to solve frequency co-ordination problems encountered by analogue and/or digital systems as described in B and C; in the case of digital systems, a minimum capacity of 10 MHz and, in the case of analogue traffic, 600 V.C. or equivalent.

3. The interfering of microwave noise from electrical power systems is a factor to be taken into account when considering possible options for future use of this spectrum. (Reference item 5 under possible options for use of the band 1710-1900 MHz).

CURRENT STATUS OF THE 6590-6770 - 6930-7125 MHz BAND (SRSP 308)

I.

| ITU (Region 2) | Canada |
|---|---|
| 6425-7250 MHz | 6425-7250 MHz |
| FIXED | FIXED C53 |
| MOBILE | |
| 379A 392AA 392B | |

Note: Canada proposes to the 1979 WARC the addition of the FIXED-SATELLITE and AUXILIARY SATELLITE services. The U.S. proposes addition of FIXED-SATELLITE. All proposals are for earth-to-space. A footnote is also proposed authorizing the use of passive sensors for Earth Exploration in the band 6625-7250 MHz on a "bear-in-mind" basis.

II. The Canadian space proposal could introduce co-ordination problems in the 6930-7125 MHz band allocated to TV pickup and temporary links.

III. STL (6590-6770 MHz), TV pickups and temporary links (6930-7125 MHz) are heavily used in most cities in Canada.

IV. Certain RF channels are reserved for particular users in the 6930-7125 MHz band for TV pickup and temporary links.

REQUIREMENTS

6590-6770 MHz
6930-7125 MHz

A. Additional spectrum is demanded for permanent STLs, TV pickup and temporary links.

B. Due to extensive usage outlined in III there is a need to maintain the present format within the band.

C. The eventual future requirement for space systems as proposed in I is uncertain at this time.

POSSIBLE OPTIONS FOR FUTURE USE

6590-6770 MHz
6930-7125 MHz

1. Instead of reserving RF channels for particular users as has been done in the 6930-7125 MHz band, consideration could be given to sharing of these channels on a co-ordinated event basis. This might reduce the congestion problem being experienced in this band.

2. The longer hops (for STL or TV pickup links) could be employed in this band or in the 2.5 GHz band, while the shorter hops (less than 10 miles) could be accommodated in the 14/15 GHz band.

3. For the two-link type of TV portable service the 14/15 band could be considered for the camera-to-mobile vehicle links and the 2.5 or 6 GHz bands for longer hops from mobile to studio.

4. Reference item 4 under possible use of the band 3500-4200 MHz.

CURRENT STATUS OF THE 7125-7725 MHz BAND (7GHz) (SRSP 305)

I.

| ITU (Region 2) | Canada |
|---|---|
| 6425-7250 MHz<br>FIXED<br>MOBILE<br>379A 392AA 392BB | 6425-7250 MHz<br>FIXED C53 |
| 7250-7300 MHz<br>FIXED SATELLITE (Space-to-Earth)<br>392D 392G | 7250-7300 MHz<br>FIXED SATELLITE (Space-to-Earth)<br>C41 C53 392D |
| 7300-7450 MHz<br>FIXED<br>FIXED SATELLITE (Space-to-Earth)<br>MOBILE<br>392D | 7300-7450 MHz<br>FIXED<br>FIXED SATELLITE (Space-to-Earth)<br>C53 C61 392D |
| 7450-7550 MHz<br>FIXED<br>FIXED SATELLITE (Space-to-Earth)<br>METEOROLOGICAL SATELLITE (Space-to-Earth)<br>MOBILE<br>392D | 7450-7550 MHz<br>FIXED<br>FIXED SATELLITE (Space-to-Earth)<br>METEOROLOGICAL SATELLITE (Space-to-Earth)<br>C53 C61 392D |
| 7550-7750 MHz<br>FIXED<br>FIXED SATELLITE (Space-to-Earth)<br>MOBILE<br>392D | 7550-7750 MHz<br>FIXED C53<br>FIXED SATELLITE (Space-to-Earth)<br>C61 392D |

Note: Canada has no proposals to the 1979 WARC affecting the terrestrial services. It is proposed to add MOBILE-SATELLITE in the exclusive fixed satellite band.

The U.S. proposes to add MOBILE-SATELLITE (Space-to-Earth) in the band 7250-7750 MHz. This would introduce co-ordination complications in the band shared with the terrestrial fixed service.

II. As a result of an extensive review of the 7 and 8 GHz bands, a 7 GHz policy statement and revised SRSP has recently been issued, covering the licensing of FIXED systems.

III. This band is employed by electrical power utilities and common carriers for both analogue and digital systems (analogue minimum capacity 12 voice channels; digital minimum capacity 1.544 Mb/s). This raises difficult co-ordination issues in situations where these two users are in the same geographic area.

REQUIREMENTS

7125-7725 MHz

A. Referring to III, consideration will have to be given to earmarking additional spectrum with appropriate channel plans to solve these co-ordination issues in order to satisfy all the requirements without introducing either excessive operational constraints or expenditures.

B. Certain users would like to have the option to use passive reflectors, for transmission of television and intermediate capacity digital systems (6.3 Mb/s to 45 Mb/s).

C. There is a requirement for immediate co-ordination between the terrestrial and space services. The location and technical and operational parameters of earth stations will be critical factors.

D. The need and significance of Canadian footnote C61 should be reviewed. (C61 gives primary use of up to 100 MHz of the band 7300-7750 MHz to the meteorological satellite service.)

POSSIBLE OPTIONS FOR FUTURE USE

7125-7725 MHz

1. The recent SRSP-305 for fixed services in the band 7125-7725 MHz should serve as the basis for planning the band over the next few years.

2. The following bands could be among those considered as alternatives to the 7 GHz band:
a) upper 6 GHz band (6425-7250 MHz)

b) 4400-4990 MHz

The issue of interference from electrical power systems would have to be taken into account.

3. Space and terrestrial services will be sharing this band. In order to ease co-ordination issues mentioned in C, the long-range terrestrial and space proposals in this band should be submitted to the department as early as possible.

4. In certain geographic areas, the introduction of new (2-frequency plan) systems is prevented due to existing 4-frequency plan systems. Consideration could be given here to having at least those portions of the systems preventing establishment of new ones converted to a 2-frequency plan.

CURRENT STATUS OF THE 7725-8275 MHz BAND (8 GHz) (SRSP 306)

I.

| ITU (Region 2) | Canada |
|---|---|
| 7550-7750 MHz | 7550-7750 MHz |
| FIXED | FIXED C53 |
| FIXED SATELLITE (Space-to-Earth) | FIXED SATELLITE (Space-to-Earth) |
| MOBILE | |
| 392D | C61 392D |
| 7750-7900 MHz | 7750-7900 MHz |
| FIXED | FIXED C53 |
| MOBILE | |
| 7900-7975 MHz | 7900-7975 MHz |
| FIXED | FIXED C53 |
| FIXED SATELLITE (Earth-to-Space) | FIXED SATELLITE (Earth-to-Space) |
| MOBILE | |
| 7975-8025 MHz | 7975-8025 MHz |
| FIXED SATELLITE (Earth-to-Space) 392H | FIXED SATELLITE (Earth-to-Space) C41 |
| 8025-8175 MHz | 8025-8175 MHz |
| EARTH EXPLORATION SATELLITE (Space-to-Earth) | EARTH EXPLORATION SATELLITE (Space-to-Earth) |
| FIXED | FIXED C53 |
| FIXED SATELLITE (Earth-to-Space) | FIXED SATELLITE (Earth-to-Space) |
| MOBILE | |
| 8175-8215 MHz | 8175-8215 MHz |
| EARTH EXPLORATION SATELLITE (Space-to-Earth) | EARTH EXPLORATION SATELLITE (Space-to-Earth) |
| FIXED | FIXED C53 |
| FIXED SATELLITE (Earth-to-Space) | FIXED SATELLITE (Earth-to-Space) |
| METEOROLOGICAL SATELLITE (Earth-to-Space) | METEOROLOGICAL SATELLITE (Earth-to-Space) |
| MOBILE | |
| 8215-8400 MHz | 8215-8400 MHz |
| EARTH EXPLORATION SATELLITE (Space-to-Earth) | EARTH EXPLORATION SATELLITE (Space-to-Earth) |
| FIXED | FIXED C53 |
| FIXED SATELLITE (Earth-to-Space) | FIXED SATELLITE (Earth-to-Space) |
| MOBILE | |

Canada has no proposals to the 1979 WARC affecting the terrestrial services. In the exclusive fixed satellite band it is proposed to add MOBILE SATELLITE.

The U.S.A. proposes to delete FIXED and MOBILE, retaining FIXED SATELLITE (earth-to-space) and adding MOBILE SATELLITE (earth-to-space) in the 7900-7975 MHz band. This would have a negative effect on future development of 8 GHz digital radio systems in Canada.

II. As a result of an extensive review of the 7 and 8 GHz bands, an 8 GHz policy statement and revised SRSP have recently been issued, covering the licensing of FIXED systems.

III. The 7725-8275 MHz band is planned for medium capacity digital systems (90 Mbits/sec).

IV. The existing 8 GHz route between Vancouver and Tabor Mountain employs a 4-frequency plan which could block a standard system in this band. The band is also heavily utilized in the Halifax area.

REQUIREMENTS

7725-8275 MHz

A. Certain users foresee a need for a separate intermediate capacity digital band employing a channeling plan permitting 45 Mb/s systems for feeding spur links and branching routes.

B. A demand has been identified for a long-term alternative to the 8 GHz band for medium capacity digital systems.

C. In view of the fact that an 8 GHz medium capacity digital system is being overbuilt by TCTS on the existing 4 GHz route, there could be a requirement on longer hops to employ frequencies in the 4 GHz band instead of the 8 GHz band to meet system reliability requirements.

D. There is a requirement for immediate co-ordination between the terrestrial and space services. The location and technical and operational parameters of earth stations will be critical factors.

E. There is a requirement to co-ordinate future digital systems with the existing analogue systems detailed in the policy and SRSP-306.

POSSIBLE OPTIONS FOR FUTURE USE

7725-8275 MHz

1. The recent SRSP-306 for the fixed services in the band 7725-8275 MHz should serve as the basis for planning this band for such systems over the next few years.

2. Some bands which could meet the requirements outlined in A), are as follows:

1900-2290 MHz
4400-4990 MHz
5925-6425 MHz

In addition, the band 7725-8275 MHz itself could be used for this purpose (with the SRSP-306 suitably modified).

3. With reference to the requirements of B) and C) the 3500-4200 MHz band could be considered.

4. Space and terrestrial services will be sharing this band. In order to ease the co-ordination issues mentioned in D, the long range terrestrial and space proposals in this band should be submitted to the Department as early as possible.

5. The options available for the future development of the fixed network will depend to a great extent on the use of the band for earth stations under the new policy with regards to the ownership and licensing of such stations.

## CURRENT STATUS OF THE 8275-8500 MHz BAND (SRSP 309)

I.

| ITU (Region 2) | Canada |
|---|---|
| 8215-8400 MHz | 8215-8400 MHz |
| EARTH EXPLORATION SATELLITE (Space-to-Earth) | EARTH EXPLORATION SATELLITE (Space-to-Earth) |
| FIXED | FIXED C53 |
| FIXED SATELLITE (Earth-to-Space) | FIXED SATELLITE (Earth-to-Space) |
| MOBILE | |
| 8400-8500 MHz | 8400-8500 MHz |
| FIXED | FIXED |
| MOBILE | |
| SPACE RESEARCH (Space-to-Earth) | SPACE RESEARCH (Space-to-Earth) |

Note: Canada has no proposals to the 1979 WARC for reallocations in this band. The U.S. proposes to add MOBILE-SATELLITE (earth-to-space) in 8215-8400 MHz and 8400-8500 MHz, with "except aeronautical mobile" for the MOBILE allocation.

II. The primary use of this band is for the conveyance of TV and radar video via both single and multihop systems. The principal users are common carriers, other private users and government.

III. In some larger metropolitan areas, and along certain regional routes, difficulty is being encountered in accommodating additional systems.

IV. Issue II of SRSP 309 has been amended recently to reflect changes in the polarization plan and preferred growth pattern.

REQUIREMENTS

8275-8500 MHz

A. In the areas mentioned in III, there is a need for a means of accommodating additional systems (e.g. for relay of video such as TV and radar) or expanded RF channel capacity in existing systems.

B. Previous and anticipated requirements substantiated the continued usage of this band for systems as outlined in II.

POSSIBLE OPTIONS FOR FUTURE USE

8275-8500 MHz

1. Generally continue to employ this band for the conveyance of video signals.

2. To help alleviate the problems mentioned in III, one could recommend that in areas of frequency congestion future systems with hops less than 10 miles consider employing the 14/15 GHz band.

3. For those cases mentioned in III having hops greater than 10 miles in length, one could consider the following alternatives:

a) non-radio (-e.g. coaxial cable, fibre-optics.)

b) lower frequency bands:

2450-2548 MHz
2548-2686 MHz (ITV band)
4400-4990 MHz
10.5-10.68 GHz

## CURRENT STATUS OF THE 10.55-10.68 GHz BAND

I.

| ITU (Region 2) | Canada | |
|---|---|---|
| 10.55-10.6 | 10.55-10.6 | |
| FIXED | FIXED | |
| MOBILE | | |
| Radiolocation | C66 | |
| 10.6-10.68 | 10.6-10.68 | |
| FIXED | FIXED | C66 |
| MOBILE | | |
| RADIO ASTRONOMY | RADIO ASTRONOMY | |
| Radiolocation | | |

Canada's proposals to the 1979 WARC would add EARTH EXPLORATION and EARTH EXPLORATION SATELLITE (both passive sensors) (10.6-10.7 GHz) and "except aeronautical mobile" for the MOBILE service (10.6-10.68 GHz).

The U.S. has proposed to the 1979 WARC to add MARITIME MOBILE to 10.55-10.6 GHz for use by telemetry data exchange and telecommunication systems. It would exclude airborne emissions to protect RADIO ASTRONOMY. Also, the U.S. proposes to add SPACE RESEARCH (passive) and EARTH EXPLORATION SATELLITE (passive), 10.6 to 10.68 GHz.

II. There is currently no SRSP for this band, and there are no fixed assignments whatsoever in it in Canada.

III. Currently, the only assignments in this band are in the portion 10.60-10.68 GHz, to radio astronomy.

IV. Footnote C66 proposes that this band be employed for low-power, low-capacity PCM radio relay systems.

V. The FCC is considering a proposal for the use of this band by low-capacity MDS data links in metropolitan areas.

* Please note comments concerning the 9800-10000 MHz band at the end of Section 6.

REQUIREMENTS

10.55-10.68 GHz

A. Utilities have suggested the use of this band for short systems ---- e.g., spurs off of their main routes. These would be low capacity digital systems (less than 6.3 Mb/s).

B. Railways have also shown interest in this band for low capacity digital systems (less than 6.3 Mb/s).

C. There is a demand for both point-to-point and multiple distribution systems.

D. Radio astronomers have a continuing interest in the 10.6-10.68 GHz portion of the spectrum.

E. There is a potential need for service related to earth exploration.

POSSIBLE OPTIONS FOR FUTURE USE

10.55-10.68 GHz

1. Develop a frequency plan to permit low capacity digital systems (as defined under A and B) to operate in this band.

2. Low capacity analog systems (less than 300 voice channels) could be permitted in at least a portion of this band.

3. Another option would be to permit the transmission of one-way TV.

4. Depending on which of the above mentioned options are considered to be most advantageous, Canadian footnote C66 would have to be reviewed.

MISCELLANEOUS (Smaller Microwave Bands) - (Not covered by SRSPs)

CURRENT STATUS AND USAGE

I.

| ITU (Region 2) | | Canada | |
|---|---|---|---|
| 1525-1535 MHz | | 1525-1535 MHz | |
| SPACE OPERATION | 350A | SPACE OPERATION | 350A |
| (Telemetering) | | (Telemetering) | |
| Earth Exploration Satellite | | Earth Exploration Satellite | |
| Fixed | | | |
| Mobile | 350D | | |

II No assignments in this band in Canada. The Fixed service is secondary in ITU Region 2 but has not been adopted for use in Canada.

---

I.

| 1670-1690 MHz | | 1670-1690 MHz | |
|---|---|---|---|
| METEOROLOGICAL AIDS | | METEOROLOGICAL AIDS | |
| FIXED | | METEOROLOGICAL-SATELLITE | |
| METEOROLOGICAL-SATELLITE | | (Space-to-Earth) | 324A |
| (Space-to-Earth) | 324A | C52 | |
| Mobile (except aeronautical mobile) | | | |

II. The allocation to the FIXED service has not been adopted for use in Canada or the United States. The band is narrow and there is no allocation to the FIXED service in the adjacent bands. The band is considered important for meteorological operations.

---

I.

| 1700-1710 MHz | 1700-1710 MHz |
|---|---|
| FIXED | FIXED |
| MOBILE | SPACE RESEARCH |
| SPACE RESEARCH | (Space-to-Earth |
| (Space-to-Earth) | 354D |
| 354D | |

II. There is one FIXED assignment in this band in Canada (in Newfoundland) to Canadian National Telecommunications.

III. A U.S. proposal for the 1979 WARC would make an exclusive allocation to the Meteorological-Satellite Service for Space-to-Earth operations.

---

I.

| 2290-2300 MHz | 2290-2300 MHz |
|---|---|
| FIXED | FIXED |
| MOBILE | SPACE RESEARCH |
| SPACE RESEARCH | (Space-to-Earth) |
| (Space-to-Earth) | |

II. There are five FIXED assignments in this band to Canadian National Telecommunications in Quebec and New Brunswick.

---

| REQUIREMENTS | POSSIBLE OPTIONS FOR FUTURE USE |
|---|---|
| ITU (Region 2) | Canada |
| 1525-1535 MHz | 1525-1535 MHz |
| A. There is no requirement for Fixed systems in this band. However, there is a requirement for mobile telemetering assignments (both air and ground). | 1. Consideration could be given to mobile telemetering assignments, to help alleviate the problem for FIXED systems in the 1427-1525 MHz band. |
| 1670-1690 MHz | 1670-1690 MHz |
| A. The only requirements identified are related to meteorology. | 1. To retain the allocation and usage as at present would appear to be the best option. |
| 1700-1710 MHz | 1700-1710 MHz |
| A. No requirements directed specifically at this band have been identified. | 1. The two main options which could be considered for this small band are as follows:<br>a) Extension of the 1710-1900 MHz FIXED band (SRSP-303) down to 1700 MHz,<br>b) Extension upwards of the Meteorological-Satellite service to include the 1700-1710 MHz band. |
| 2290-2300 MHz | 2290-2300 MHz |
| A. No requirements directed specifically at this band have been identified. | 1. The main option suggested for future use of this small band is an upward extension of the FIXED band 1900-2290 MHz (SRSP-304). |

MISCELLANEAOUS (Smaller Microwave Bands) - (Not Covered by SRSP's)

CURRENT STATUS AND USAGE

I.

| ITU (Region 2) | | Canada | |
|---|---|---|---|
| 2686-2690 MHz | | 2686-2690 MHz | |
| FIXED | 364C 364D | FIXED | |
| FIXED SATELLITE (Earth-to-Space) | | FIXED SATELLITE (Earth-to-Space) | 364E |
| MOBILE (except aeronautical mobile) | | BROADCASTING SATELLITE | 361B 364H C53 C54 |
| BROADCASTING SATELLITE | 361B 364H 364E 364G | | |

II. No assignments in this narrow band. This 4 MHz is left over from the ITV band (2548-2686 MHz) (SRSP-300) as the TV channels in this band are 6 MHz.

---

I.

| 9800-10000 MHz | 9800-10000 MHz |
|---|---|
| RADIOLOCATION | RADIOLOCATION |
| Fixed | C63 401A |
| 401A | |

II. The Fixed service is secondary in the ITU allocation but has not been adopted for use in Canada.

| REQUIREMENTS | POSSIBLE OPTIONS FOR FUTURE USE |
|---|---|
| ITU (Region 2) | Canada |
| 2686-2690 MHz | 2686-2690 MHz |
| A. No requirements directed specifically at this 4 MHz band have been identified. | 1. If services other than ITV are considered for this band as mentioned in options for the 2548-2686 MHz band, this 4 MHz could possibly be used. |
| 9800-10000 MHz | 9800-10000 MHz |
| A. As the Fixed service is not allocated for this band in Canada, DOC has received no requests for its use on a secondary basis as specified in the ITU Region 2 allocation. | 1. Because there is 200 MHz of spectrum and the band appears to be lightly loaded, certain Fixed services could be considered on a secondary basis to the RADIOLOCATION service. |

## 7. MAJOR CANADIAN PROPOSALS RELATED TO BANDS NOT ALLOCATED TO THE FIXED SERVICE

These are bands now generally allocated to either a single service or to a set of closely-related services. Canada has made a number of proposals about these bands for consideration at WARC-79. No further action on domestic allocations or utilization of the bands is contemplated at this time (i.e., in the context of this paper).

These Canadian proposals for WARC reflect a number of broad issues and needs. The following are noted:

..To accommodate requirements for the general area of Earth Exploration. This is a relatively new activity requiring spectrum. The need includes spectrum for both active and passive sensors and for data links. It is the Canadian position, reflected in proposals for WARC-79, that both space and terrestrial systems need to be accommodated.

Due to the physics of the parameters to be studied, sensors must be operated in specific parts of the spectrum: for certain operations, the spectrum 1-10 GHz is most appropriate. However, this part of the spectrum already has a high level of utilization and operations of certain of these services are not compatible with those of Earth Exploration. The proposed allocations are mostly limited to footnote additions on either a subject-to-agreement or non-interference basis;

..The needs for spectrum for the Mobile and Radionavigation space services, and for the Aeronautical and the Maritime space services in particular. The main proposals involve a reallocation of the spectrum in the range 1535-1660 MHz among several services. The intent is to strengthen the position of the Maritime space services and reduce frequency-sharing between the Maritime and Aeronautical space services. Some additional spectrum for the Radionavigation Satellite service has been proposed for near 1215 MHz;

..Because of the similarity of many of the radar operations in Radiolocation and Radionavigation, the latter service has been added to a number of bands allocated at present to only the other service (e.g., 2300- 2350 MHz, 3100-3300 MHz, 8850-9000 MHz and 9200-9800 MHz);

..The allocations to Radio Astronomy have been strengthened in a number of-ways: 1. The strengthening of existing footnotes (e.g., FN 349A in 1350-1400 MHz); 2. The addition of footnotes (e.g., FN 370A in 3325-3360 MHz); 3. The increase in bandwidth of an allocation, either by adding to an existing band or by changing a band (e.g., 4950-4990 MHz added to 4990-5000 MHz, and the band 2690-2700 MHz changed to 3325-3360 MHz); 4. The addition of added protection by eliminating downward transmissions (e.g., addition of "except aeronautical mobile" to mobile in 4950-5000 MHz); and 5. The suppression of the Meteorological Aids service in the band 1664.4-1668.4 MHz, which it shares with the Radio Astronomy service;

..The addition of the Mobile-Satellite service to the bands 7250-7300 MHz and 7975-8025 MHz, previously allocated exclusively to the Fixed-Satellite service;

..The addition of the Fixed-Satellite (Earth-to-Space) service to the Radiolocation service on a co-equal primary basis, in the range 5825-5925 MHz as a downward extension of the existing allocation;

..The addition of the Amateur-Satellite service by Footnote 320A and, on a non-interference basis, to a number of bands already allocated to the Amateur service.

## 8. SUMMARY

The emphasis in this initial phase of the review process is on utilization of the spectrum in the nominal 1-10 GHz range for point-to-point relay systems. The department's aim is to stimulate discussion, particularly on the main issues, and ensure through consultation that all these issues are identified and put in their proper perspective. Further information which might be provided is solicited.

An assessment of present usage has been summarized. Requirements for service that might be met by the radio systems referred to have been discussed in a general sense and again with reference to specific bands. While some possible options for future use of the bands by Fixed systems have been suggested, the publishing of specific proposals would follow further study of the main issues and a review and assessment of responses to this paper on these issues.

Identification of new services, and estimates of future growth of both existing and new services, are questions to be addressed. The optimum form of networks in terms of both providing services and using spectrum efficiently, while paying due attention to economics, will need to be established. The impact of emerging technologies, both radio and non-radio, on use of the spectrum will require adequate assessment.

It is hoped that a broad response to this discussion paper will be forthcoming. This would ensure a strong background of information and opinion to serve as the basis for the next stage in the process of planning for the optimum utilization of this very important range of spectrum - the information and publishing of proposals for policies, channelling plans, and technical standards.

# REFERENCES

1. Radio Licensing Policy for Short-Haul Microwave Systems in the Band 12.7-12.95 GHz, Department of Communications, December 3, 1977.

2. Radio Licensing Policy for Short-Haul Microwave Systems in the Band 14.5-15.35 GHz, Department of Communications, December 3, 1977.

3. Radio Licensing Policy for Fixed Services in the Bands 7125-7725 and 7725-8275 MHz, Department of Communications, July 16, 1977.

4. Standard Radio System Plan (SRSP-306), Technical Requirements for Line-of-Sight Radio-Relay Systems Operating in the 7725-8275 MHz Band, Department of Communications, July 16, 1977.

5. Standard Radio System Plan (SRSP-305), Technical Requirements for Line-of-Sight Radio-Relay Systems Operating in the 7125-7725 MHz Band, Department of Communications, July 16, 1977.

6. Standard Radio System Plan (SRSP-303), Technical Requirements of Line-of-Sight Radio-Relay Systems Operating in the 1710-1900 MHz Band, Department of Communications, June 23, 1975.

7. Standard Radio System Plan (SRSP-309), Technical Requirements for Line-of-Sight Radio-Relay Systems Operating in the 8275-8500 MHz Band, Department of Communications, December 20, 1978.

8. Spectrum allocation policy in the 406-960 MHz frequency band, Department of Communications, February, 1979.

ANNEX I

## FINANCIAL ANALYSIS

As part of its mandate to manage the radio spectrum, the Department of Communications from time to time considers changes to policy and technical standards, with the objective of improving future spectrum usage. In such an eventuality users may be forced to modify or change their equipment and a requirement would exist for the department to be aware of the net costs which accrue to users as a result of any change in policy.

In undertaking an analysis of these costs of change, several factors must be take into consideration:

..certain categories of radio equipment (transmitters, receivers, antennas, wave guides) may be characterized as "frequency-sensitive". They will likely be altered or replaced if policies to re-allocate to other frequency bands or replace with more spectrum-efficient equipment are adopted.

..the cost of new equipment (or of modifications to existing equipment) either at current prices or at an adjusted figure, (for inflation) depending on when the change in government policy is to be implemented.

..the age of old equipment and its original cost. Whether it was purchased 20 years ago or last year would have a very different cost impact in the analysis. Included in this factor is consideration of the capital cost allowances affecting taxes paid and the resulting improvement to cash flows (not relevant for government and other tax exempt operations).

..the re-usability of equipment. Even if it is wholly replaced it may have resale value in some remote location where it can be used on a non-conforming basis.

..a financial analysis discounting cash flows over time such that an objective NET estimate of the equipment costs owing to changes in public policy can be derived.

This paper makes no specific proposals about the 1-10 GHz band. Nor does it suggest changes in policy towards which a cost-of-equipment study would be directed. The above, however, indicates the type of study which could be undertaken and states some of the conceptual issues which would be addressed. In a particular situation where a specific change in public policy was under consideration and the option involved amortization, the analysis would firstly undertake to identify and cost the relevant equipment for all users affected by the change. Then, depending on factors such as age, estimates of life expectancy of equipment, current and projected interest rates, etc., an estimate of the net costs to users associated with the change can be derived. The extent and perceived impact of these costs may then enter into the final decision on the timing of the new policy.

ANNEX II

## POWER LINE RADIO NOISE

One factor in the department's review of microwave bands is the suitability (or unsuitability) of the bands below about 6 GHz for electrical power utility services, due to the high values of corona and gap-type interference produced by high-voltage power lines. This claim is based on experimental data from a study done for the U.S. Air Force by Westinghouse Corporation[1,2].

The department has reviewed the Westinghouse report and other pertinent facts and documents[3]. It appears the matter is inconclusive. All factors cannot be properly assessed, given the present state of knowledge on this subject. However, present indications support the argument that power line-generated interference is not high enough to cause problems to power utility telecontrol facilities, even at frequencies as low as 1.5 GHz.

The departmental study concludes that several aspects of this apparent problem need further investigation. Most important of these are:

1. The method of measuring interference levels (i.e. peak, quasi-peak, root-mean-square, average) for signal-to-noise calculation purposes has not been established conclusively. In fact, at the present time, there is international disagreement on this item, between C.I.S.P.R. and C.C.I.R.

2. Generation of gap-type interference, which has a broader spectrum than corona and is the most significant at microwave frequencies, is dependent on the level of maintenance afforded to the power line itself.

3. Generation of gap-type interference and fading on a microwave hop are believed to be mutually exclusive events. Reference 3 suggests that on deep fades the meteorological conditions are such that gap interference generation decreases by about 20 dB from the normal value.

4. Several participants present when the Westinghouse results were made public questioned the interference measurements (see discussion at the end of reference 2). Because of these reservations caution was suggested regarding conclusions to be drawn from the result in the report.

5. Several power utilities have systems operating in the 2 GHz region, and no complaints of interference attributed to electrical power systems appear to have been voiced to date.

In view of the above, there is clearly a need to research further in this area, and investigate the use of new technologies for power line telecontrol purposes (e.g. fibre-optic systems). The Department hereby wishes to invite submissions on this topic from any interested individual, group of individuals, organizations, companies, and the general public, with a view to resolving this apparent problem.

ANNEX III

STATISTICS OF USAGE IN CANADA FOR FIXED SYSTEMS

It is the purpose of the two plots in this annex to convey to users an indication of the number of assignments and the growth since 1970 of 12 selected terrestrial fixed microwave bands in Canada.

It should be noted that the curves are cumulative growth curves and indicate the number of frequency assignments licensed at any given time.

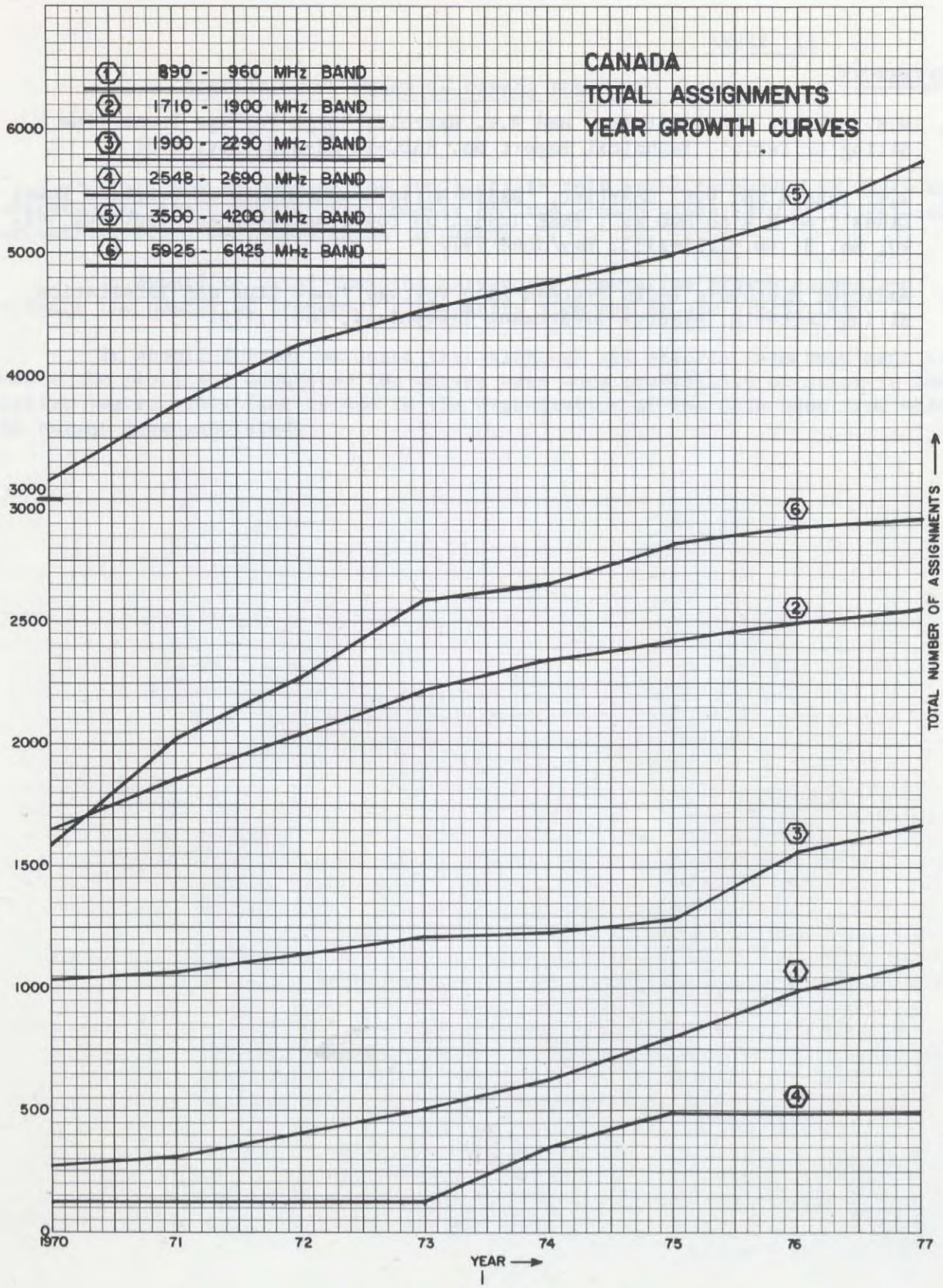
It should further be noted that although all efforts have been made to ensure the plots are accurate, the curves have more probability of error in the earlier years. This fact is due to the organization of the data base from which the curves were generated.

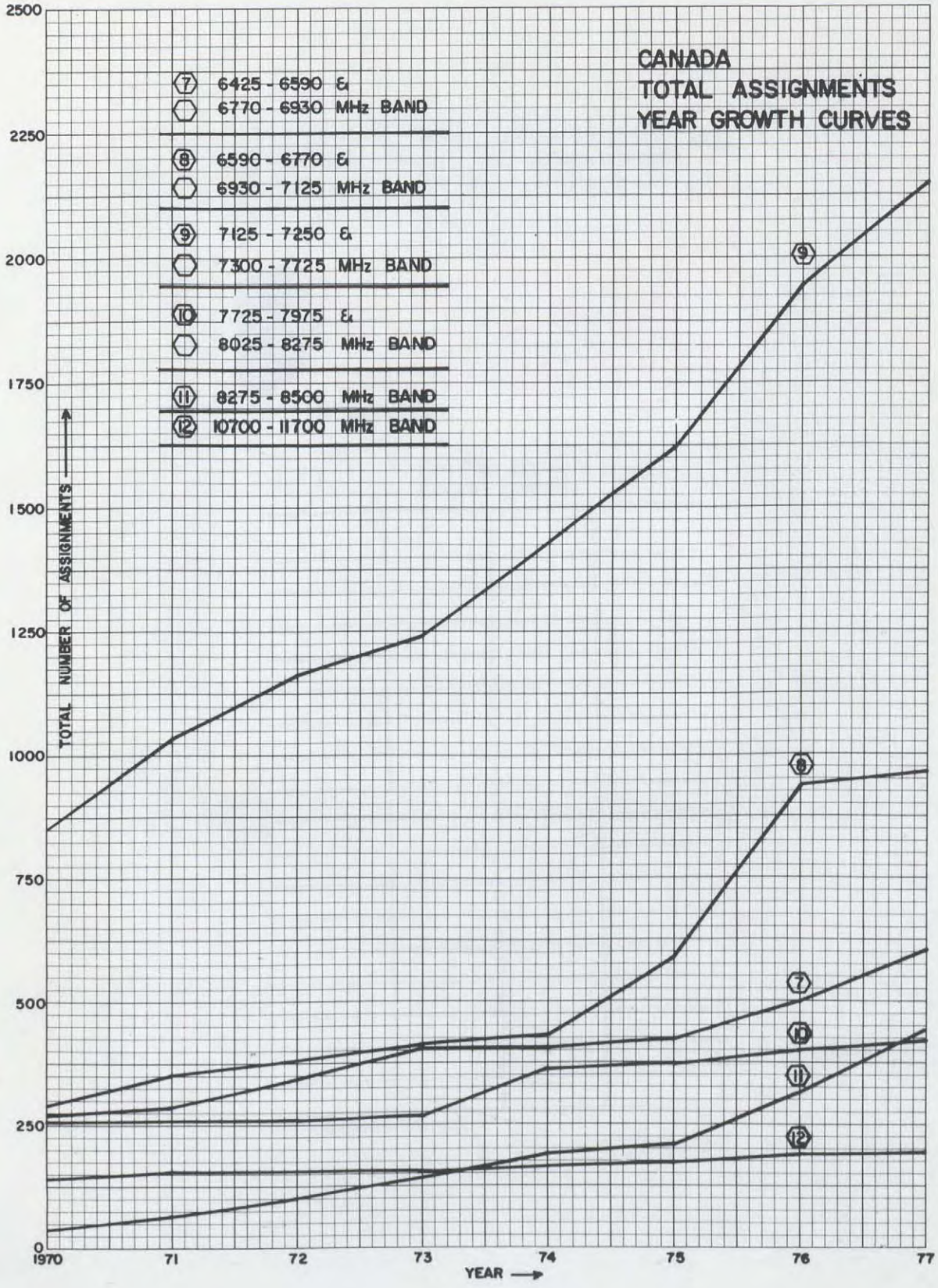
REFERENCES

1. W.E. Pakala, V.L. Chartier, and R.T. Harrold, 'High Voltage Power Line Siting Criteria', Technical Report No. RADC-TR-68-316, Nov. 1968

2. W.E. Pakala and V.L. Chartier, 'Radio Noise Measurements on Overhead Power Lines from 2.4 to 800 kV', IEEE Trans. on Power Aparatus and Systems, Vol. 90, No. 3, pp. 1155-1165, May/June 1971

3. Analogue Microwave Radio Systems High Voltage Power Line and Intallation Siting Criteria, Alberta Government Telephones, Dec. 1976.


CANADA
TOTAL ASSIGNMENTS
YEAR GROWTH CURVES
1 890 - 960 MHz BAND
2 1710 - 1900 MHz BAND
3 1900 - 2290 MHz BAND
4 2548 - 2690 MHz BAND
5 3500 - 4200 MHz BAND
6 5925 - 6425 MHz BAND
TOTAL NUMBER OF ASSIGNMENTS
YEAR
0
500
1000
1500
2000
2500
3000
4000
5000
6000
1970
71
72
73
74
75
76
77


CANADA
TOTAL ASSIGNMENTS
YEAR GROWTH CURVES
⑦ 6425 - 6590 &
⬡ 6770 - 6930 MHz BAND
⑧ 6590 - 6770 &
⬡ 6930 - 7125 MHz BAND
⑨ 7125 - 7250 &
⬡ 7300 - 7725 MHz BAND
⑩ 7725 - 7975 &
⬡ 8025 - 8275 MHz BAND
⑪ 8275 - 8500 MHz BAND
⑫ 10700 - 11700 MHz BAND
TOTAL NUMBER OF ASSIGNMENTS
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
1970
71
72
73
74
75
76
77
YEAR