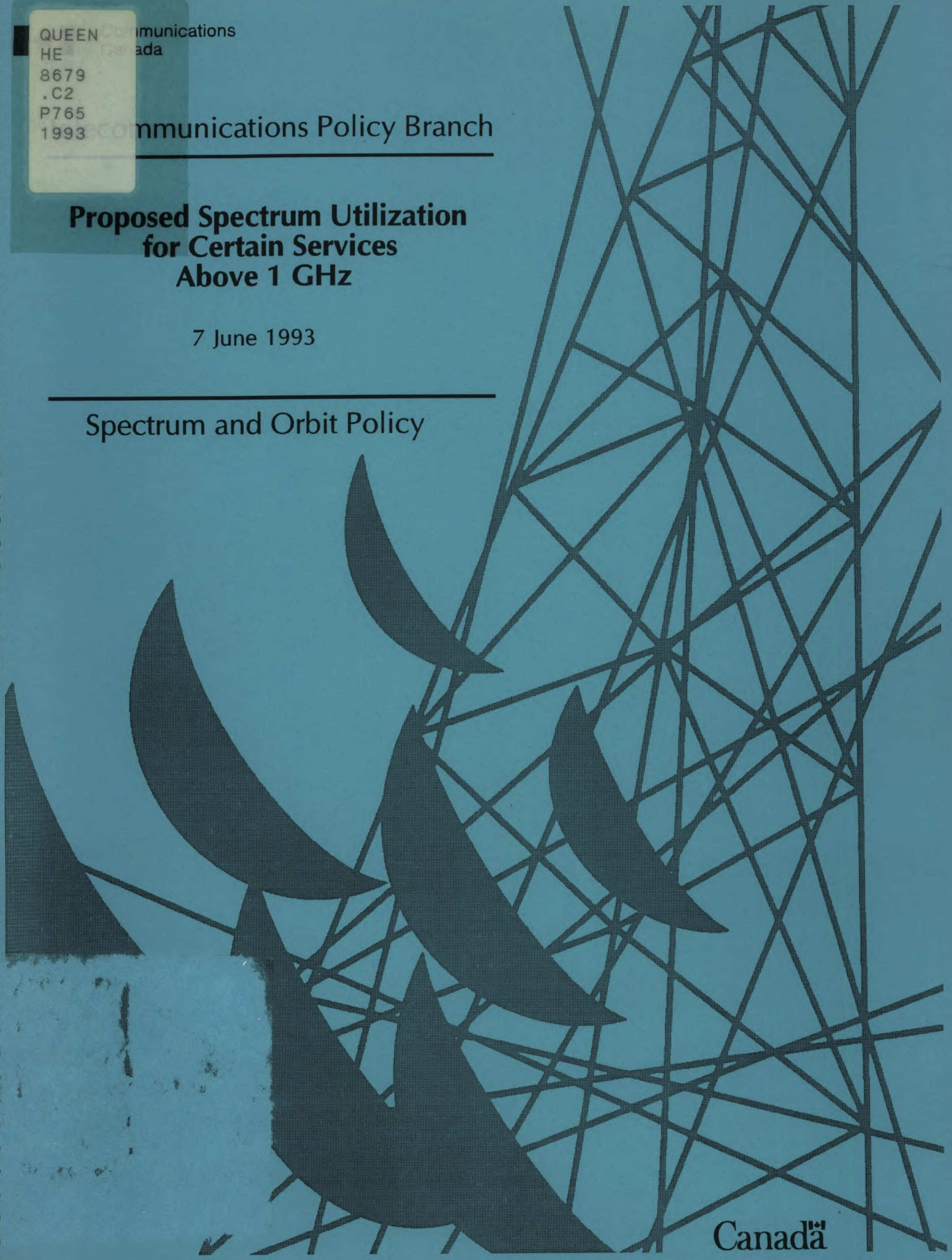
Communications Canada

Communications Policy Branch

Proposed Spectrum Utilization for Certain Services Above 1 GHz

7 June 1993

Spectrum and Orbit Policy



Canada

Preface

As a consequence of the new frequency allocations made by the 1992 World Administrative Radio Conference (WARC-92) convened by the International Telecommunications Union (ITU) in Spain, and the ongoing demand for new and existing radio services the Department has undertaken a comprehensive Spectrum Policy Review covering a wide range of spectrum allocation and utilization issues. This document forms part of the Review and addresses specific proposals for

- **spectrum utilization for certain services above 1 GHz;**

Other documents being released for public comment separately address and propose

- **spectrum allocations in the HF band, 3-30 MHz;**
- **spectrum allocations and spectrum utilization in the range 30-960 MHz;**
- **spectrum allocations in the 1-3 GHz range;**
- **spectrum allocations above 3 GHz.**

Based on the public comments received on these documents, revisions will be made to the Canadian Table of Frequency Allocations, to the relevant Spectrum Utilization Policies and, eventually to the Standard Radio System Plans.

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PART I

1 Introduction

1.1 . . . . . Intent

This paper makes proposals for spectrum utilization policies for certain services using bands above 1 GHz. Two other documents identified in the Preface, Proposals for the Allocation of Spectrum in the 1-3 GHz Range, and Proposals for the Allocation of Spectrum Above 3 GHz, have influence on the subject matter in this paper. In particular, readers may wish to refer to the 1-3 GHz Allocations paper which has many elements common to this document.

This Review will result in changes to the Canadian Table of Frequency Allocations and update Spectrum Utilization Policies to support certain radio services over the foreseeable future.

Part I of this paper discusses and proposes new or changes to existing Spectrum Utilization Policies (SPs) for bands above 1 GHz. To ensure that full attention is given to the consideration of the proposals and the suggestion of alternatives for the proposed policies, comments are invited only on Part I.

As noted in the 1-3 GHz Allocations document, this Review is complex and of relatively short duration. Based on comments from the Review, the Department will first issue revisions to the Canadian Table of Frequency Allocations, followed as soon as possible by the release of Spectrum Utilization Policies.

1.2 . . . . . Schedule of Activity

You have until 1 November 1993 to comment on Part I of this document.

The public is invited to submit written comment on the proposals, questions and observations in Part I of this document, to the Director General, Telecommunications Policy Branch, 300 Slater Street, Ottawa, Ontario, K1A 0C8, by 1 November 1993. Please reference Canada Gazette Notice DGTP-005-93/SMEP-006-93 in all replies. The Department will study all public comments and take them into consideration in the revision of the Table that is planned to be released in early 1994. The public submissions will also serve to finalize spectrum utilization policies for release beginning in the first quarter of 1994.

2 Spectrum Utilization Requirements

2.1 . . . . . Intent

This section contains discussion and general proposals for spectrum utilization of bands above 1 GHz for the broadcasting, mobile and fixed services which were changed by WARC-92. It encompasses fixed service utilization issues in other bands which may be indirectly affected by WARC-92 decisions, or other factors, such as changing demand.

2.2 . . . . . Utilization of the Radio Spectrum Resource

A radio system must conform with both the Spectrum Utilization Policy (SP) and the Standard Radio System Plan (SRSP) to be called standard. Conformance with only one of these will result in a non-standard designation. There are exceptions:

1. Where no SP or SRSP has been issued, only the primary/secondary designation applies to the assignment;

2. Where an SP has been issued, but there is no intent to issue an SRSP, conformance to the SP confers standard status. The Department may have internal technical guidelines that it may apply at its discretion.

Although a system must conform to an SP and SRSP to be "standard," it does not become non-standard if there are none.

There are more bands and services not defined by SPs and SRSPs, than those that are. There is little or no need for the establishment of policies and standards when the potential types of systems in a given band are small in number. It is also desirable to avoid setting policy or standards criteria too early in certain bands in order to allow the development of new, innovative applications and technologies.

Technical standards for the use of the spectrum are contained in SRSPs developed through a public consultative process. It is difficult to determine the need for change in existing SRSPs or the content of new SRSPs, until the SPs are finalized. From time to time, the Department also issues Radio System Policies to guide the development and implementation of new technologies. These, along with other licensing policies, guidelines and procedures constitute the published complement of direction for using the spectrum in Canada.

2.3 Preparations for the Implementation of Digital Radio Broadcasting

2.3.1 . . Radio Action Plan

Consultation with industry

On September 24, 1992 the Minister of Communications announced the composition of the Task Force on the Introduction of Digital Radio to provide leadership, focus and coordination for the technical, policy and regulatory tasks required to implement the radio industry's use of digital technology. Members include senior private radio broadcasters, the CBC, campus and community radio, the Consumer Electronic Marketers

of Canada (CEMC), the music industry, the Canadian Radio-Television and Telecommunications Commission (CRTC), and the Department.

The Task Force was one of the recommendations contained in a report to the Minister, by the Radio Action Plan Consultative Group. In addition, $1 million has been made available by the Department for joint digital radio research projects, with comparable investments coming from the public and private broadcasting industry.

The mandate of the Task Force contains a number of objectives. Digital radio in Canada should be introduced in a non-disruptive, evolutionary manner. It should provide a level of technical quality and signal reliability that is strikingly superior to current AM and FM systems, should achieve the maximum possible spectrum efficiency consistent with the stated technical quality and reliability objectives. It should serve as a direct terrestrial-based replacement for existing AM and FM radio broadcasting services; accommodate a future complementary direct satellite delivery component and should be implemented outside the current AM and FM bands, at L-band. This is to achieve an optimal system.

Experimental stations have been established in Canada to identify and characterize the system specifications of a digital radio broadcasting (DRB) system leading to the development of a Canadian allotment plan within the spectrum allocation.

2.3.2 . . . . Activities Leading to Implementation

In Canada, the implementation of DRB will proceed with minimum disruption of existing services and evolve in accordance with the objectives of the Broadcasting Act and the Radiocommunications Act. The Department and the CRTC will establish policies and regulations for the implementation plan of this service to ensure a smooth transition after full consultation with the broadcasting industry..

In order to proceed with the timely introduction of digital radio broadcasting, a number of associated studies and activities will be required:

- o Creation of an allotment plan to satisfy Canadian needs within the WARC-92 allocation;
- o Identification of sharing and coordination criteria for a satellite service in conjunction with the USA.
- o Investigate the introduction of DRB in a way that delays the impact on existing fixed services at various locations throughout the country.

2.3.3 Implementation Strategy

The Radio Action Plan Consultative Group made a number of assumptions regarding the implementation of digital radio broadcasting in Canada:

- Digital radio broadcasting is a replacement technology, with migration to the new technology by AM and FM services after a period of simulcast and appropriate level of receiver penetration.
- Implementation will consider a mix of terrestrial and satellite systems.
- Existing services and growth requirements will be taken into account.
- Local, regional and national services must be accommodated.

Priorities for the implementation of digital radio include allotment planning, facilitating and financing the transition for radio broadcasters and developing an adequate regulatory framework. The anticipated sequence of events for the introduction of digital radio is as follows:

o Establishment of Experimental Stations	Fall'92/Spring'93
o Comment on proposed technical regulations	Summer'93
o Domestic Allocation and Allotment Plan	1994-1995
o Licensing Policies and Regulations	1994
o Equipment Development	1992-1994
o Licensing of Stations	1995
o Availability of Receivers	1995-1996

Any implementation of DRB will depend upon a Canadian allotment plan which considers existing and future radio broadcasting requirements and frequency coordination with the U.S. As indicated in the footnotes to the proposed revisions to the Canadian Table, existing fixed services will be considered in any implementation plan. With radio broadcasting stations concentrated in the urban centres, and subscriber radio fixed services concentrated in the rural areas, early implementation of DRB is expected to cause only moderate impact on existing services in this band.

2.3.4 Implementation of Broadcasting Multipoint Distribution Systems

2.3.4.1 . Discussion

Since the initial announcement of the spectrum utilization policy for the 2500-2686 MHz band, which incorporated Multipoint Distribution Systems (MDS) broadcasting, there have been a number of applications for service. The few MDS systems approved in this band, have been for the maximum of 15 channels, as required by the policy. Most of these have been approved as experimental systems.

Future considerations

Some of the new allocations to the mobile-satellite service overlap portions of the band currently used by the MDS service. It will be necessary to assess the impact that services will have on each other. However, as noted in the document *"Proposed Spectrum Allocations in the 1-3 GHz Range"*, the 2 GHz band is the preferred band for the mobile-satellite service (MSS) and the MSS will not be allocated in the 2.5/2.6 GHz band at this time. Also, due to the heavy utilization of the 2.5/2.6 GHz band in the U.S. for MDS, and projected growth in Canada, this band is not likely to be used in North America for MSS until past the year 2005.

Any future review of the spectrum utilization policy for this band will need to consider:

(a) The use of video compression techniques, which are rapidly being developed. This could increase the availability of video channels by at least a factor of four.

(b) The future use and feasibility of alternate higher frequency bands for both the fixed and broadcasting services. Frequency bands above 10 GHz have the potential to offer cost-effective alternatives to the 2.5 GHz band.

(c) Coordination with the U.S.A. is a factor which may have to be taken into account for changes in spectrum utilization.

(d) Future demands for MDS and multipoint communications systems (MCS) in rural and urban areas including required protection criteria, flexibility and possible allotment planning.

2.4 Mobile: Personal Communications - A Discussion of Options

2.4.1 . . Background

The document, *Spectrum Allocations in the 1-3 GHz Range,* makes proposals to plan for the eventual implementation of personal communication systems in new mobile bands in the 2 GHz range. Although other types of mobile systems will likely be implemented above 1 GHz, it is expected that most requirements for "conventional mobile"

services will be met below 1 GHz for the medium term and possibly longer.

2.4.2 . . . . Discussion

There is ample evidence of a worldwide interest in the development of personal communications. In Canada cellular radio is commonplace, which illustrates the requirement to extend communication services to the person. The implementation of digital cellular is motivated by the need to solve capacity problems inherent with the existing analog cellular system in areas of greatest use. Digital systems will also permit the introduction of new service features.

Digital cordless telephony has been recently licensed in the 900 MHz band and is expected to achieve a large penetration in business and personal consumer markets. The implementation of digital cordless will meet near term service demand for additional personal communication services. However, many of the participants in the development of the regulatory structure for the digital cordless telephone, expressed a need for an eventual move to bands above 1 GHz in order to access more spectrum. Access to spectrum near 2 GHz will support the broader types of personal communications envisaged.

2.4.3 . . . . . Future Public Land Mobile Telephone System (FPLMTS)

As discussed in the *1-3 GHz Allocations* paper, the ITU is developing a standard for Future Public Land Mobile Telecommunications System (FPLMTS), for personal communication systems. This is endorsed by Canadian industry and the Department of Communications for systems using the 2 GHz range, in the longer term. ITU CCIR Task Group 8/1 is developing the FPLMTS standard, recognizing that a period of time will be needed for the convergence of digital cellular and early personal communication systems in different parts of the world, notably the United States and Europe. The CCIR Task Group currently foresees the implementation of FPLMTS in about the year 2000.

Proposal

In Canada, the target standard for personal communication systems will be the international standard recommended for FPLMTS.

There is no universally accepted definition of personal communication services. Several different terms are already in use for particular systems or standards groups. Given the state of evolution of personal communication services, it would not seem prudent to unnecessarily limit the scope of these emerging applications by creating narrow definitions.

Proposal

Definition for personal communication services: Communications employing personal user radio terminals operating primarily in a mobile mode and normally interconnected to the public switched telephone network.

This definition may require refinement or modification as the service concept matures.

Until FPLMTS arrives, there will likely be a need to accommodate interim personal communication systems in the 2 GHz range to satisfy medium term requirements.

Proposal

Personal communication systems will be accommodated in the 2 GHz band in the medium term with due regard to the impact on existing services and the flexibility required for the eventual deployment of systems meeting the FPLMTS standard.

2.4.4 . . . . . Factors to Consider

In the Department's view, there are three basic tenets to consider in developing a strategy for the identification of spectrum for personal communication systems.

Comments are invited on the identification of FPLMTS as the target for personal communication systems and means of achieving this.

i) The choice of spectrum for personal communications should consider the need to eventually implement systems meeting the FPLMTS standard.

The bands identified by the WARC-92 for FPLMTS were 1885-2025 MHz and 2110-2200 MHz. Factors that need to be considered in the selection of sub-bands for the initial deployment of FPLMTS systems are:

- o the basic parameters of the system including the need for duplex or simplex bands;
- o the need to access the global allocations to the mobile-satellite service (MSS) at 1980-2110 MHz and 2170-2200 MHz that will, among other applications, support the implementation of space techniques for FPLMTS, and
- o the need to obtain global agreement on the FPLMTS standard and recommended initial use of the frequency bands.

Comments are invited on the designation of spectrum for personal communication systems in the 2 GHz range given the current implementation of digital cellular and the development of digital cordless telephone.

ii) Compatibility with other countries, particularly in North America, would enlarge markets and support roaming in early personal communication systems.

The USA is advancing the implementation of personal communication systems through two parallel and related paths. In September 1992, the FCC reallocated the spectrum 1850-1990, 2110-2150 and 2160-2200 MHz for emerging technologies through Docket 92-9. The allocation to emerging technologies is deliberately vague at this point. However it will support personal communications and likely MSS and other services. In the parallel stream, the FCC is considering comments on specific proposals for personal communications issued in Docket 92-314.

Comments are invited on the desirability of compatibility of spectrum allocations, plans and standards with other countries, particularly the United States.

Currently spectrum allocations for three licensed systems are proposed in the bands 1850-1895 and 1930-1975 MHz. Unlicensed operations are proposed in the band 1910-1930 MHz.

Given the very limited spectrum in the 900 MHz band for personal communications, and from other indicators, it is apparent that attention in the USA is focused on early implementation of personal communications in the 2 GHz band. The issue of the displacement of the fixed service has received special attention.

In the European Community, a number of initiatives are underway on the development of personal communications. Among these are digital cordless telephones in the band 1880-1900 MHz and GSM based personal communications in the band 1710-1880 MHz, in some countries.

Comments are invited on the desirability of establishing an Industry Advisory Committee to advance industry interests regarding the development of personal communications.

The USA is Canada's largest trading partner. Canada and the United States share a long common border with its inherent implications in coordination of spectrum. More Canadians travel to United States than other countries. There are, consequently, advantages in achieving compatibility in spectrum use with the United States.

iii) The impact on existing services should be minimized to the extent possible.

Comments are invited on the appropriate means and timing to introduce the personal communication service in the presence of existing radio services.

The frequency spectrum under consideration is in use today for the fixed service. A fixed service channelling plan covers the band 1710-1900 MHz and another covers the band 1900-2290 MHz as later described in this document. During our preparations for WARC-92 it was recognized as preferable to confine the implementation of new services such as personal communications and mobile satellite to one of these bands. Canada's proposals to the WARC placed the implementation of the new services in the band 1900-2290 MHz, which left the band 1710-1900 MHz unaffected. However, the results of the WARC included 1885-1900 MHz for FPLMTS. More significantly, the proposed allocation of spectrum to personal communication systems in the United States uses a lower limit of 1850 MHz. This could have significant influence as Canada develops its own plans for the implementation of personal communication systems.

Comments are invited on the feasibility of sharing spectrum between the existing fixed (microwave) service and personal communication services on a geographical basis.

It may be possible to share personal communications and the fixed service on a urban/rural basis for a part, if not most, of the spectrum. Although the impact of the new services may not be felt on the existing ones for a considerable time, it would be best to initiate early consultation to allow the maximum time to reach satisfactory solutions.

2.4.5 . . . . Spectrum Utilization Options

The preceding discussion reveals a number of unknowns in the development of domestic spectrum utilization plans for personal communications. This is primarily due to the uncertainties in the outcome of the international process. In the United States, consultation on proposals for personal communications is underway. A lengthy delay is seen before the introduction of the FPLMTS standard. Given this situation, several options are developed for discussion based on the three tenets presented in the previous Section.

As discussed in the *Proposed Spectrum Allocations in the 1-3 GHz Range* paper, there is apparently a potential to geographically share at least some of the spectrum between the fixed service and the mobile service. It is reasonable to expect the initial deployment of mobile services in urban areas. In the longer term we can expect the bulk of the mobile requirement (the indoor and outdoor personal components and the vehicular component) will remain in these urban areas. This will enable some continued use of the fixed service in remote and rural areas in bands also used for these personal communication services.

The possible timing of introduction of personal communication systems is very relevant to the opportunity for the development of these services and to the potential impact on the fixed service. The initial implementation of FPLMTS has been forecast for the year 2000. There are some indications of a delay in implementation of one or two years. As Canada has sufficient spectrum available at 944 MHz to implement digital cordless telephony providing many personal communication features, the requirement for immediate deployment of personal communication systems in the 2 GHz band in Canada should not be as pressing as in the USA. The expected investment in infrastructure at 944 MHz suggests that the initial implementation of personal communications at 2 GHz will not be necessary before 1997.

Proposal

Spectrum for the initial deployment of personal communication systems should be made available by the year 1997. Planning for the introduction of universal personal communications (FPLMTS standard) should be based on an initial deployment in 2001.

Comments are invited on:

- the use of dynamic frequency sharing for greater flexibility in access to spectrum;

- the most efficient means of dividing the spectrum among several operators using fixed frequency block (or other) plans.

One of the issues currently being considered in the development of plans for personal communications is sharing the spectrum resource among multiple service providers. One alternative is to employ a scheme of dynamic frequency sharing among the operators providing the personal communication services. The other alternative is to divide the spectrum into frequency blocks. The following options section show specific blocks of spectrum. These blocks are included for illustrative purposes and in practice might be further sub-divided. The listed advantages and disadvantages may aid in the consideration of the options.

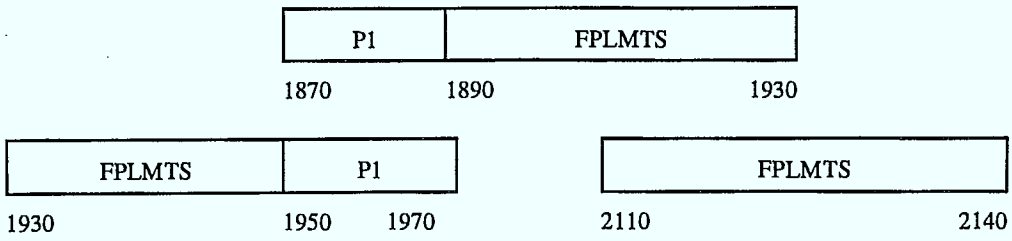
Invitation to Comment on Options

The following three options present some possibilities for the designation of spectrum for personal communications. Comments are invited on these or other options for spectrum for early personal communication systems and for the identification of spectrum for the initial implementation of FPLMTS.

Legend to the following Options:

Pn	Identifies paired block(s) of spectrum for the initial licensing of personal communication system(s).
Unlicensed	Identifies block(s) of spectrum for unlicensed personal communication systems
FPLMTS	Identifies spectrum for the initial implementation of personal communication systems meeting the FPLMTS standard.

OPTION 1



Advantages:

o Provides some spectrum (two blocks of 20 MHz) for the initial introduction of personal communications, partially aligned with the FCC plans.

o Lessens the impact on fixed systems by limiting the initial deployment of personal communications. It also confines the development of personal communication systems above 1870 MHz.

o Reserves a large amount of spectrum for personal communication systems meeting the FPLMTS standard providing the flexibility to implement either a frequency or time division duplex plan. Permits the development of an FPLMTS duplex plan with the same spacing as the MSS satellite allocations in the bands, 1970-2010 MHz and 2160-2200 MHz.

o Maintains the integrity of the MSS allocations.

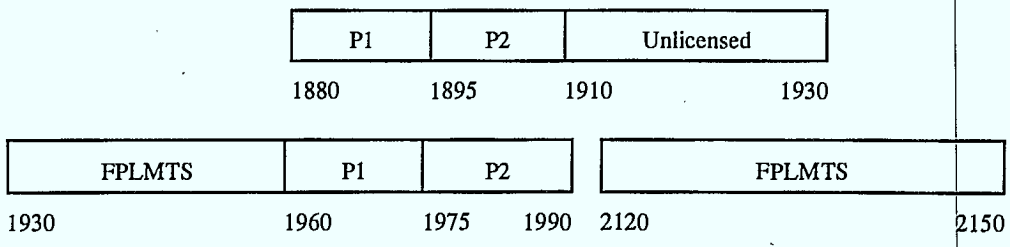
Disadvantages:

o Provides a relatively small amount of spectrum for the initial development of personal communication systems.

o Makes no provision for unlicensed systems, although such a designation could be made from the spectrum identified for personal communication systems using the FPLMTS standard.

o 2110-2115 MHz overlaps a space research (deep space) (Earth-to-space) band which supports high power earth stations in a few countries.

OPTION 2



Advantages:

o Provides 60 MHz of spectrum (paired blocks of 15 MHz each) for initial licensed personal communication systems and 20 MHz of spectrum for unlicensed operations. The paired blocks of spectrum could be further sub-divided to accommodate more operators on a dynamic sharing basis should this approach be chosen, eliminating the need to segregate operators.

o A moderate degree of compatibility with the proposed FCC plan. Block P1 matches a paired block of the proposed FCC plan and the P2 block is frequency shifted from other blocks of the FCC plan.

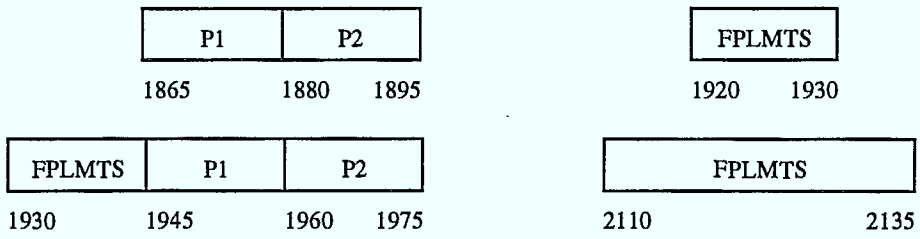
o Limits the impact on existing fixed services to frequency spectrum above 1880 MHz.

o Permits the implementation of personal communication systems meeting an FPLMTS standard with frequency division duplex spacing that is the same as that of the MSS allocations in the bands, 1970-2010 MHz and 2160-2200 MHz. As an alternative, time division duplexing could be deployed in the band 1910-1960 MHz. The deployment of unlicensed personal communications in 1910-1930 MHz will affect the implementation of personal communication systems meeting the FPLMTS standard in this band.

Disadvantages:

The spectrum, 1970-1990 MHz is part of the allocation of 1970-2010 MHz for MSS. There will likely be an incompatibility between the MSS and any high density deployment of personal communication systems. The earliest implementation date for the Canadian usage of the MSS is currently the year 2005 as decided by WARC-92. However, the World Radiocommunications Conference (WRC) in November 1993 may include the consideration of this MSS band on the agenda of the WRC in 1995.

OPTION 3



Advantages:

o Provides 60 MHz of spectrum (paired blocks of 15 MHz) for initial personal communication systems aligned directly with the FCC proposal.

o There is only a 5 MHz overlap with the MSS allocation (1970-1975 MHz).

o The spectrum identified for the deployment of personal communication systems meeting an FPLMTS standard has the same duplex spacing as the MSS in 1970-2010 MHz and 2160-2200 MHz.

Disadvantages:

o There is a larger impact on existing systems in the 1710-1900 fixed channelling plan than other options due to the lower limit of 1865 MHz.

o Appears to have less flexibility in the deployment of personal communication systems meeting the FPLMTS standard. This option caters to the use of frequency duplex techniques. In expansion of FPLMTS, spectrum above 1945 MHz and 2135 MHz could be used with the displacement or modification of the initial personal communication systems in the range 1945-1975 MHz. Other possibilities exist.

2.4.6 Experimentation

Extensive marketing and technical trials were used to determine consumer needs and to solve technical problems for the recently authorized digital cordless telephone service. The trials were important in defining the service, and will also be needed to support the development of personal communication systems in the 2 GHz range. This will require experimentation in the appropriate bands.

The use of the fixed service varies across Canada. There should be opportunities to coordinate experimental personal communication systems with existing fixed stations in the 2 GHz range in most urban areas. This will require appropriate site and frequency selection. This approach will allow many more opportunities for the use of experimental systems than searching for common sub-bands across Canada.

Proposal

To enable early investigations of the use of the 2 GHz range of spectrum for personal communication systems, it is proposed to authorize technical and marketing trials in appropriate bands subject to successful coordination with the existing fixed service.

2.5 . . . . . Fixed Service Spectrum Use

The fixed service use of spectrum above 1 GHz is already well established, but some of it may see significant change

Future changes to the fixed service will be strongly influenced by the large number of systems already using the spectrum.

As the new services accommodated by WARC-92 are implemented, the spectrum in 1-3 GHz will undergo a slow metamorphosis. This change has already begun, as fixed users avoid certain sub-bands, and some elect for higher bands that are less subject to change in the medium to long term. Changes to the existing systems in 1-3 GHz will be a product of the spectrum demand for the new services, and the alternatives available to the fixed service, which in many cases can include remaining below 3 GHz.

Although the fixed service will continue to use portions of 1-3 GHz, the policies and standards will be changed. Existing assignments in bands designated for the operation of new services will be protected and remain unchanged for as long as possible. In some cases, particularly in remote areas, this could be for the useful life of the system. The revision of policies and standards in a timely manners will allow affected existing users to move to other parts of the band, as well as the establishment of new systems.

With appropriate changes, the 3-10 GHz range will support many of the systems no longer able to use 1-3 GHz. This range also warrants change because of the evolution of the fixed service arising from equipment improvements and digitization of all types of traffic. The evolution of public and private telecommunications networks, including separate data

networks, based on ISDN, SONET and ATM architectures using both radio and fibre optic transmission, and the prospect of a comprehensive Electronic Highway is also putting great pressure on this part of the spectrum.

Above 10 GHz, there are very large amounts of spectrum that are very lightly used. Short path lengths are best suited to this range of spectrum due to high propagation losses. There are many short microwave links in 1-3 GHz (see 2.6.6) that might move to above 10 GHz. Utilization policies and standards above 10 GHz should be revised to make this spectrum more attractive to users, and to take pressure off of lower bands.

2.5.1 . . Current Use

The analysis of the utilization of the fixed spectrum is done in four band groups. The first three, 1-3 GHz, 3-10 GHz and above 10 GHz, contain all fixed uses except those contained in the fourth band group. The fourth band group consists of several bands between 1.7 and 15.175 GHz that are used primarily by fixed service systems for the carriage of signals to broadcast undertakings. The bands (such as the conventional 4 and 6 GHz bands) used for common carrier carriage of program signals are contained in the first three band groups.

Tables 6.1 through 6.4 in Annex 1 display the current arrangements including the number of analog and digital frequency assignments in each of the four band groups. These are divided into traffic capacities per RF channel. As shown, these capacities range from Very Low Capacity (VLC) to Very High Capacity (VHC). Table 1 below, summarizes this occupancy for the first three band groups. The fourth band group is summarized in Table 2, in section 2.5.5.

Table 1.1 shows the use of the three band groups by capacity. For example, 57.9% of the frequency assignments in 3-10 GHz are High Capacity (HC) while the largest use of 1-3 GHz is Medium Capacity (MC) at 51.1%. Rows are shown as totalling 100% but may not due to rounding errors.

Table 1.2 shows the use of capacities across the band groups. Although Table 1.1 shows that 57.9% of 3-10 GHz are HC, this table shows that this represents 91% of all HC assignments in these three band groups, showing the importance of 3-10 GHz for HC. While Table 1.1 shows that 29.8% of 1-3 GHz assignments are Low Capacity (LC), Table 1.2 displays that the 1-3 GHz band supports 69% of all LC assignments. In this table, columns should total 100%.

Table 1 - Assignments in 1-23.6 GHz
(Non-Broadcast Related Fixed Service Bands)

(Note: there is a total of 28,812 assignments in the three band groups)

Band (GHz)	VLC	LC	MC	HC/VHC	Total Assigns
1-3	7.9%	29.8%	51.1%	11.2%	100% (8,387)
3-10	<0.1%	1.9%	40.2%	57.9%	100% (18,893)
10-23	6.3%	49.7%	31.7%	12.2%	100% (1,532)

Table 1.1 - By Band Group

Band (GHz)	VLC	LC	MC	HC/VHC
1-3	86.1%	69%	34.7%	7.8%
3-10	1.2%	9.9%	61.4%	91%
10-23.6	12.7%	21.1%	3.9%	1.6%
Total Assigns	100% (765)	100% (3,619)	100% (12,368)	100% (12,060)

Table 1.2 - By RF Channel Capacity

2.5.2 . . . . . General Observations on Capacities

Note: for brevity, only the lower band edge frequency is referred to in this discussion.

Very Low Capacity (VLC)

VLC accounts for only 2.7% of the assignments (765/28,812) in these three groups of bands, 44% of which are in 1427 MHz (see Annex 1 for detailed band-by-band information). The majority (51%) are in 1710 MHz and 18.58 GHz supports almost all of the rest. All of the bands supporting VLC, except 1710 MHz, have low levels of use.

Low Capacity (LC)

LC accounts for 12.5% of all the assignments (3,619/28,812) in these groups. About 70% of LC is in the 1-3 GHz range, about 10% in 3-10, and 20% above 10 GHz. There are very few (15) LC assignments in

1900 MHz. Most of the 3-10 GHz LC assignments are in 7125 MHz. Above 10 GHz, LC is found in 10.55 GHz, 18.58 GHz and 21.8 GHz. LC makes up about 50% of the assignments above 10 GHz. The pattern of use of bands supporting LC is the same as for VLC ie. low, except in 1710 MHz, which is medium.

Medium Capacity (MC)

MC accounts for 43% of these assignments (12,368/28,812), about 60% of which are in 3-10 GHz and about 35% in 1-3 GHz. Only about 5% are above 10 GHz. In the 1-3 GHz range, 51% of the assignments are MC divided primarily between 1710 MHz (1,879) and 1900 MHz (2,164). The existing channelling plan in 1710 MHz does not support MC; these are assignments that pre-date the current arrangements. In 3-10 GHz, 56% of the MC assignments are in 7725 MHz, 15% in 7125 MHz, 9% in 6425 MHz and the remainder in the conventional 4 and 6 GHz bands.

Of the bands that support MC, only the 7125 MHz band displays a low level of use. The 1710 and 1900 MHz band have a medium level of use, and the 6425 MHz and 7725 MHz bands have a high level of use.

High Capacity/Very High Capacity

HC accounts for 42% of all assignments (12,060/28,812), 90% of which are in 3-10 GHz. Of these, 38% are in 3500 MHz and 34% in 5915 MHz bands, 11% in 6425 MHz, and 8% (860) in 7125 MHz. There are also 922 assignments in the 1900 MHz band. About 1.5% of HC are above 10 GHz. The 3700 and 5915 MHz bands exhibit a high level of use. The 3500-3700 portion is in the low category, along with 7125 MHz. As noted above, the 1900 MHz band is medium.

2.5.3 . . . . . General Observations on Bands

1. The high levels of use achieved in the 1900-2290 MHz, 6425-6930 MHz, 3700-4200 MHz, 5915-6425 MHz and 7725-7975/8025-8275 MHz bands should also be achievable in the 2290-2596 MHz, 3500-3700 MHz, 5850-5915 MHz and 7125-7250/7300-7725 MHz bands.

2. High levels of use of spectrum below 10 GHz display the importance of this frequency range to the fixed service, while the low level of use of bands above 10 GHz suggests a large growth potential for the fixed service.

3. The nature of the WARC-92 allocation changes indicate a good potential to relocate SRS systems in 1427-1525 MHz to either end of the band. The higher levels of use of the 1710 and 1900 MHz bands suggest that any significant reduction will require the removal of systems and/or the use of much more spectrum-efficient equipment.

4. Unlike many other developed countries, Canada has a greater need for lower frequency bands to provide long and economical microwave systems over large distances between relatively small populations.

In 1-3 GHz, most of the microwave links (based on the age of their assignments) in 1700-1900 MHz, 1900-2290 MHz and 2500-2596 MHz are older than 10 years. In contrast, the majority of systems are less than 10 years old in the 1427-1525 MHz and 2290-2450 MHz bands. Similarly, the majority of the links in the 3-10 GHz group are older than 10 years.

Except for 10.7-11.7 GHz most of the systems above 10 GHz in fixed bands are less than 10 years old. (As before, excluding those bands used predominantly in support of signal delivery to broadcast-undertaking applications.) Annex 2 contains maps that demonstrate the relative congestion of bands by geographic location.

2.5.4 . . . . Overview of Future Needs Based on Existing Usage

1-23.6 GHz Range (Excluding fixed bands that are used primarily in support of broadcast undertakings)

As noted in section 2.5.2, VLC accounts for less than 2.7% of all fixed assignments above 1.71 GHz. As an alternative to making specific provisions for this capacity, it may be preferable to allow its use in any band where the normal assignment process has created spectrum gaps, which are unusable by larger capacity systems, or in band fragments that are too small to channelize for LC.

Proposal

It is proposed to remove the VLC capacity from the System Capacities shown in Table 6, Annex 1. Comments are requested on the alternatives of either designating the use of less than 1.544 Mbit/s systems as a allowable subset of LC on a band-by-band basis, or simply allowing them to be assigned on a case-by-case basis where they will not block assignments to higher capacities.

Telecommunications Common Carrier companies are the largest users of microwave radio, and most of the existing analog systems are operated by them. In Canada, most of the telephone exchanges will be completely converted to digital switching by 1996; most inter-exchange switches are already digital. New carrier facility installations over the last 10 years have been digital. New private microwave radio systems also tend to be digital. This rapidly spreading use of digital strongly indicates that existing analog systems will disappear. The last area of microwave digitization will likely be made to systems that carry video, and even these will be gradually replaced by digital in the short to medium term. Not counting the broadcast-related fixed bands, over 60% of the existing fixed assignments are analog and can be expected to be replaced or removed within 10 years.

Proposal

The utilization proposals in Section 3, except as noted, are based on digital radio. Comments are requested on this approach, which would base the SP and SRSP for a band on its use by digital systems. This means that analog systems would be required to use the band based on criteria established for digital microwave radio.

Please note that the proposals in Section 3, are based on the existing set of RF Channel capacities shown in Table 6, Annex 1. The set of transmission capacities has evolved over the years, and now has overlap in some of the capacities. This may be an appropriate opportunity to rationalize these ranges. Comments are invited on the following alternative. If accepted, the specific band by band proposals contained in this document will need to be thoroughly reviewed.

Proposal for an Alternate Table of System Capacities

Proposal

RF Channel Capacity	Traffic Load (Mbit/s)	
LOW (LC)	**≥ DS-1 (1.544)**	**< DS-2**
MEDIUM (MC)	**≥ DS-2 (6.312)**	**< DS-3**
HIGH (HC)	**≥ DS-3 (44.736)**	**< 1 STM-1**
VERY HIGH (VHC)	**≥ 1 STM-1 or 3 DS-3 (155.52 or 134.2)**	

2.5.5 . . . . . Fixed Service Bands Used in Support of Broadcast Undertakings

Certain fixed bands have been specifically identified, and for the most part, have been dedicated for the delivery of audio and video signals to broadcast undertakings. This distinction (which will be less apparent in the future) has been based on certain characteristics of broadcast program transmission, ie:

- o analog vestigial single-sideband NTSC TV signals;
- o high quality audio channels for monaural and stereo AM and FM stations;
- o different interference protection needs;
- o convergence of systems at common broadcast transmitter or head-end sites;
- o transportable or portable and in-motion use of systems for sports or other remote news gathering locations;
- o dedicated facilities to sometimes remote transmitter sites.

Except for rounding errors, the columns in Table 2, following, total 100 %

Table 2 - Fixed Band Use in Support of Broadcasting

Band (MHz)	VLC	LC	MC	HC/VHC
	Equivalent Digital/Analog (No. of Assignments)			
1700-1710	23%		0.4%	
2450-2500			1.4%	
6590-6770			9.8%	1.4%
6930-7125	2%	45.8%	39.7%	3.6%
8275-8500	3.4%		48.9%	91%
12700-13250	72%	41.6%	0[1]	4%
Total Assigns	146	24	2113[1]	224

(1) Excludes 12,788 VHCM assignments

2.5.6 . . . . . Analysis of Fixed Service for Broadcast-Related Use

1. The spectrum for Studio Transmitter Link (STL) for Sound at 1700-1710 MHz is lightly used, reflecting reported problems with equipment availability, site coordination with other services and relatively low demand.

2. TV Pick-up (portable or transportable units) can use 2450-2500 MHz, 6930-7125 MHz and 13150-13250 MHz. Although these microwave systems are often switch-retunable, they typically operate on pre-assigned frequencies that do not require frequency coordination, to accommodate their mobility. The 2450 MHz band has a small number of permanent assignments and a very limited number of channels. It is shared with ISM (2400-2500 MHz, which includes microwave ovens) and possibly MSS in 2483.5-2500 MHz. The 6930 MHz band use is moderate. Low use has been made of the 13150 MHz band.

3. Temporary TV Links share the 2450 and 6930 MHz bands with TV Pick-ups. The two uses are indistinguishable in the Department's database. Unlike TV Pick-ups, Temporary TV Links are intended to be systems that are deployed on a semi-permanent basis, and could be coordinated.

4. TV STLs have been using the 6590-6770 MHz band. These systems are concentrated near populated areas and are generally unused elsewhere.

5. Multi-Hop Video (MHV), 8275-8500 MHz, has been extensively used to transport one-way video channels of distant signals to CATV head-ends or for regional TV network distribution. Overall, the use of the band has been moderate, except in a few areas. The greater use of satellite and fibre delivery has decreased reliance on this band. The limitation of this band to MHV was intended to provide sufficient spectrum, which near urban areas, would not be blocked by single hop systems such as STLs. There is possibly as much broadcast-related video carried in the U2, L4 and 6 GHz bands, as is carried in the 8 GHz band. However, in the other bands the carriage is mixed with other traffic resulting in a near balance between go and return traffic loading.

6. Very High Capacity Microwave (VHCM) in 12.7-13.2 GHz makes the highest use of fixed frequencies in support of broadcast undertakings. The recent addition of mobile-satellite feeder links in the band means more sharing and coordination between the two services.

2.6 ..... General Issues Relating to Spectrum Utilization

Although the general issues presented here can apply to many services, there is greater emphasis on the fixed service, which has the majority of proposals for spectrum utilization proposals in this document.

2.6.1 .... Spectrum Efficiency

Greater spectrum efficiency will allow more radio systems and longer use with less need for future change

Greater spectral efficiency in geographical areas of high demand is an effective means of achieving better use of the radio spectrum. Spectrum efficiency is a measure of the level of use of a block of spectrum in a given area. In mobile, it may be expressed in erlangs/km^2. It is dependent on the characteristics of the radio equipment, systems design and service provided, the interference protection afforded to systems, and the techniques used to make frequency assignments. Although there are theoretical methods of determining the efficiency of spectrum use, empirical or judgemental assessments of attainable efficiency are often the only practical approach.

Greater spectrum efficiency is needed when most of the frequencies in a band are in use and the supply (allocation) of spectrum cannot be expanded. Improvements in spectrum use result from increasing the spectral efficiency (eg. voice circuits/MHz or (bits/second/Hz), better antennas (spatial efficiency), lower powers, higher acceptable interference levels between systems, better loading (trunking, dynamic assignment) and more powerful frequency assignment tools and techniques. Sometimes, higher spectrum efficiencies have been encouraged by limiting the supply of spectrum in a band. This forces users to more spectrum efficient techniques.

Conversely, situations experiencing low demand may warrant the use of less spectrum efficient techniques. For example, lower costs may

improve the accessibility of telecommunication services to Canadians in areas that might otherwise be unaffordable. As well, the lack of alternative communication possibilities in sparsely populated or low demand areas may serve to provide economic justification for spectrum-based alternative delivery systems.

Spectral efficiency will increase with time at reasonable cost with the natural evolution of radio equipment and system design. However, the re-use of older radio equipment that does not meet modern spectral efficiencies is a possibility in a remote areas. Existing policies and standards tend to discourage this, even in areas where spectrum is plentiful. This issue is expanded in 2.6.2 below.

In a study of the fixed service in the U.K. (Deregulation of the Radio Spectrum in the UK, Her Majesty's Stationery Office, London, 1987, page 49), it was found that the frequency re-use in 2 GHz in a 65 km radius around the London area, was in the order of 2. The study examined the most congested part of the USA, and with corrections, revealed a re-use factor of 19. At 4 GHz the factors were less different, 15 and 37 respectively. The amount of spectrum re-use is obviously variable, and depends on a number of factors, many of which would vary widely across Canada. Because of this no effort has been made to calculate re-use in Canada, but the referenced study illustrates the issue.

The aggregate sum of single-entries of interference for a multi-hop system results in much lower interference signal levels than is acceptable for a single-hop system. This suggests that single-hop systems could bear a greater interference level, resulting in greater frequency re-use. In Canada, systems using Automatic Power Control are coordinated using the highest power, while in the USA, coordination uses the nominal transmitted power. If the spectrum re-use factor can be increased through tighter coordination procedures, there should be less frequent need to change policies and standards or displace systems to accommodate new demand.

Proposal **The availability of spectrum to fulfil demand is greatly influenced by assignment techniques (tools) and spectrum management criteria, which go beyond factors covered in utilization policies and standards. It is recommended that government and industry examine assignment and coordination alternatives to increase access to the spectrum while providing adequate attention to levels of service.**

The burden of less than optimally-used bands must be weighed against the cost of obtaining greater use from them. Since demand varies across Canada, burden to cost may vary.

2.6.2 . . Geographical Differences

There may be a need to permit differences in the use of radio across Canada

In the 1982 spectrum utilization policy review which dealt only with the fixed service, it was concluded that it was not practical to relax the requirements of policies or standards in remote areas. This was based on two factors:

1) Frequency congestion can occur in remote areas where there are major network junctions or limited choices of radio sites (such as mountain tops).

2) In areas outside of those identified in 1) above, low spectrum demand would protect non-standard users against premature removal in order to accommodate a standard system. Some new factors have emerged that may warrant a revisit of this policy:

- the concentration of high density mobile and digital sound broadcasting will be in the populated areas. This will allow different uses of the spectrum in unpopulated areas;
- the fixed service can install much more high efficiency radio equipment to overcome frequency congestion and to offset spectrum losses in the 1-3 GHz range;
- it may make economic sense to re-deploy used and decommissioned equipment in areas that are less demanding in spectrum efficiency;
- in many geographical areas, such as the Prairies, Atlantic Canada and some parts of Central Canada, the need for more High Capacity radio by existing users is being reduced considerably by Fibre Optic Transmission Systems (FOTS);
- in practice, it has been found that many users will not install non-standard equipment, because of the uncertain tenure of use that a non-standard designation implies.

Frequency congestion increases the difficulty of finding a new frequency assignment. When the difficulty of making a frequency assignment is too great, or the cost of implementing it is too high, the frequency manager will recommend the use of another band. In an operational sense, this is a dynamic process.

Another solution is to upgrade the policies and standards in the band, but this takes time. Solutions which are intended to resolve problems in congested areas may cause unnecessary cost to users in uncongested areas. If a universal solution is imposed in both areas, it may be necessary to wait until the problem has become widespread. This makes

those areas of greatest frequency demand (and therefore the earliest frequency congestion) wait the longest before congestion is relieved.

It is possible to specify policies and standards applicable only to congested areas if those areas can be identified. An ability to identify areas and levels of congestion opens other possibilities. For example, less stringent policies and standards could be applied in areas of low congestion and certain policies and standards could even be waived in areas where spectrum use is very low or non-existent.

Proposal **Definitions of Fixed Service Frequency Congestion:**

1. Uncongested Area

The band has been available for use for a number of years but has little or no use in the area, nor is any projected. In terms of fixed service assignments, an indicator of an uncongested area is when 90% or more of the channels are available for use in 90% or more of the possible directions.

2. Moderately Congested Area

The band is well used as intended, and there is adequate spectrum for future growth. A suitable indicator may be when 50% or fewer of the channels are available in 90% or more of the possible directions.

3. Highly Congested Area

The possibility of finding an assignment for a specific system application is low or it is very difficult to make an assignment. In this case an indicator may be when 10% or fewer of the channels are available in 90% or more of the possible directions.

These definitions can only be used as guidelines. In some cases, there is no possibility of establishing a radio site except within 50% of the possible directions, such as near large bodies of water. As well, a band could be unused because it has been available only for a short period of time. Local conditions, such as USA usage in a border area, must be factored into these criteria.

The Department has created a computer capability to determine congestion levels in each of the fixed service bands throughout Canada. Sample maps from these studies, contained in Annex 2, indicate areas of high, moderate and low congestion. The computer generated maps display channel availability at a large number of sample points on the map. The disparity in the geographic distribution of spectrum congestion

reinforces the need for a selective mechanism to relieve congestion. It also demonstrates an approach to identify geographical differences and selectively apply policies and standards.
Areas identified as highly congested should be subject to priority treatment for relief of the congestion. An increase in spectral efficiency and a consequential reduction of channel bandwidth is an appropriate spectrum congestion relief action.

Proposal

Relief of highly congested areas

New spectrum utilization policies and standards should specify enhanced criteria to be applied in highly congested areas. With the promulgation of final system standards, as revised in accordance with the policies resulting from this Review, existing systems in highly congested areas that do not meet the highly congested area criteria should be considered non-standard unless other specific provisions are made in the policy or standard.

Regional Offices should confirm that substantial relief will be made by the upgrade or removal of systems in the highly congested area before requesting changes to such non-standard systems. Systems which have been authorized under lower congestion criteria, should be given some minimum period of operation.

Proposal

Geographical Differences Policy

Subject to a satisfactory finding by the Regional Executive Director:

1) In an uncongested area, which could be site specific, systems may be exempted from the SPs and SRSPs and given the status of "standard," if less than 25% of the channels in the band are assigned.

2. Where the use of the spectrum exceeds the uncongested area limit, but has not reached the moderately congested level, the minimum SP and SRSP criteria for a band would apply. Systems meeting these criteria would be "standard".

3. Where the moderately congested level is exceeded, but it is not yet highly congested, applicants may be required to conform to SP's and SRSP's normally applicable to highly congested areas, where there is an expectation of more demand for spectrum. Previously authorized exempted systems and minimum standard systems would remain on a standard basis.

4. In a location of highly congested spectrum, systems not conforming to highly congested area SP and SRSP criteria and which were originally licensed more than 15 years ago, are subject to removal or replacement within 2 years after a written notice from the Department.

If adopted, the Department will develop more detailed methods to implement this policy. This could be the annual publication of a spectrum atlas containing congestion information in different parts of the country. It may also be possible to determine congestion on a site by site basis, as required.

2.6.3 . . . . Reducing the Number of Types of Use

The Department assists applicants in determining the best band for a specific need. As bands become more congested, it is more difficult to find suitable spectrum. There are several bands for the carriage of analogue video, such as MCS-Video, STLs, TV Pick-ups Temporary Links and (Multi-Hop Video) MHV. The only band identified above 1 GHz exclusively for sound STLs is 1700-1710 MHz.

There is also a growing demand for the transmission of broadcast and non-broadcast program audio and video. Non-broadcast transmission sometimes exceed broadcast quality, and include medical, commercial, educational and scientific applications. Video applications can range from teleconferencing to movie production. This blurring of non-broadcast video and audio with broadcast program delivery suggests that where technical standards are maintained, all of these signals should share fixed bands.

The transmission of broadcast network programs over long distances is often provided by satellite and common carrier microwave networks in the 4 GHz and 6 GHz bands. The increasing use of digital telephony and data has accelerated the conversion to digital of common carrier inter-city microwave systems, and phase-out analog video transmission. In many bands, video-only transmission has been discouraged for reasons of optimizing the use of the spectrum. Traffic in some bands must be relatively balanced in both directions, ie., not predominantly one-way video.

The broadcast industry is gradually converting to digital for production, delivery to broadcast undertakings, and eventually distribution to subscribers. Digital transmission for program and non-program video signals should allow the choice of a larger number of bands for these applications, to provide more alternatives without danger of loss of quality, provided they meet policy and standard requirements.

As the transmission of broadcast program material is implemented in digital form, the removal of specific broadcast type of use designations, eg. STL, may be possible. Special provisions will still be required in bands that support temporary or transportable use where normal frequency coordination is not possible.

Proposal **Fixed systems carrying broadcast undertaking-related traffic service systems which use digital signals may use any fixed band in which the use conforms to the SP and SRSP for that band.**

Except as decided in this Review, a future policy review may be initiated in fixed service bands now used for the transmission of broadcast-undertaking program signals to accommodate other fixed uses.

Proposal **For video transmission, spectrum policies should encourage:**

- **the orderly transition from analog to digital transmission;**
- **more flexibility for digital systems than for analog systems;**
- **grandfathering of existing analog systems.**

Valid reasons for maintaining discrete bands, such as for small user groups that ease coordination, the isolation of one-way systems, and a greater tendency to share systems may be outweighed by the need for greater flexibility for all users.

Existing spectrum policies identify bands for TV Pick-ups and Temporary TV Links. In all cases these are common bands, and the conditions of use are the same.

Proposal **It is proposed to eliminate the definition of Temporary TV Links in SP-GEN.(1) The definition of TV Pick-up as written is broad enough to include this function.**

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(1) SP-GEN, General Information Related to Spectrum Utilization and Radio System Policies, Department of Communications, January, 1991.

2.6.4 . . Reaccommodation of Existing Systems

Existing fixed systems can be re-assigned in other parts of the spectrum in the event the spectrum they are using is re-allocated. Several factors and approaches may come into play in doing this.

1. The creation of new mixes of traffic types or system capacities in bands which still have more than adequate growth potential.

2. Increased spectral efficiencies and decreased bandwidths to allow more assignments in a given band.

3. The use of guardbands and other unused fixed spectrum. At the same time, the redistribution of microwave spectrum should consider the possibility of:

4. Greater alignment with foreign market usage, particularly the USA and Europe.

5. The eventual transition from analog systems to digital systems.

6. The eventual replacement of heavy route radio by FOTS.

Band-by-band Spectrum Utilization Policy proposals presented in Section 3 take these factors into account in the redistribution of spectrum.

2.6.5 . Non-Spectrum Alternatives

The Development of Networks

There are three major transcontinental microwave radio networks in Canada, supplemented with several inter- and intra-provincial systems. Some cross-sections use two or more frequency bands. Additional bands were typically used when the growth of a system was blocked by a neighbouring system, or when the existing band (or bands) capacity was exhausted. The development of the Fibre Optic Transmission System (FOTS) is driven by the need to continue to increase the transmission capacity of large public and private networks, economics, and the shortage of spectrum.

FOTS is quickly leading to the replacement of High Capacity radio in the public networks. It has excellent transmission quality, and technology is continuing to increase the amount of traffic it can carry. There are certain disadvantages. The fibre cable is vulnerable to damage in proportion to its exposure and its length. Repair of cable damage and the restoral of service in a single fibre route system can take hours, resulting in unacceptable outages. Two design approaches that improve reliability are underground burial and parallel routes. The parallel routes can use traffic diversity and cross-connect switching to bypass and automatically restore a broken section.

The economy of these approaches change with the geography of the route and the number of circuits to be carried. Some light traffic routes cannot justify the cost of fibre and will retain radio. For large capacity routes, different transmission solutions may evolve in different sections of the route. For example, in one section the evolution might follow this course:

1. Transmission capacity can be provided by a new or existing radio system that can be expanded to handle increasing traffic until the economics of a FOTS route is justifiable, and it is installed.

2. The radio route is retained to provide transmission diversity.

3. As traffic continues to increase, a decision may be made to install a parallel fibre, or to upgrade the radio for higher traffic.

4. The radio route may be abandoned when it no longer provides sufficient transmission or restoral capacity.

Thus even where fibre is used in high capacity routes, radio can play a significant role. Microwave radio systems can rival the reliability and current capacity of fibre, and in certain situations are more cost-effective. However, microwave systems that complement fibre can require a large amount of spectrum. The equivalent transmission capacity of one OC-48 requires a bandwidth of 640 MHz to 830 MHz bandwidth (depending on spectral efficiencies, protection channels and guardbands). One objective of this Review should be to ensure that sufficient high capacity digital spectrum is available to develop these complementary radio systems.

Proposal **While the Department will continue to urge the use of non-spectrum alternatives, the satisfaction of new high capacity demand by radio will be supported where it fosters the orderly and economic development of telecommunications.**

Proposal **The Department may choose to not authorize new radio systems or the expansion of existing radio systems when the applicant has adequate alternatives (such as fibre systems). Furthermore, the Department may require the removal of existing microwave systems under these circumstances, when they block the evolution of another radio system that is critically dependant on spectrum.**

Bands in the 3-10 GHz region of the spectrum support the combination of very long, wide-bandwidth, highly reliable and spectrum-efficient systems much better than lower or higher bands. Radio systems that complement and support FOTS networks will heavily rely on this part of the spectrum. On the other hand, the new services allocated in the 1-3 GHz bands place additional demand on this range of frequencies which has been used for "smaller" fixed systems. It can be expected that the growth of both types of systems will continue in the event of relaxed licensing policies discussed in 2.6.11, below.

It is evident that the use of the HC bands by the major microwave networks will continue to evolve, by growing in certain cross-sections, and by being gradually replaced in others. Major networks are operating primarily in the 4 GHz bands between 3500 and 5000 MHz, which can provide 880 MHz of channels and in the 6 GHz band. These networks make use of portions of both bands in certain areas, as well as other bands. Portions of all three trans-Canada networks have large fibre

sections. The 6 GHz microwave systems are limited to 500 MHz or less in some areas, although they may need more than that in the future. As radio networks are being reconfigured to integrate with FOTS, it is opportune to give direction to rationalize this type of demand on spectrum.

Proposal

1. Microwave networks that off-load traffic to other bands or fibre systems may cause an assignment to become non-standard because minimum RF channel capacity requirements are no longer met. Such channels are subject to removal if they are required for a standard application.

2. Networks that are primarily based in either the 4 GHz or the 6 GHz band should consolidate their use in one of the bands, by removing or replacing portions of sections that also use another band.

3. Expansion of HC 6 GHz systems can take place in the frequency range 5915-6930 MHz under certain conditions that are compatible with the existing use of this band.

4. Higher frequency bands or FOTS will be encouraged for entrance links to major metropolitan areas.

2.6.6 . . . The Use of Higher and Alternate Bands

Historically, every radio service has used higher and higher frequency bands. The disadvantage of shorter transmission distances in higher bands is often offset by the availability of "new" spectrum. This trend is ongoing and will continue. The Department will continue to encourage the use of higher bands. The ongoing implementation of FOTS is also supporting the non-spectrum alternative and will moderate, if not decrease, the demand for microwave radio.

Higher frequency bands, particularly above 10 GHz, remain relatively unused and are available to replace some shorter hops that may be displaced below 3 GHz. There has been a question of the reliability of these higher frequencies due to rainfall outages, where the radio path may be too long in certain critical applications. Industry may wish to establish a set of criteria to determine the circumstances under which the use of higher frequencies is not acceptable.

CCIR Study Group 9 drafted a new recommendation showing achievable hop lengths for bands above 17 GHz in rainfall region (G). An excerpt is shown in Figure 1, which follows the next page.

An examination of the use of systems around 2 GHz shows the following distribution of path lengths.

Table 3 - Path Lengths in 2 GHz Bands

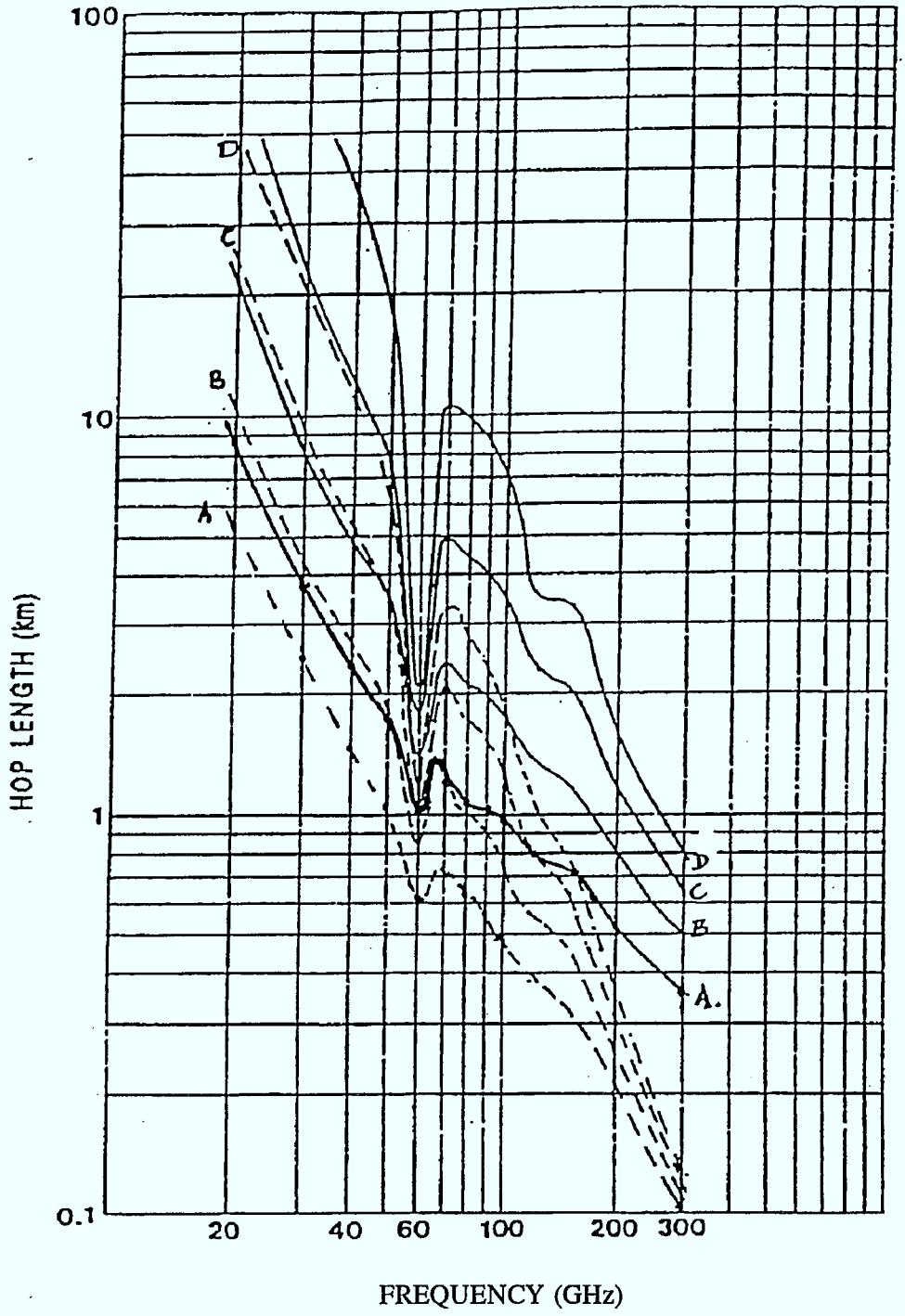
Band (MHz)	Avg. Path Length(km)	< 30 km
1700-1710	21.8	82%
1710-1900	36.6	38%
1900-2290	39.9	30%
2290-2450	37.5	36%

This information suggests that a significant portion of the demand for spectrum around 2 GHz can be satisfied above 10 GHz. Specific proposals of this nature are also made in Section 3.

Request for Comment

Respondents are invited to comment on a general policy that requires the assignment of specific microwave systems or short links to bands above 10 GHz.

Figure 1 (Source: CCIR 9B/TEMP/49-E)



BIT RATE: _____ 2 Mbit/sec
- - - - - - - 140 Mbit/sec

OUTAGE: Curve A - 0.001 % Curve C - 0.1 %
Curve B - 0.01 % Curve D - 1 %

2.6.7 . . . . . ISM

The FCC has approved low power spread spectrum equipment that can provide VLC or LC point-to-point or multi-point services, or possibly mobile services that can operate on an unlicensed basis in the ISM bands 2400-2500 MHz and 5725-5875 MHz. The fixed applications overlap similar licensed uses in 2290-2350/2390-2450 MHz and 5850-5915 MHz. Preliminary calculations by the RABC suggest the possibility of interference between these licensed and unlicensed systems. This is also discussed in the *1-3 GHz Allocations* document where comments are requested on the treatment of policies in these bands.

In the 2290 MHz band, a proposal is made to issue guidelines in place of standards because of the overlap with ISM in 2400-2500 MHz. Comment is requested on this approach and a similar treatment of the 5850-5915 MHz band and any other alternatives.

2.6.8 . . . . . New Technologies

As noted in 2.6.3 a change that will take place within the next 15 years will be the replacement of analog video transmission by digital video transmission. The 1-10 GHz spectrum has several "video" bands. These bands are not specified as analogue or digital; there is little digital transmission in use in them today. Once digitization occurs, the need for separate video bands may be diminished (except perhaps for ENG, which has special coordination problems), since the digital video signal can likely be delivered as any other digital transmission.

As the use of FOTS expands in the long term, fixed radio may take on more specialized applications, such as wideband transmission to temporary, portable or even mobile locations. Fixed service radio will continue to be used where it proves more suitable than other alternatives. It is conceivable that optical digital data rates will become the standard transmission rates for higher capacity radio systems. The spectral efficiency of radio equipment will continue to increase with increases in digital signal processing and with new modulation schemes.

2.6.9 . . . . . Fixed Spectrum Use by Other Countries

The band-by-band tables in Section 3 depict the different fixed channelling plans approved, or being prepared by Study Group 9 of the CCIR. It also shows US fixed usage, including TV Pick-ups (also known as ENG), which the FCC considers as mobile, although they operate in and share fixed bands.

Although there are regulatory reasons (such as ease of coordination) for alignment of Canadian use with others, the primary reason for greater alignment may be economic or operational.

Comments are invited on this issue, specifically addressing the disadvantages of an existing difference in the use of spectrum in Canada and other countries and the advantages of a possible new alignment.

2.6.10 . . . Industrial Opportunities for the Fixed Service

Canada has a strong manufacturing presence in the international fixed radio equipment market. The development of new equipment and new market areas by these companies can be affected by the availability of spectrum in their home market. Spectrum utilization approaches that accommodate innovation and development should be considered.

Proposal

Radio stations that are in support of the development of products that are to be designed and built in Canada, but which do not meet the spectrum-related policies and standards of a band, may at the discretion of the Regional Executive Director, be exempted from the utilization policies and standards applying to a band, provided that a condition of licence is the removal of the system within two years of written notice.

Although there may be less flexibility in some fixed bands below 10 GHz because of the relative intensity of usage, there is more flexibility above 10 GHz, and particularly, above 24 GHz.

Proposal

Bands above 20 GHz will have few, if any, specific spectrum utilization policy provisions until there is a clear need to do so, in order to resolve potentially competing and conflicting demands. Prior to the issuance of policy, technical requirements in these bands will be limited to guidelines.

In Section 3, no policy is proposed at this time for fixed bands above 24 GHz.

2.6.11 Our Changing Environment

To help Canadian telecommunications users to compete in the global economic and trading market, the general trend is toward less government intervention in the operation of radiocommunication services. Recently the Department instituted the Radio Licensing Policy for Limited Area Fixed Radio Systems. This policy greatly relaxes the requirements for the development of microwave facilities in local areas. It does this by reducing eligibility requirements and socio-economic justification, provided that the new radio system satisfies a public need and the area of operation is within a geographic area, so as not to bypass toll services. These systems would normally be used as city wide local area networks for data and voice services. As more of these systems are implemented, there will be pressure placed on fixed spectrum requirements, especially in urban areas. Additionally, the linking of these systems between cities will increase the demand for intercity transmission facilities, including microwave.

The Department is currently reviewing the possible relaxation of the intercity microwave licensing policy, which could also place pressure on the availability of fixed spectrum. Should additional carriers be allowed or the definition for a limited area be expanded, it is inevitable that more inter-city microwave facilities will be developed. Additional carriers could also have an effect on the existing channelling plans, as set out in the SRSPs. In a number of bands, the plans are set up to allow future expansion of existing licensees' systems on an economical basis.

The CRTC recently introduced open competition in the long distance market in an attempt to foster market efficiencies for better service and lower costs. Significant pressure will now be placed on the spectrum for new facilities for long distance service due to competition among the existing and new interexchange carriers.

Increased domestic competition through policy, regulatory and technical change is foreseen in the fixed and mobile services. The broadcasting industry is facing a similar, competition, from video stores, CD sound recording and broadcasting-satellites.

Future Changes

The formation of large international trading blocs will almost inevitably result in the creation of special radiocommunication markets designed to serve the specific needs of the bloc members. This is already taking place in the EC for such systems as DECT and GSM. International regional interests lead to different and, sometimes, conflicting frequency allocations around the world. If this was the only force in play, more fragmented international frequency allocations and the desire for more frequent changes could be foreseen. Fortunately, the ITU is working to make the use of the radio spectrum more flexible, to enable each country to satisfy its changing needs without requiring changes to the ITU Radio Regulations. It is anticipated that future world radiocommunication conferences will begin to implement the necessary changes as early as 1995.

Despite this, there will always be a national need to adjust the spectrum to match changing demands. Canadian experience during the WARC-92 activity strongly reinforced the benefits of the policy of allocating spectrum by type of use rather than by type of user. It permitted a great deal of flexibility in adjusting the spectrum through the identification and choice of possible spectrum alternatives. In many cases the different alternatives had a similar overall impact on the existing users. When bands are designated by type of user (sometimes called "block allocations"), changes to the spectrum inevitably penalize one group of users for or more than another.

This spectrum review makes proposals to build on this experience. It does so by proposing changes that maximize the interchangeability of spectrum by further broadening the types of use of bands. This should spread the impact of change over more users. It should also provide a much wider selection of bands to a user resulting in more system design alternatives. It should reduce the incidence and impact of frequency congestion. This approach also offers greater ability to satisfy new types of users.

3 Proposals to Modify Spectrum Utilization Policies for the Fixed Services

3.1 . . . Introduction

This Section contains band-by-band spectrum utilization policy proposals for certain bands above 1 GHz. For the most part, proposals are limited to the fixed service. In some bands, proposals are made for other services.

Note: In this Section, proposals for new, or for the modification to existing spectrum utilization policies which are specific to a band, are wholly contained in the Proposal section of the band-by-band tables which follow. Each band table is preceded by a short discussion of the highlights of the proposals for the band. To avoid repetition, not every item in a proposal is discussed where there has been detailed discussion of the relevant issues earlier in the document.

These proposals are based on existing RF channel digital capacities

Many of the following proposals are based on discussion and proposals in earlier parts of this document, and also in related documents dealing with spectrum allocations above 1 GHz. The existing table of fixed service traffic RF channel capacities (Annex 1) is used and not the proposed alternate table of system capacities (section 2.5.4). If the alternate is adopted, there will be some consequential adjustments, and respondents may wish to identify those bands where such a change would be significant. As also proposed in section 2.5.4, these proposals do not include explicit provisions for VLC (systems less than 1.544 Mbit/s), although some bands allow "sub DS-1 capacities" in an LC band. Above 1 GHz, VLC is treated according to the proposal in 2.5.4, ie., accommodated on a case-by-case basis, in the natural channel gaps that occur during the assignment basis. This may require additional work to search for these gaps and the use of "customized" equipment.

The following proposals seldom differentiate between analog and digital use of the bands. In 1982 digital systems had to conform to conditions established for analog systems. In 1993 it is suggested that policies and standards first meet the requirements for digital radio and appropriate provisions be made for the rapidly disappearing use of analog. Analog video transmission has been "replaced" in some bands by digital equivalents. For example, a 6 MHz RF video signal might be replaced by digital DS-2 data stream (6.312 Mbit/s) operating at about 1/bit/s/Hz, and a studio quality video transmission might be contained in an RF channel carrying a DS-3 (44.736 Mbit/s). These digital equivalents should more than satisfy existing bandwidth requirements through anticipated digital video compression.

As discussed in section 2.6.3, digital video and audio will be supported in any band in which they meet the other requirements for the band. This

will give much more flexibility in the choice of bands, and possibly give access to less specialized and lower cost equipment.

Waivers

The proposed Geographical Differences Policy (see 2.6.2) is important to several of the proposals. This policy, if adopted, will enable "standard" licensing of systems not meeting these SPs or consequential SRSPs, in areas that are declared uncongested. For example, four frequency plans may be licensable on a standard basis in uncongested areas, but not in moderately or highly congested areas.

3.2 . . . . . Options for Band and System Capacities

The radio frequency spectrum is becoming an increasingly limited resource due to the increase of demand from new and competing services. This has a significant impact on Canadian objectives in areas of social, cultural, economic and industrial endeavors. There is a vital dependence on the judicious use of spectrum to meet the many competing needs.

A range of new and emerging mobile, mobile-satellite and broadcasting services are being developed to use the traditional microwave bands. In the medium to long term, this means less spectrum will be available to the fixed service, and what remains will be required to achieve greater transmission capacity through the use of advanced technology and design. Several approaches can be used to achieve this policy objective.

The current system capacities as defined in SP-GEN have been very useful in designating the analogue and digital traffic levels in the fixed service bands. However, the advances in digital technology over recent years have significantly increased the transmission rates which may be transmitted over a given channel bandwidth. Furthermore, manufacturers are able to offer a broader range of equipment to meet specific transmission rates, channelling arrangements and other technical requirements specified by the client. The result is that there appears to be a greater need for flexibility to provide a full range of digital rates within any of the system capacities defined in SP-GEN, or the alternate proposed in section 2.5.4.

The future challenge in microwave will be to develop new ways to designate frequency bands such that all systems, from 64 kbit/sec to 156 Mbits/sec and above, have access to the radio spectrum and the available spectrum is used in the most efficient manner. Some options which may address this challenge are as follows:

Option 1. **Provide a greater number of system capacities** as shown below:

System Capacity Level	Digital (Mbits/sec)		
1		Less than	DS-0
2	> DS-0	≤	DS-1
3	> DS-1	≤	DS-2
4	> DS-2	≤	2DS-2
5	> 2DS-2	≤	4DS-2
6	> 4DS-2	≤	DS-3
7	≥ DS-3	≤	STS-1
8	> STS-1	≤	2DS-3
9	> 2DS-3	≤	STM-1
10	> STM-1		

The narrower range of digital rates would permit more precise designations of bands to equipment of common capacity and consequently common transmission characteristics. This may improve the coordination efficiency between systems operating in the same area. Furthermore it is possible to assign incrementally higher data rates in existing channels. This may be very useful in areas of moderate to high congestion.

Option 2. **Restrict the digital rates of the current system capacities where congestion levels or other conditions warrant this measure.** For example a medium capacity band which is expected to be heavily used may be restricted to systems of DS-3 rates and above in moderate to highly congested areas, as defined by the Geographical Difference Policy.

Option 3. **Replace the system capacity designation with a minimum spectral efficiency.** The digital rates within a band could be controlled by the available channel bandwidth and the minimum bit rate per Hz of RF channel bandwidth. Equipment of higher data rates tend to be more spectrally efficient due to the economics and available channel bandwidth factors.

In areas of moderate to high congestion the minimum spectral efficiency could be raised to accommodate a greater number of systems. Alternately, in these areas the channel bandwidth could be reduced with a corresponding increase in the minimum spectral efficiency.

Option 4. Minimum band capacity to establish a total transmission objective capacity for each band

A minimum band capacity could be designated to each fixed service band, with the intention of specifying an overall traffic level. The minimum band capacity concept would be used as guidance for assessing the availability of suitable spectrum, the development of channelling arrangements and other technical standards.

The minimum band capacity is given as "a minimum of N DS-n transmission streams or equivalent capacity." Of concern to respondents to the policy proposals are the values of N and n, which will decide the band capacity. A proposal for each relevant band is shown in Table 4.

Of course, practical considerations arising from system design, coordination, guardbands, etc. will result in less than the stated band capacity at real sites, in the same way that all RF channels are not available at all sites. The minimum band capacity will encourage greater use of a band, by establishing a trade-off between such things as guardband size against efficiency. The proposals in some bands include provisions for moderately and highly congested areas by stating different band capacities in such areas.

Table 4 Proposed Minimum Band Capacities for The Fixed Service

Band/Channel Capacity	Minimum Transmission Stream Equivalents
1700-1870 MHz LC	170 DS-1
1700-1870 MHz LC	340 DS-1 in highly congested areas and new systems in moderately congested areas
2025-2110/2200-2290 MHz MC	16 DS-3
2290-2314/2398-2422 MHz MC	48 DS-1
2290-2314/2398-2422 MHz MC	96 DS-1 in highly congested areas and new systems in moderately congested areas
2500-2596/2566-2596 MHz LC MCS	5 DS-2
2500-2596/2566-2596 MHz LC MCS	10 DS-2 in highly congested areas
3500-4200 MHz HC	64 DS-3
3500-3700 MHz MC	12 DS-3
4545-4705/4735-4895 MHz HC	30 DS-3
U4 GHz splinter bands LC	70 DS-1
5915-6425 MHz HC	48 DS-3
5850-5915 MHz LC	70 DS-1
5850-5915 MHz	4 DS-3
6425-6930 MHz MC/HC	48 DS-3
7300-7450/7575-7725 MHz MC/HC	20 DS-3
7125-7250/7450-7575 MHz LC	160 DS-1
7725-7975/8025-8275 MHz MC/HC	42 DS-3
10.7-11.7 GHz MC/HC	44 DS-3
14.5-15.075/15.175-15.35 GHz LC/MC	240 DS-1
17.7-18.14/19.26-19.7 GHz LC/MC/HC	20 DS-3
18.58-19.26 GHz LC MCS	440 DS-1
18.14-18.58 GHz MCS (LC) (which includes video, voice and data)	68 DS-2
21.2-23.6 GHz LC/MC/HC	1500 DS-1

3.3 . . . . . Cross-section size

In some bands, a given user is proposed to be limited to the use of only a portion of the band. This limit is specified in MHz. In these bands, it is a requirement that more than one user has access to the band. The intent is to specify the total bandwidth assigned for use between two sites.

For example, the proposed limit on "cross-section size" in 1700-1870 MHz is:

"3. a) any cross section shall not exceed 21 MHz in each direction, including protection channels;

b) for systems requiring four frequency plans, any system cross section shall not exceed 10.5 MHz in each direction, including protection channels."

In the example, item a) should make it possible to have at least four bidirectional users in a band each using up to a maximum of three 7 MHz wide RF channels, or six 3.5 MHz wide channels in each direction, including protection. If the users wish to use four frequency plans, item b) will still permit at least four such users in the band, but they would be limited to three 3.5 MHz channels. Should the total capacity requirement exceed the maximum cross-section size, a different band should be used to avoid a non-standard designation.

3.4 . . . . . General provisions

In each of the following bands, except where alternate provisions are explicitly made, the transition to the new policy will be subject to:

1. The 5 and 2 year rule as described in SP-GEN. In general, this means that existing systems not meeting the new requirement will have at least 5 years continued operation after the policy is issued. In the event the frequency is required for "standard" use, the user will be given notice two years before the equipment must be upgraded or removed from service;

2. Other proposed policies, eg., the Geographical Differences Policy.

3.5 Band-by-Band Proposals

3.5.1 1350-2690 MHz

The actual amount of spectrum, location and timing of the implementation of some of the new applications of radio in 1-3 GHz may not be fully determined for several years. However, planning can be based on existing projections of a the deployment of these future services.

In the 1-3 GHz bands, the future reduction in fixed spectrum suggests that the remaining spectrum be conserved for use by systems that cannot operate at higher frequencies. For each of the 2 GHz fixed point-to-point bands it is proposed that one-hop systems be at least 30 km in length and the majority of hops in a multihop system be 30 km.

In the lower and upper 2 GHz bands, sharing may be possible with the mobile service, so some existing systems may continue to operate without change, particularly in more remote areas.

1350-1400 MHz

There is no proposal for a spectrum utilization policy for the bands 1350-1400 MHz. The difficulty of sharing with in-band and adjacent band radar interference will limit their use to a case-by-case basis.

1427-1525 MHz
(The L-Band)

In 1427-1525 MHz (98 MHz) the long term outlook indicates that the band 1452-1492 MHz (40 MHz) will be fully used for terrestrial and satellite Digital Radio Broadcasting (DRB), and the band 1515-1525 MHz (10 MHz) will be used for MSS.

The reallocation of the band will significantly alter the existing SRS/MCS and LC Digital channel plan and supports the need to create a new plan. With this degree of change, it is appropriate to re-examine the fixed use of the band, since the remaining spectrum (48 MHz) appears inadequate to support LC and SRS/MCS uses. Short of creating another SRS/MCS band, it will be difficult to replace the 22 MHz lost to SRS/MCS in higher point-to-point radio bands. It may be possible to use other bands in some rural and remote areas (Geographical Differences Policy). Since LC Digital can be satisfied in several other bands, this band is proposed for SRS only. Until the deployment of DRB, it will be possible for existing fixed systems to continue to operate in certain areas. Urban MCS should use higher bands at 10 and 18 GHz.

Existing Policy	USA and CCIR
1427-1525 MHz VLC/LC/MC Analog VLC/LC Digital SRS, SRS Radio Entrance Links MCS (VLC Data/Voice) - VLC/LC/MC analog systems will make use of the RF channels now allocated to LC digital systems so as to not interfere with the existing SRS channelling plan - MCS is primarily urban and will not conflict with SRS - Frequency diversity is non-standard; 2 and 4 frequency plans are standard - SRS frequencies may be used for SRS entry links	CCIR: MCS f(channel) = 1530 - 0.5n MHz (Rec. 701) Point-to-Point: 1.5, 1.75, 2, 3, 3.5, 4 MHz (Rep. 379-5, Annex II) No US F use of this band, mobile telemetry in 1 MHz channel multiples in 1435-1535 MHz

Proposal

1427-1525 MHz
SRS

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations.

2. Existing fixed stations operating according to policies and standards in place in 1993 may continue to operate in accordance with criteria which will be established with other services using the 1452-1492 MHz and 1515-1525 MHz.

3. New SRS systems shall be limited to 1427-1452/1492-1517 MHz. Existing SRS systems may be retuned to these bands.

4. It should be noted that channels S8-S8' and S9-S9' in the existing 1427-1525 MHz channel plan are unaffected by the use of this band by other services.

1427-1525 MHz

1700-1900 MHz STL

The band 1700-1710 MHz was designated for aural broadcast STLs. It has been lightly used because of equipment availability, and the need to coordinate with tracking earth stations (which is more difficult than with GSO network earth stations) found in or near some metropolitan areas. It is proposed to expand the L2 GHz band down to 1700 MHz for the reason mentioned above, and to allow STL access to all of the L2 GHz band. This should provide broadcasters with more sources of equipment, and access to another band in locations where there are earth stations. Non-STL users are often removed from metropolitan areas.

The existing Lower 2 GHz (L2 GHz) band, 1710-1900 MHz, contains 190 MHz: a 45 MHz guardband and two 72.5 MHz bands of paired channels. The guardband is also channelled, but unpaired. If the recommended mobile option is selected (see 2.4.5 Option 1), any foreseeable implementation of mobile will be above 1870 MHz and 160 MHz would be left available to the fixed service. There are three alternatives:

- leave the existing channelling plan in place, retaining the residual of the existing channel plan, ie. 2 x 42.5 MHz,

- revise the channelling plan (1700-1765/1805-1870 MHz), for 130 MHz of channelled spectrum, with a reduced guardband (or more paired channels if the guardband can be reduced),

- modify the existing channelling plan by making it continuous from 1700 to 1870 MHz, with 170 MHz of channelled spectrum.

The final selection of a preferred option can be left to the development of the SRSP.

The Geographical Differences Policy is proposed to identify congested areas where it is self-evident that increased access to a band is required. Item 3 does this by requiring greater band throughput in congested areas, and also sets conditions to discourage but not necessarily prevent four frequency plans in these areas. The policy also allows less stringent conditions in uncongested areas. Item 8 uses this policy to "rejuvenate" the band.

Existing Policy	USA and CCIR
1700-1710 MHz STL (mono or stereo) - This is the preferred band for monaural and stereophonic AM and FM STL's 1710-1900 MHz VLC/LC/MC Analog VLC/LC Digital - Frequency diversity non-standard; 2 and 4 frequency plans standard - VLC (1-6 voice channels (vc) or equiv) might use sub-channels from existing plan for VLC/LC 6-60 vc or equiv, and geographic separation will be maintained with respect to systems of higher capacity	CCIR: MCS f(channel) = 1900 - 0.5n MHz (Rec. 701) Point-to-Point 14 MHz channels (Rec. 283-5) 29 MHz channels (Rec. 382-5) USA: Government fixed systems only if 1710-1850 MHz not available 1710-1850 MHz security surveillance: 1720-1800 MHz in 20 MHz channels, secondary basis 1850-1900 MHz 2.5 (10) MHz grid channels paired above 1900 MHz NPRM ETI 1850-1990 MHz CEPT: GSM 1700-1800/1805-1880 MHz APC 1800-1805 MHz DECT 1880-1900 MHz

Proposal

1700-1900 MHz LC

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations

2. The band 1700-1870 MHz shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2). This capacity can also be extended to the band 1870-1900 MHz, which may be subject to sharing conditions established for the use of the mobile service.

3. In highly congested areas, and for new systems in moderately congested areas; in the band 1700-1870 MHz:

   a) any system cross-section shall not exceed 21 MHz in each direction, including protection channels;

   b) for systems requiring four frequency plans, any system cross-section shall not exceed 10.5 MHz in each direction, including protection channels;

   c) the band shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2);

   d) systems carrying one DS-3 stream or greater per channel will be authorized only as an upgrade to a previously operating channel carrying at least one DS-2 stream.

4. In uncongested rural and remote areas, SRS may be authorized in accordance with the (proposed) Geographical Differences Policy taking into account non-fixed uses of parts of the band which may have a higher priority.

5. Studio to Transmitter Links (STLs) for aural broadcasting using digital techniques will be considered as LC systems.

6. New one-hop systems less than 30 km in length are non-standard unless it can be shown that higher bands are not usable for the specific application because of propagation outages.

7. The length of the majority of hops in a multihop system should be greater than 30 km.

8. Subject to sharing conditions with the mobile service in the band 1870-1900 MHz, existing systems may continue to operate on a standard basis, except those in moderately or highly congested areas not meeting the policies and standards which were in place in 1993. Such systems will be subject to the (proposed) Geographical Differences Policy.

9. In the band 1700-1710 MHz, fixed stations are required to coordinate with existing and future earth stations in the meteorological-satellite service which either receive from GSO space stations or track low earth orbit earth stations.

1900-2290 MHz (The Upper 2 GHz Band)

Because of the unlikely sharing between high density mobile systems and space services, the bands 2025-2110 MHz and 2200-2290 MHz, a total of 175 MHz, are foreseen to remain available for a new fixed channelling plan in all geographic locations.

The existing Upper 2 GHz band (U2 GHz), 1900-2290 MHz, is 390 MHz wide. Of this, 348 MHz is channelled in 29 MHz go and return channels. A guardband accounts for the remaining 42 MHz, approximately 2080-2120 MHz, and although not channelled, is used. In the long term (15-30 years) and in congested areas, it is not unreasonable to assume that all of 1900-2025 MHz and 2110-2200 MHz will be needed for mobile or mobile-satellite use (ie. a total of 215 MHz). Even in the medium term, ie. 5-10 years, the exact mobile spectrum use for emerging technologies is difficult to predict, however, it is reasonable to assume that fixed service use of any part of 1900-2025 MHz and 2110-2200 MHz could be subject to displacement in this time frame. Nonetheless, some portions of these latter bands should remain available for fixed in less densely populated areas in the long term.

Other than items 8. and 9. the proposals in this band are similar to those for 1700-1900 MHz. Items 8. and 9. are proposed for the clearing of the "core" bands to enable the entry of new systems into the band and to allow retuning of existing systems.

With regards to 5., the sharing between fixed and mobile is discussed in detail in the *1-3 GHz Allocations* document.

Existing Policy	USA and CCIR
1900-2290 MHz HC Analog MC Digital Wideband Radar Conveyance - 2 frequency plans standard for digital; 2 and 4 for analog - Analog and digital share same channel plan - Carriage of wideband (29 MHz) radar on case by case basis	CCIR: MCS f (channel) = 2300 - 0.5n MHz f (channel) = 2100 - 0.5n MHz (Rec. 701) Point-to-Point 14 MHz channels (Rec. 283-5) 29 MHz channels (Rec. 382-5) USA: 1850-1990 MHz: 10 MHz channelling plan for F 1990-2110 MHz: 7 x 17 MHz channelling for BC Aux 2110-2200: 2 x 20 MHz of 800 kHz & 3.5 MHz channels 10 MHz for BC Aux/P Opl F NPRM ETI 1850-1990 MHz CEPT: FPLMTS throughout 1900-2025/2110-2200 MHz

Proposal

1900-2290 MHz MC

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations.

2. The bands 2025-2110 MHz and 2200-2290 MHz shall together achieve a transmission capacity of (according to one of the four options outlined in section 3.2). This capacity can be extended to the bands 1900-2025/2110-2200 MHz, subject to sharing conditions which may be established for the use of the mobile and mobile-satellite services.

3. The inequality in the number of go and return channels shall not exceed 25% of the total.

4. In moderately or highly congested areas; in the band 2025-2110/2200-2290 MHz:

a) any system cross-section shall not exceed 30 MHz in each direction, including protection channels;

b) four frequency plans shall not be authorized.

c) Systems carrying three DS-3 streams or greater per channel will be authorized only as an upgrade to a previously operating channel carrying at least one DS-3 stream.

4. In uncongested rural and remote areas, SRS may be authorized in accordance with the (proposed) Geographical Differences Policy in the bands 1900-2025/2110-2200 MHz, taking into account non-fixed uses of the band which may have a higher priority.

5. Fixed systems may be required to coordinate with PCS systems near metropolitan areas, major highways and other specified areas. Typically, fixed systems pointing towards these areas may need a separation distance of 120 km, reducing to 10 km if pointing in the opposite direction. Fixed systems, a) in these areas, or b) likely to cause or receive interference, should attempt to use the bands 2025-2110 MHz and 2200-2290 MHz.

6. New one-hop systems less than 30 km in length are non-standard unless it can be shown that higher bands are not usable for the specific application because of propagation outages.

7. In this band, the length of the majority of hops in a multihop system should be greater than 30 km.

8. Existing systems in 2025-2110/2200-2290 MHz will be subject to the (proposed) Geographical Differences Policy. For this band, a system will be considered 15 years old if the site, tower, antennas and RF equipment have been in use for 15 years.

9. No new 29 MHz channel systems may be installed in moderately or heavily congested areas after 1 January 1994.

2290-2500 MHz

The most recent issue of SP 2290 gave the fixed service a lower status than RDSS in this band. WARC-92 retained F, MSS and RDSS on a primary basis. Subject to changes to the Canadian Table of Frequency Allocations (see the related document, *1 to 3 GHz Allocations*), RDSS will be removed from the Table, and the fixed service use of the sub-band may become secondary to the MSS at a future date.

It may be required to remove TV Pick-ups (a fixed service) from 2483.5-2500 MHz when the MSS allocation is used. However, the increasing difficulty of using the 2400-2500 MHz band because of ISM and unlicensed devices (see footnote C AAW in the Canadian Table) and the increasing use of TV Pick-ups results in a proposal to make greater accommodation for them in the next higher band. The dynamic nature of electronic news gathering will mean that in this band and others, TV Pick-up frequencies will require on-site frequency coordination. In some areas, a frequency may not be available for TV Pick-up, because of other fixed or other service use.

The current spectrum policy for this band makes more than the 2350-2390 MHz band available for mobile telemetry, however, it appears the geographical constraints in the existing policy are too limiting, and access to more spectrum is proposed. The expansion of the unshared telemetry band by 16 MHz is made in conjunction with the reduction and separation of the point-to point and MCS bands. There are two reasons for this separation:

- o area licensing of SRS is being proposed, which will make detailed frequency coordination with point-to-point systems more difficult;
- o there is an increased need for LC systems as a result of changes at L-band and L2 GHz.

The second factor also leads to a proposal to increase the point-to-point band traffic capacity in congested areas, as well as the use of the SRS band for point-to-point in congested areas where SRS is not likely needed. These increases offset any reduction in point-to point spectrum. In uncongested remote areas, SRS can expand into the point-to-point bands through the proposed Geographical Differences Policy (see 2.6.2), here and in the 1900-2290 MHz band.

Existing Policy	USA and CCIR
2290-2350/2390-2450 MHz VLC/LC Analog and Digital MCS (VLC Data/Voice) 2350-2390 MHz Mobile Telemetry 2450-2500 MHz TV Pickups and Temporary TV Links - Use of 2332-2350 by fixed within 333 km of Suffield, Tracadie and Gagetown only if 2290-2332 not available. Mobile telemetry may use 2332-2350 on a non-interference basis - Existing in-plant video non-standard in 2400-2500 MHz - TV Pick-ups to use above 10 GHz wherever possible - In 2400-2500 MHz, radio services must accept harmful interference from ISM. Might be used for primary power to SHARP - existing high power radars in 2310-2500 MHz	Fixed Use CCIR: MCS 2100-2300 MHz f (channel) = 2300 - 0.5n MHz 2300-2500 MHz f (channel) = 2500 - 0.5n MHz Point-to-Point 1, 2, 4, 14, 28 MHz (Rep. 1055-1, Annex IV) USA: No fixed plan in 2290-2450 MHz DOC and FCC channel widths and locations for 2450-2690 MHz already match

Proposal

2290-2314/2398-2422 MHz LC 2314-2342/2422-2450 MHz SRS 2342-2398 MHz Telemetry

2450-2500 MHz TV Pick-up

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations.

2. The bands 2290-2314 MHz and 2398-2422 MHz shall together achieve a transmission capacity of (according to one of the four options outlined in section 3.2). In highly congested areas, and for new systems in moderately congested areas, the band pair shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2). In addition:

a) any system cross-section shall not exceed 12 MHz in each direction, including protection channels;

b) four frequency plans shall not be authorized;

c) systems carrying one DS-3 stream or greater per channel will be authorized only as an upgrade to a previously operating channel carrying at least one DS-2 stream.

3. In highly congested areas, the band 2314-2342/2422-2450 MHz can be used as an extension to the band 2290-2314/2398-2422 MHz for point-to-point systems, under the conditions specified in 2. above

4. One-hop LC systems less than 30 km in length are non-standard unless it can be shown that higher bands are not usable for the specific application because of propagation outages.

5. The length of the majority of hops in a multihop system should be greater than 30 km.

6. Assignments may be made on a case-by-case basis to aeronautical telemetry in uncongested areas in the band 2290-2314 and 2398-2422 MHz on a permanent basis.

7. Existing systems may continue to operate subject to the (proposed) Geographical Differences Policy.

2290-2500 MHz

2500-2596 MHz

This band is lightly used for ITV systems, and was considered for, but rejected as an expansion to the 2596-2686 MHz MDS band. Existing TV Pick-up equipment is often tunable to this band, and it would be a valuable addition for the broadcasting community. It is proposed that pre-assigned channels not be used, as this might result in non-tunable equipment and unnecessary frequency conflicts.

The band is now designed for one-way 6 MHz MCS video transmission. The proposal also attempts to broaden this to include one or two way analog or digital video, or data. This may provide a unique opportunity to develop a new radio application for a world market.

Existing Policy	USA and CCIR
2500-2596 MHz limited to 16 Fixed MCS channels - MCS-Video consists of a central radio station with one or two-way communication with two or more stations. Not a substitute for VHCM. Can be used for video-conferencing. ITV is a subset of MCS. - ITV is for instructional programming MCS for licensed educational institutional locations.	Fixed Use CCIR: MCS f(channel) = 2690 - 0.5n MHz (Rec. 701) Point-to-Point 2500-2700 MHz 14 MHz channels (Rec. 283-5) USA: 6 MHz RF channelling plan

Proposal

2500-2530MHz and 2566-2596 MHz
MCS(LC)

2500-2596 MHz
LC and TV Pick-ups

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations.

2. The bands 2500-2530 MHz and 2566-2596 MHz shall each achieve a transmission capacity of (according to one of the four options outlined in section 3.2), and a minimum capacity of (see section 3.2 for options) in highly congested areas.

3. TV Pickup use of the band 2500-2596 MHz is on a temporary, per-event coordination basis, but LC or MCS use has priority.

4. Analog MCS systems (eg. video) may operate on MCS (LC) channels.

5. Existing analog systems may continue to operate on a standard basis.

2500-2596 MHz

2686-2690 MHz

Existing Policy	USA and CCIR
VLC Analog, Digital - One-way paging fixed links	See previous band for CCIR USA: MCS return links
Proposal	
No Policy	

2686-2690 MHz

3.5.2 . . . . . 3500-8500 MHz

Some bands in this region of the spectrum support major networks which consist of the combination of very long, wide-bandwidth, large cross-section, highly reliable and spectrum-efficient systems, particularly necessary for the growing demand for SDH compatible radio systems which will complement fibre optic networks. This region of the spectrum will continue to meet this need much better than lower or higher bands. On the other hand, the new services allocated in the 1-3 GHz bands will place additional demand on this range of frequencies for "smaller" fixed systems. It can be expected that the growth of both types of systems will continue in the event of relaxed microwave licensing policies (see 2.6.11).

Major telecommunications networks are encouraged to therefore concentrate their use of spectrum to as few bands (preferably one) as possible (see 2.6.5). Minimum traffic carriage requirements are placed in the preferred bands to ensure that sufficient spectrum remains available for future use by large networks, to the extent possible. Over the next 5-10 years, it should become clear if this need will continue. In some regions of the country it appears that fibre optic will become the preferred means for long-haul, heavy-route transmission.

At this time, there is no foreseen need for MCS systems in this frequency range. MCS is implicitly (by no mention) excluded from each of these bands to facilitate their use by point-to-point systems.

3500-4200 MHz

The adjacent band interference problem (item 8.) has caused the 3500-3700 MHz band to be more lightly used than the remainder. It is proposed to add MC to this band as an offset to the loss of MC in the 1-3 GHz range.

Items 4. and 5. are intended to maintain the existing type of HC use of this band in the future.

Existing Policy	USA and CCIR
HC Digital VHC Analog - With phasing out of analog, band will be re-structured for digital - 2 frequency plans are standard	CCIR MCS 3400-3800 MHz (Rec. 635-1) f(channel) = 4200 - 10n MHz, or f(channel) = 4195 - 10n MHz (interleaved channels) Point-to-point 3600-4200 MHz: 10, 40, 60, 80, 90 MHz channels (Rec. 635). 3580-4200 MHz: 40 MHz channels (Rep. 934-2). 3700-4200 MHz: 20 MHz channels (Rep. 934-2). 3800-4200 MHz: 29 MHz channels (Rec. 382).

Proposal

3500-3700 MHz MC (minimum 1 DS-3)
3500-4200 MHz HC

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations.

2. The HC use of the band 3500-4200 MHz shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2).

3. The MC use of the band 3500-3700 MHz shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2).

4. New HC systems in the band 3500-4200 MHz must have a minimum traffic capacity of 3 DS-3 and also justify a growth to at least 9 DS-3. The inequality in the number of go and return channels shall not exceed 25% of the total number of go and return channels.

5. Any HC system cross-section may use and begin growth in 3500-3700 MHz only after justifying that the full use of 3700-4200/4545-4705/4735-4895 MHz is required.

6. No new analog assignments; existing analog channels now carrying video may continue to operate only until the existing traffic is converted to digital.

7. This band is shared with receiving earth stations in the fixed-satellite service, some of which may be unlicensed.

8. Emissions from radars operating below 3500 MHz may cause interference in the lower parts of this band in some coastal areas.

3500-4200 MHz

4400-5000 MHz

The existing policy and channelling for this band has left several band fragments that can be used to support the smaller capacity systems in locations where lower frequency band alternatives are not available. The limitation in the Government bands to troposcatter is no longer required.

Existing Policy	USA and CCIR
4540-4900 MHz HC Digital 4460-4540/4900-4990 MHz Government of Canada - Fixed use in Government bands limited to troposcatter	CCIR 4400-5000 MHz (9B/TEMP/35) f(channel) = 5000 - 10n MHz, or f(channel) = 4995 - 10n MHz (interleaved channels) 10, 40, 60 MHz channels. 4540-4900 MHz 20, 40 MHz channels (9B/TEMP/35) US Government tropo and mobile band

Proposal

4545-4705/4735-4895 MHz HC 4460-4540/4900-4990 MHz Government of Canada (Fixed and Mobile)

4400-4460 MHz, 4705-4735 MHz, 4540-4545 MHz, 4895-4900 MHz and 4990-5000 MHz LC

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations.

2. The HC use of the band 4545-4705/4735-4895 MHz shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2).

3. The LC use of the splinter bands shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2)

4. New HC systems in this band must have a minimum traffic capacity of 6 DS-3 and also justify a growth to at least 12 DS-3. The inequality in the number of go and return channels shall not exceed 25% of the total number of go and return channels.

5. The HC use of this band is limited to digital.

6. Emissions from airborne radar altimeters operating below 4400 MHz may cause interference in the lower parts of this band.

4400-5000 MHz

5850-6425 MHz This band shares many of the characteristics of the 4 GHz bands. Since the last revision of the SP for this band, a Technical Guideline has been published for the 5850-5915 MHz band, as reflected here. ISM use of 5275-5875 MHz may be an issue (see 2.6.7).

Existing Policy	USA and CCIR
5850-5915 MHz VLC/LC Analog/Digital 5915-6425 MHz HC/VHC Analog HC Digital - Analog and digital share channel plan in 5915-6425 MHz - in 5915-6425 MHz 2 frequency plans are standard	CCIR 5850-6425 MHz Channels: 60, 80, 90 MHz (Rec. 383-4/Annex 1). 5925-6425 MHz Channels: 29.65 MHz (Rec. 383-4). USA 10, 29.65 MHz channels

Proposal

5850-5915 MHz LC/MC 5915-6425 MHz HC

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations.

2. The HC use of the band 5915-6425 MHz shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2). This capacity by a specific system can be extended to the band 6425-6930 MHz on a case by case basis, if it can be justified, and subject to coordination with existing systems.

3. The LC use of the band 5850-5915 MHz shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2). This band may also be used for systems carrying less than 1 DS-1.

4. The MC use of the band 5850-5915 MHz shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2). and is limited to spurs from systems operating in 5915-6425 MHz.

5. New HC systems in the 5915-6425 MHz band must justify a growth to at least 9 DS-3. The inequality in the number of go and return channels shall not exceed 25% of the total number of go and return channels.

6. HC systems may use and begin growth in 6425-6930 MHz only after justifying that the use of 5915-6425 MHz alone is not sufficient.

7. No new analog assignments; existing analog channels now carrying video may continue to operate only until the existing traffic is converted to digital.

6425-6930 MHz

Except for provisions for very large systems (item 5) this band will support MC and HC, from 1 to 3 DS-3's. The STL band is included, and existing systems are grandfathered. Future digital systems will have access to the whole band. Note the limit of the use of STL to 4 channel-hops: larger video systems have a separate band at 8 GHz.

Existing Policy	USA and CCIR
6425-6590/6770-6930 MHz HC/VHC Analog MC/HC Digital (See next band proposal for existing policy in 6590-6770 MHz) - Analog and digital share same channels in existing plan - 2 frequency plan standard	CCIR 6425-7110 MHz Channels: 40, 20 MHz (Rec. 384-5) USA 6425-6925 MHz, 29.65 MHz channels 6525-6875 MHz, 10 MHz channels B Aux 6425-7125 MHz

Proposal

6425-6930 MHz MC (Minimum 1 DS-3)/HC

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations.

2. The MC/HC use of the band 6425-6930 MHz shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2). This capacity by a specific system may be an expansion to the band 5915-6425 MHz on a case by case basis, if it can be justified, and subject to coordination with existing systems in this band.

3. This band may also be used for digital STL's, which are limited to a maximum of 4 channel-hops.

4. HC systems in this band which are not expansions of systems in 5915-6425 MHz are limited to 1 go and 1 return channel.

5. HC systems which are expansions of systems in 5915-6425 MHz may use 6425-6930 MHz under the conditions established for 5915-6425 MHz, but only after justifying that the use of 5915-6425 MHz alone is not sufficient.

6. No new analog assignments; existing analog channels now carrying video may continue to operate. Existing STL's may continue to operate.

6930-7125 MHz

The increasing number of mobile TV production units and the roaming nature of TV Pick-ups no longer supports the pre-assignment or allotment of spectrum in 6930-7125 MHz. Switch-tunable equipment makes channel selection and coordination possible by the users on location. Frequency assignments in the band 6590-6770 MHz can be determined and coordinated as required on a per-event basis.

Existing Policy	USA and CCIR
6590-6770 MHz TV STL 6930-7125 TV Pickups and Temporary TV Links - existing licensing arrangements in SRSP in 6930-7125 MHz retained (ie. six out of ten 20 MHz wide channels in 6930-7130 MHz have been assigned to "prime users") - TV Pickups should use above 10 GHz wherever possible for camera to mobile and 2.5 GHz or this band for mobile studio to main studio. - STL's less than 16 km should use above 10 GHz or non-radio whenever possible. - EIRP limited to 47 dBW - carriage of AM/FM STLs as sub-carrier of TV STL is encouraged	CCIR 6425-7110 MHz Channels: 40, 20 MHz (Rec. 384-5) 7110-7750 MHz Channels: 28 MHz (Rec. 385, Annex 3, 9B/TEMP/36) USA 5925-6925 MHz 29.65 MHz channels 6525-6875 MHz 10 MHz channels

Proposal

6930-7125 MHz TV Pickups

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations.

2. Pre-allotted frequencies for specific users will no longer be identified in this band.

3. EIRP limited to 47 dBW

6930-7125 MHz

7125-7250/ 7300-7725 MHz

Priority in this band has been given to microwave systems used in support of telemetry, protection and control. There has been relatively little new use of the band in recent years, and it is expected that most future systems will be digital. There has been a need stated to provide for higher capacities in this band. Providing access to non-telemetry, protection and control applications should result in more use and better availability of equipment. The use of frequency diversity for high reliability networks should not be required in ring-configured systems.

Existing Policy	USA and CCIR
7125-7250/7300-7725 MHz VLC(minimum 12 voice channels)/LC/MC/HC Analog LC/MC Digital - Frequency diversity and two frequency plans are subject to conditions in SRSP and Statement of Interpretation of 7 November 1978 - TV carriage is non-standard - Assignments in this band will be made primarily, but not exclusively to systems serving the telemetry, control and protection purpose.	CCIR 7110-7750 MHz Channels: 28 MHz (Rec. 385, Annex 3, 9B/TEMP/36) 7425-7725 MHz Channels: 7, 28 MHz (Rec. 385, Annex 1, 9B/TEMP/36). 7435-7750 MHz Channels: 5 MHz (Rec. 385, Annex 2, 9B/TEMP/36). 7425-7900 MHz Channels: 7, 14, 28 MHz (Rec. 385, Annex 4, 9B/TEMP/36). USA 7125-8500 MHz 20, 30 MHz channels

Proposal

7125-7250/7450-7575 MHz LC 7300-7450/7575-7725 MHz MC/HC

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations.

2. Existing systems are grandfathered, may continue to operate, expand and be modified according to SRSP 307.1 Issue 3

3. No new analog systems

4. In moderately and highly congested areas, new systems shall not employ four frequency plans or frequency diversity.

5. The MC/HC use of the band 7300-7450/7575-7725 MHz shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2).

6. The LC use of the 7125-7250/7450-7575 MHz shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2). These bands may also be used for systems carrying less than 1 DS-1.

7. Assignments in this band will be made primarily to systems carrying telemetry, control and protection circuits, however, other uses may be justified on a case by case basis. This justification includes the unavailability of alternative bands.

7125-7250/7300-7725 MHz

7725-7975/ 8025-8275 MHz

The recent use of this band has been very low. The addition of MC may generate new interest in its use. There is no minimum number of channels required for the use of this band.

Existing Policy	USA and CCIR
7725-7975/8025-8275 MHz HC Digital - 2 frequency plan standard	CCIR 7110-7750 MHz Channels: 28 MHz (Rec. 385, Annex 3, 9B/TEMP/36) 7435-7750 MHz Channels: 5 MHz (Rec. 385, Annex 2, 9B/TEMP/36). 7425-7900 MHz Channels: 7, 14, 28 MHz (Rec. 385, Annex 4, 9B/TEMP/36). 7725-8275 MHz: Channels: 29.65, 40.74 MHz (Rec. 386, Annex 1, Annex 2) 8200-8500 MHz: Channels: 11.662 MHz (Rec. 386). USA 7125-8500 MHz 20, 30 MHz channels

Proposal

7725-7975/8025-8275 MHz MC/HC

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations.

2. The MC/HC use of the band 7725-7975/8025-8275 MHz shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2).

7725-7975/8025-8275 MHz

8275-8500 MHz The continued use of this band for multi-hop video is foreseen The broadening of this band to other video applications should increase spectrum flexibility.

Existing Policy	USA and CCIR
8275-8500 MHz Multi-Hop Video - one-hop systems are non-standard unless they are in support of CATV and a spur from a system operating in another band - wideband radar (max 37.5 MHz bandwidth) on case-by-case basis - digital video if RF bandwidth < 18.75 MHz	CCIR 8275-8500 MHz: Channels: 7, 14 MHz, (Rec. 386, Annex 3) 8200-8500 MHz: Channels: 11.662 MHz (Rec. 386). USA 7125-8500 MHz 20, 30 MHz channels

Proposal

7125-8500 MHz LC (Video)/MC (Video)

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations.

2. Existing analog systems may continue to operate and expand

8275-8500 MHz

3.5.3 . . . . . 10.5-23.6 GHz

Excluding frequency assignments to VHCM systems, only 8% of all fixed assignments in Canada are above 10 GHz. One reason for this pattern of low usage is our widely distributed population which favours the use of lower frequency, longer path bands, instead of the higher frequency, shorter path bands. The loss of lower bands by the fixed service is relatively important to Canada. To alleviate this, short path length systems should be concentrated in the higher bands so the lower bands are available for longer paths where necessary.

Excluding VHCM, 17 European countries have only about 50% more assignments between 3 and 10 GHz than between 10 and 23 GHz. In Canada, there are about 12 times more assignments below 10 GHz, than above. This shows great potential for growth above 10 GHz.

10.5-10.68 GHz

This band will provide metropolitan area services

Existing Policy	USA and CCIR
10.5-10.68 GHz VLC/LC Analog/Digital MCS (VLC Data/Voice) - separate groups of channels will be assigned for VLC/LC and MCS according to local demand - 2 frequency plans are standard	CCIR 10.5-10.68 GHz Channels: 2 MHz (9B/TEMP/34, Annex 4) 10.38-10.45 GHz/10.58-10.65 GHz Channels: 5 MHz 10.5-10.68 GHz Channels: 3.5, 7 MHz (Rec. 747, Annex 1) 10.55-10.68 GHz Channels: 1.25, 2.5, 5 MHz (Rec. 747, Annex 2).
Proposal	
10.5-10.68 GHz LC/MCS(LC) 1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations. 2. Sub DS-1 service may be provided 3. There is possible interference from low power speed measuring devices operating at 10.525 GHz.	

10.5-10.68 GHz

10.7-11.7 GHz

The FSS use of this band in ITU Region 2 is in the space-to-Earth direction. MSAT feeder links are planned to use most of 10.7-10.95 GHz. WARC-92 reallocated the band 13.75-14 GHz for the FSS, which will most likely be paired with 11.45-11.7 GHz. Unlike MSAT, there are no specific plans at this time for the expansion of ANIK into this band. Prior to WARC-92, it was believed that fixed users should avoid 10.7-10.95 GHz for as long as possible to avoid FSS conflicts. In the long term this may not be a feasible approach, since the aforementioned FSS uses overlap parts of the most likely fixed service channelling pairs.

Existing Policy	USA and CCIR
10.7-11.7 GHz MC/HC Digital - HC must carry balanced two-way traffic - MC subject to availability of channels in SRSP - Existing analog systems are grandfathered, but any changes make them non-standard - Users must demonstrate use of higher band not practical on basis of hop length and reliability - MSS feeder links in 10.7-10.95 GHz within specific sub-bands (although not specified, the sub-bands for MSAT (space-to-Earth) feeder links are within the 10.7-10.95 GHz part of the WARC-ORB allotment plan)	CCIR 10.7-11.7 GHz Channel BW (MHz) CCIR Rec 40 387, Annexes 1 and 2 67 387, Annex 3 60, 60, 67 387, Annex 4 USA 20, 40 MHz channels

Proposal

10.7-11.7 GHz MC/HC

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations.

2. The MC/HC use of the band 10.7-11.7 GHz shall support a minimum capacity of (see section 3.2 for options).

3. The first use of the FSS in this band is foreseen in 10.7-10.95 and 11.45-11.7 GHz

4. No new analog systems.

12.7-13.25 GHz

This band is capable of delivering a large number of video channels in a point-to-point or multipoint configuration. It fulfils an important CATV distribution need between cable networks and between different parts of a cable network by eliminating the many repeating amplifiers that would be needed in an all-cable system.

Significant changes are taking place in CATV system architecture with the introduction of fibre optic transmission. Digital video compression will increase CATV system capacity. The Canadian cable industry has outlined an aggressive plan to improve their competitive position through the use of new technologies. Before the end of the century, the effects of these technologies on this band should be clear. Until then, VHCM remains an essential multipoint transport mechanism for CATV program signals. Providing the primary role of program signal transport is protected, there are many other uses possible by CATV operators.

Existing Policy	USA and CCIR
12.7-13.2 GHz VHCM 13.15-13.25 GHz TV Pick-up 13.0-13.15/13.2-13.25 GHz MSS Feeder Links - MSS feeder links (E-s) in specific sub-bands within 13-13.5 GHz and 13.2-13.25 GHz, which shall not prevent the VHCM use of these frequencies by existing or formally proposed stations - TV Pick-ups in 13.15-13.25 GHz =< 45 dBW EIRP. In 13.2-13.25 they may not claim protection from harmful interference from feeder links - In 13.15-13.2 GHz TV Pick-ups may operate on a case by case and on non-interference basis (NIB) with respect to VHCM. - Users of new or existing systems are required to undertake reasonable and appropriate measures to modify their stations so as to permit other standard uses of the band.	CCIR 12.75-13.25 GHz Channel BW (MHz) CCIR Rec 28, 7, 3.5 497 35 497, Annex 1 12.7-13.25 GHz 25, 12.5 497 Annex 5, (1) USA 6, 12.5, 25 MHz channels B Aux 12.7-13.6 GHz

Proposal

12.7-13.25 GHz VHCM, TV STL, TV Pick-up, and any other video applications

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations.

2. The first use of the FSS in this band is foreseen in 13-13.15 and 13.2-13.25 GHz for MSS (MSAT) feeder links.

3. The use of this band by the FSS or by any other video systems shall not prevent the use of these frequencies by existing or formally proposed stations used by VHCM in conjunction with CATV systems, except as otherwise agreed.

4. TV Pick-ups shall not exceed an EIRP of 45 dB(W/m^2)

12.7-13.25 GHz

14.5-15.35 GHz

The whole of the band 14.5-15.35 GHz is under-utilized, possibly because of a lack of affordable and readily available equipment. Although the sub-band 15.075-15.175 GHz is proposed to continue to be designated for TV Pick-up, greater accessibility might be gained for all fixed users if the band is made available for lower capacities at low spectral efficiencies. This would permit manufacturers and suppliers the opportunity to provide equipment that can satisfy many types of demand. This could be an important alternative to the 18 GHz band. Comments are invited.

Existing Policy	USA and CCIR
14.5-15.075/15.175-15.35 GHz Video/Data/Voice 15.075-15.175 GHz TV Pick-up, Temporary TV Link - V/D/V bands may be used for point-to-point or multipoint systems - TV PU and TTVL may be licensed on a per-system basis, but must coordinate at the scene of event - Existing VHCM systems and growth are standard, new VHCM systems are non-standard	CCIR 14.4-15.35 GHz 3.5, 7, 28 MHz channels 2.5 MHz pattern USA (NTIA) 14.5-14.7145/15.1365-15.35 GHz 2.5, 3.5 MHz channels

Proposal

14.5-15.075/15.175-15.35 GHz LC/MC
15.075-15.175 GHz TV Pick-up

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations.

2. The LC/MC use of the 14.5-15.075/15.175-15.35 GHz band shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2). These bands may also be used for systems carrying less than 1 DS-1.

3. Existing VHCM systems and growth are standard, new VHCM systems are non-standard

4. It should be noted that the band 14.7145-15.1365 is used by aeronautical mobile in the USA, which can be difficult to coordinate.

14.5-15.35 GHz

17.7-19.7 GHz

17.7-18.14/ 19.26-19.7 GHz — This band does not appear to need any major changes, although a provision is made (item 5) for the future potential use of 17.7-17.8 GHz by the broadcasting-satellite service.

18.14-18.58 GHz — This band could be put to similar uses as the VHCM band 12.7-13.2 GHz. However, the introduction of digital video compression in the near future would seem to favour expansion within the 12 GHz band, rather than construction of overlay networks at 18 GHz. Note should be taken of the potential sharing of 18.1-18.4 GHz band with BSS feeder links. A variety of video and other traffic applications under the more general MCS designation may prove more useful for this band.

18.58-19.26 GHz — This is similar to the 17.7-18.14/19.26-19.7 GHz except that the band is more suitable for lower capacities and lower spectral efficiencies. The future use of the band 18.58-19.26 GHz could involve sharing with stations which may be licensed on a site, area or a license exempt basis.

Existing Policy	USA and CCIR
17.7-17.8 GHz BSS Feeder Links 17.7-18.14/19.26-19.7 GHz LC/MC/HC Digital 18.58-19.26 GHz VLC/LC Digital MCS-Digital - VLC in 18.58-19.26 GHz may use 18.56-19.26 GHz if suitable channel plan in the SRSP - 17.7-17.8 GHz licensing deferred until Canadian BSS feeder link requirements are known or until a future policy review. Growth plans (F and FSS) are to take this into account. - 18.14-18.58 GHz is reserved. No licensing before a future review	CCIR 17.7-19.7 GHz Rec 595 220, 110, 55, 27.5 MHz 220, 80, 40, 20, 10, 6, 5 MHz Annex 2 13.75,20,110 MHz Annex 3 17.7-21.2 60 MHz Annex 1 USA similar to Canada

Proposal

17.7-18.14/19.26-19.7 GHz LC/MC/HC 18.58-19.26 GHz LC MCS
18.14-18.58 GHz MCS (LC)

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations.

2. The LC/MC/HC use of the 17.7-18.14/19.26-19.7 GHz band shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2).

3. The LC MCS use of the 18.58-19.26 GHz band shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2).

4. The MCS (LC) use (which includes video, voice and data) of the 18.14-18.58 GHz band shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2). As with other MCS applications, these may be bidirectional.

5. Users of the band 17.7-17.8 GHz will be able to operate until at least 1 April 2007. After that date such systems may be required to retune to other portions of the 17.7-18.14/19.26-19.7 GHz band.

21.2-23.6 GHz

Coordinated point-to-point TV Pick-ups are now possible on a case-by-case basis. Under such provisions, these links are treated the same as any other point-to-point application.

The lack of any restriction on point-to-point capacities has not caused any difficulty and has proven flexible. The deferral of licensing 21.2-21.8/22.4-23 GHz is no longer needed since WARC-92 removed the Region 2 allocation to BSS from this band.

Existing Policy	USA and CCIR
21.2-23.6 GHz Analog/Digital - 22.2-23 GHz also allocated to BSS and may be planned in early 1990's, resulting in a review. - Licensing in 21.2-21.8/22.4-23 GHz is deferred until SRSP issued, in order to keep a portion of band in lightly used state for future systems. 5. TV Pickups on case by case, but only for specific point to point links.	CCIR 21.2-23.6 GHz Rec 637 3.5, 2.5 MHz (patterns) 112, 8, 14, 7, 3.5 MHz (Annex 1) 28, 3.5 MHz (Annex 2) 28, 14, 7, 3.5 MHz (Annex 3) 50 MHz (Annex 4) 112 to 3.5 MHz (Annex 5)

Proposal

21.2-23.6 GHz LC/MC/HC

1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations.

2. The LC/MC/HC use of the 21.2-23.6 GHz band shall achieve a transmission capacity of (according to one of the four options outlined in section 3.2)

21.2-23.6 GHz

3.5.4 . . . 25.25 GHz and Above

There are no specific uses proposed for these bands, including MCS. This permits the greatest flexibility. Should a type of application arise that requires special attention and dedicated spectrum, the appropriate spectrum policy will be developed. It is suggested that such action be based on a specific system with clear evidence that there is a large unsatisfied demand that requires special protection. Otherwise the danger arises that a policy will be created for an application that does not materialize, and the band is unusable for other valid needs.

There are a number of uses proposed in the USA and Europe that respondents may be aware of and may bring forward and demonstrate a valid need for a specific supporting policy. Among conventional point-to-point and multipoint applications, these include micro-cell interconnection and wireless CATV. Arguments should be made also for the choice of band, noting there is very little use of most of the bands above 10 GHz, and in most cases user needs are better satisfied at lower frequencies.

Comments are invited on potential uses of these bands for public or private transmission systems, including the nature, scope and demand for such systems. Equally, comments are invited on the advantages or disadvantages of holding back on specific utilization proposals at this time.

25.25-29.5 GHz

Existing Policy	USA and CCIR
None	CCIR 25.25-29.5 GHz 2.5, 3.5 GHz patterns
Proposal	
1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations. (any fixed use - no specific utilization policy at this time)	

25.25-29.5 GHz

31-33 GHz

Existing Policy	USA and CCIR
None	CCIR 31-31.3 GHz 25, 50 MHz channels
Proposal	
1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations. (any fixed use - no specific utilization policy at this time)	

31-33 GHz

36-40 GHz

Existing Policy	USA and CCIR
None	CCIR 36-40.5 GHz 3.5, 2.5 MHz pattern 37-39.5 GHz 3.5, 7, 14, 28 MHz channels 38.6-40 GHz 50 MHz channels
Proposal	
1. For the relationship of the fixed service to other services sharing the band refer to the Table of Frequency Allocations. (any fixed use - no specific utilization policy at this time)	

36-40 GHz

3.6 Summary and Analysis of Utilization Proposals

The proposals represent some significant changes to the availability of spectrum for the fixed service. As noted in 3.2, several options are presented to specify transmission criteria in addition to RF channel capacity to express spectrum utilization. Option 4 is used in the following comparison of the "before" and "after" effects of these proposals. The "before" is the equivalent band capacity as calculated from the existing SRSP's. The "after" is the value of n x DS-N presented in option 4 for each band. This approach helps avoid the uncertainty associated with future channelling plan changes. It also reduces the ambiguity of comparisons in bands which share or overlap different RF channel capacities. In some bands, higher band capacities are proposed in congested areas: these are not reflected in these tables.

In Table 5, following, 100% means no change from the existing amount of spectrum available for the indicated capacity.

Table 5 - Band Capacities (MBit/s)
Existing/Proposed
Point-to-Point and Multipoint Excluding Broadcast-related Fixed

Band (GHz)	SRS/MCS	VLC	LC	MC	HC
1-3	135/106	235/0	520/432	532/716	
3-10			540/468	1927/5683	8943/11408
10-23.6		1290/0	2215/3540	2360/5618	3760/5168
Total	135/106	1525/0	3275/4440	4819/12017	12703/16576
% Change in Capacity	(79%)		135.6%	249%	130%

( ) - indicates a reduction in the amount of the indicated capacity

Tables 5.1, 5.4 and 5.3 present a more detailed breakdown. As shown in Table 5.1, the changes in the 1-3 GHz band present some losses to the SRS and LC users in most areas of Canada. However, the tables do not take into account increases that may be made in remote areas resulting from the Geographical Differences Policy or requirements for greater spectrum efficiency in congested areas. For example, the proposals in the L2 GHz band for highly congested areas would double the band capacity for LC. Although there is a significant loss of spectrum to MC in the U2 GHz band, it is more than made up for by requiring more from the remaining spectrum in both congested and uncongested areas.

Table 5.1 - 1 to 3 GHz

Band (MHz)	SRS[1]	VLC[2]	LC	MC
	Existing Band Capacity/Proposed Band Capacity (Mbits/s)			
1427-1525	70/50		84/0	
1710-1900		168/0	168/262	
1900-2290				532/716
2290-2450	63/56	72/0	72/74	
2500-2686			96/96[3]	
Totals	135/106	235/0	420/432	532/716
% Change in Capacity	(79%)		103%	135%

(1) SRS/MCS represent systems with sub-DS-1 capacities, so the values shown are calculated from the available bandwidth.

(2) VLC is not recognized in these proposals (see 2.5.4)

(3) In this band, a combination of point-to-point and multipoint is being proposed

In 3-10 GHz, as shown in Table 5.2, there is an increase to LC at 4 GHz, but an overall slight net loss to LC at 7 GHz as a result of increasing MC and HC access. The sizes of the increases to MC are somewhat misleading, as the majority of the increases are shared with HC, which uses spectrum at a faster rate than MC. The single most important proposal in this range is the possibility of making provisions for systems in the 6 GHz HC bands for systems capable of carrying OC-48, as is the 4 GHz band.

Table 5.2 - 3 to 10 GHz

Band (MHz)	VLC	LC	MC	HC
	Existing Band Capacity/Proposed Band Capacity (Mbits/s)			
3500-3700			0/549	720/720
3700-4200				2160/2160
4400-5000	[4]	0/108		1440/1440
5850-5915		110/110	180/180	
5915-6425				1423/2134
6425-6590/ 6770-6930			1280/2134[5]	1280/2134
7125-7250/ 7300-7725	[4]	430/250	467/900	0/900
7725-7975/ 8025-8275			0/1920	1920/1920
Totals		540/468	1927/5683	8943/11408
% Change in Capacity		(87%)	295%	127%

(4) VLC may be assigned on a case by case basis

(5) Includes 6590-6770 MHz

As shown in Table 5.3 for the 10-23.6 GHz range, most of the large increases are due to the increase of available spectrum in the 23 GHz band from 1.2 GHz to 2.4 GHz. Another significant change is the addition of MC to 10.7-11.7 GHz, but as before, it is shared with HC.

Table 5.3 - 10 to 23.6 GHz

Band (GHz)	VLC	LC	MC	HC
	Existing Band Capacity/Proposed Band Capacity (Mbits/s)			
10.5-10.68	90/0[4]	90/90		
10.7-11.7			0/1968	1760/1968
14.5-15.075/ 15.175-15.350	[4]	245/370	280/370	
17.7-18.14/ 19.26-19.7			880/880	800/800
18.58-18.82 18.92-19.16		480/480		
18.82-18.92/ 19.16-19.26		200/200		
20.2-23.6	1200/0	1200/2400	1200/2400	1200/2400
Totals	1290/0	2215/3540	2360/5618	3760/5168
% Change in Capacity		160%	338%	137%

4 Synopsis of Major Proposals

This document advances proposals for spectrum utilization for new and existing applications. It is reasonable to expect that the final decisions will vary as a result of public comment. Given this, the following conclusions may be drawn from this document.

1. Personal communications systems will be introduced into bands above 1870 MHz subject to conditions that will be determined in greater detail in a subsequent policy proceeding. The use of the FPLMTS standard is proposed as the target network for personal communications. It is acknowledged that there will be a need to introduce initial personal communication systems in parts of this frequency spectrum prior to the implementation of systems meeting the FPLMTS standard.

2. Experimentation for personal communication systems will be permitted in the 2 GHz range subject to successful coordination with existing systems of the fixed service.

3. Digital Radio Broadcasting (DRB) development will be supported in the band 1452-1492 MHz, and subject to allotment planning.

4. As DRB service approaches commercial reality, greater detail will be provided regarding the future fixed use of the band. Also, at that time, the potential impact of satellite DRB will be better known, and can be taken into account.

5. The fixed and mobile use of the bands 1515-1525 MHz, 1970-2010 MHz, 2160-2200 MHz and 2483.5-2500 MHz which are being proposed for use by the MSS, will also be subject to the outcome of future utilization policy deliberations on the mobile-satellite service. In general, the implementation of the MSS allocations at 2 GHz are preferred over other bands.

6. The implementation of the mobile-satellite service in the bands 1515-1525 MHz and an equivalent amount from the band 1675-1700 MHz is dependent on obtaining successful coordination with existing systems of other services.

7. Subject to possible minor adjustments in the frequency plans for the band to remove the overlap between point-to-point and multipoint services, the fixed service is encouraged to continue use of the 2290-2450 MHz band.

8. L-band Subscriber Radio Systems may continue to operate on the existing frequency plan, but new systems should be capable of operating on a new frequency plan that straddles the DRB band.

9. The proposed Geographical Differences Policy, if adopted:

- o will in areas where there is practically no other use of the spectrum allow fixed systems to obtain a waiver on the SP and SRSP requirements and still operate on a standard basis. Among other things, in remote areas this could encourage the use of point-to-point bands for SRS or the redeployment of older point-to-point equipment;

- o allow the Department to define highly congested areas in which a mandatory upgrade of equipment in systems older than 15 years will serve to relieve frequency congestion.

10. More efficient use of the fixed service spectrum will be required, initially in congested areas in the L2 GHz, U2 GHz, S2 GHz band and 7125-7250/7450-7575 GHz band. This should significantly increase the availability of spectrum below 10 GHz.

11. Overall, disregarding the application of the Geographical Differences Policy, there is a slight loss of spectrum to SRS and LC, but increases to MC and HC in these proposals. In the U2 GHz band, despite the loss of spectrum the amount of MC traffic that can be carried in the band will be increased.

12. With some exceptions, explicit provisions for either analog systems or VLC will not be made in future SP's or SRSP's.

13. Digital STL's may use any band in which they meet the conditions of the SP and SRSP for digital systems.

14. A good part of the L2 GHz band will remain available, and may be extended down to 1700 MHz.

15. The long term future of the U2 GHz band will be in 2025-2110/2200-2290 MHz, for high efficiency MC systems. The remainder of the U2 GHz band may be subject to change, but existing users may be able to continue to operate for some time in some areas.

16. Spectrum is proposed for TV-Pickups and two-way wideband fixed service in 2500-2596 MHz.

17. o New LC spectrum is added in 4400-5000 MHz

- o LC is reduced in 7125-7250/7300-7725 MHz in order to increase the MC use of the band, and to add HC

- o Improved use of 14.5-15.35 GHz for LC and MC is proposed

18. o MC is added to 3500-3700 MHz, 5850-5915 MHz and 10.7-11.7 GHz

19. o The band capacity for MC/HC use of 5915-6425 MHz is increased

o Heavy route HC systems operating in 5915-6425 MHz may expand up to 6930 MHz

20. The usable spectrum in the band 21.2-23.6 GHz is doubled.

21. A policy is proposed in the 1-3 GHz bands to require short hop systems to use frequencies above 10 GHz.

22. Spectrum utilization-related guidelines are proposed for the licensing of radio systems that are used in conjunction with fibre optic telecommunications systems.

23. In the absence of a clear demand, no specific proposals are made for fixed bands above 23.6 GHz. The public is invited to comment on the future use of these bands, and the appropriateness of the setting and timing of policy in these bands for any identified needs.

24. A simplified table of RF Channel transmission capacities for the fixed service is proposed for consideration.

25. The public is requested to identify possible international alignments of allocations, utilization and standards.

26. The coordination requirements imposed by WARC-92 for new space services in 1-3 GHz are adequate to protect the interests of terrestrial users of these bands from foreign systems.

Current Utilization Tables

Current Use: SRSP

Tables 6.1a through 6.4a show how each band is now channelled for analog and digital systems in the most recent SRSP. The distribution of capacities in the Standard Radio System Plan system capacities table is generally based on Table 6.

Table 6 - SP-GEN[1] System Capacities

Radio Frequency Channel Capacity	Analogue (equivalent voice channels)	Digital (Mbit/s)
VERY LOW (VLC)	1-24	≤ 1.544
LOW (LC)	25-120	≥ 1.544 ≤ 18.936
MEDIUM (MC)	121-600	≥ 18.936 ≤ 103.68
HIGH (HC)	601-1200	≥ 89.472
VERY HIGH (VHC)	1201 & up	

The following presents this table in terms of Digital Signal levels (DS levels).

VLC	≤ 1 DS-1	DS-0	64kbit/s	1 voice ch. + signalling	
LC	≥ 1 DS-1 ≤ 3 DS-2	DS-1	1.544 Mbit/s	1 T1	24 DS-0
MC	≥ 3 DS-2 ≤ 2 STS-1	DS-2	6.312 Mbit/s	1 T2	96 DS-0
HC	≥ 2 DS-3 and above	DS-3	44.736 Mbit/s	1 T3	672 DS-0
		STS-1	51.84 Mbit/s	1 OC-1	672 DS-0
		STM-1	155.52 Mbit/s	OC-3	2016 DS-0
		16 STM-1	2.48832 Gbit/s	OC-48	32,256 DS-0
		32 STM-1	4.97664 Gbit/s	OC-96	64,512 DS-0

Notes: SONET is the North American technology used for STM-1

T1	24 circuits	OC-1	1 T3
T2	96 circuits	OC-3	3 T3
T3	672 circuits		

Current Use: Actual Assignments

Tables 6.1b through 6.4b are counts of the capacities of actual assignments as recorded by the Department in 1992. The analog and digital capacities are those shown in Table 6. It should be noted that all analog FM TV signals are counted as MC.

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[1] SP-GEN, General Information Related to Spectrum Utilization and Radio System Policies, Department of Communications, January, 1991.

Table 6.1 Current Utilization of 1-3 GHz

6.1a Current Use: SRSP

Band (MHz)	SRS/MCS	VLC	LC	MC	Unchannelled (MHz)
	SRSP Channel Bandwidth/No. of Channel Pairs/Efficiency (bits/s/Hz)				
1427-1525	3.5/10/<1		7/6/<1		0
1710-1900		0.875/93/>1	1.75/46/>1 3.5/24/>1 7/12/>1		17.5
1900-2290				29/6/>1.5	0
2290-2450	3.5/9/>1	1.5/24/>1	3/12/>1 4.5/8/>1 6/6/>1		0
2500-2686	6/16/-				0

6.1b Current Use: Actual Assignments

Band (MHz)	VLC	LC	MC	HC & VHC
	Digital/Analog (Actual No. of Assignments)			
1427-1525	25/308	175/216	0/246	0/7
1710-1900	84/198	531/790	35/1844	0/10
1900-2290	0/8	4/11	1356/808	0/922
2290-2450	34/0	771/2		
2500-2596	0/2		0/63	
Total	143/516	1481/1019	1391/2898	0/939

Table 6.2 Current Utilization of 3-10 GHz

6.2a Current Use: SRSP

Band (MHz)	VLC	LC	MC	HC	Unchannelled (MHz)
	SRSP Channel Bandwidth/No. of Channel Pairs/Efficiency (bits/s/Hz)				
3500-3700				20/4/>4.5 40/2/>4.5	40
3700-4200				20/12>4.5 40/6>4.5	20
4400-5000				20/8>4.4 40/4/>4.4	110
5850-5915		1.75/18/>0.8 3.2/9/>1.75 5.25/6/>1.75	10/2/>4.5	20/1/>4.5	0
5915-6425				29.65/8/>3	6
6425-6590/ 6770-6930			10/16/>4(2.25)	20/8/>4(2.25) 30/5/>4(2.25)	5
7125-7250- 7300-7725		3.5/4/>1	9.75/6/>1 19.5/6/>1		39
7725-7975/ 8025-8275				40.74/6/>0.5(2)	

6.2b Current Use: Actual Assignments

Band (MHz)	VLC	LC	MC	HC/VHC
	Digital/Analog (Actual No. of Assignments)			
3500-3700			44/219	0/579
3700-4200			156/1650	0/4257
4400-5000				108/0
5850-5915			4/4	0/4
5915-6425	0/2	0/2	148/264	1930/1757
6425-6590/ 6770-6930			440/217	249/937
7125-7250/ 7300-7725	0/6	162/191	36/1131	0/860
7725-7975/ 8025-8275	0/1	4/0	4243/37	0/253
Total	0/9	166/191	5071/2522	2287/8647

Table 6.3 Current Utilization of Above 10 GHz

6.3a Current Use: SRSP

Band (GHz)	VLC	LC	MC	HC	Unchannelled (MHz)
	SRSP Channel Bandwidth/No. of Channel Pairs/Efficiency (bits/s/Hz)				
10.5-10.68	1.25/36/>1	2.5/18/>1 5/9/>1			50
10.7-11.7				40/11/>2	120
14.5-15.075/ 15.175- 15.350		12.5/14/>0.7 25/7/>0.7	37.5/5/>0.7 50/4/>0.7 62.5/3/>0.7 75 to 112.5/2/ >0.7 in 12.5 MHz increments	112.2 to 200/1/ >0.7 in 12.5 MHz increments	0
17.7-18.14/ 19.26-19.7			20/22/>1 40/11/>1	80/5/>1	0
18.58-18.82 18.92-19.16		10/44/>1*			
18.82-18.92/ 19.16-19.26		10/10/>1			0
20.2-23.6	50/12/-	50/12/-	50/12/-	50/12/-	1200

* 10 MHz channels in the 17.7 GHz band are available only when 10 MHz channels in 18.5 GHz are no longer available. In addition the licensing in 17.7-17.8 GHz and paired channels has been deferred, subject to the outcome of this policy review.

6.3b Current Use: Actual Assignments

Band (GHz)	VLC	LC	MC	HC
	Digital/Analog (Actual No. of Assignments)			
10.55-10.68	16/0	237/0		
10.7-11.7		2/0	49/38	130/46
14.5-15.35		6/0	12/140	
17.7-18.14/ 19.26-19.7	1/0	6/0	75/0	
18.58- 18.82/ 18.92-19.16	52/0	270/0		
20.2-23.6	18/10	241/0	41/131	0/11
Total	87/10	762/0	177/309	130/57

Table 6.4 Current Utilization of Fixed Service Bands Used Primarily in Support of Broadcasting Undertakings

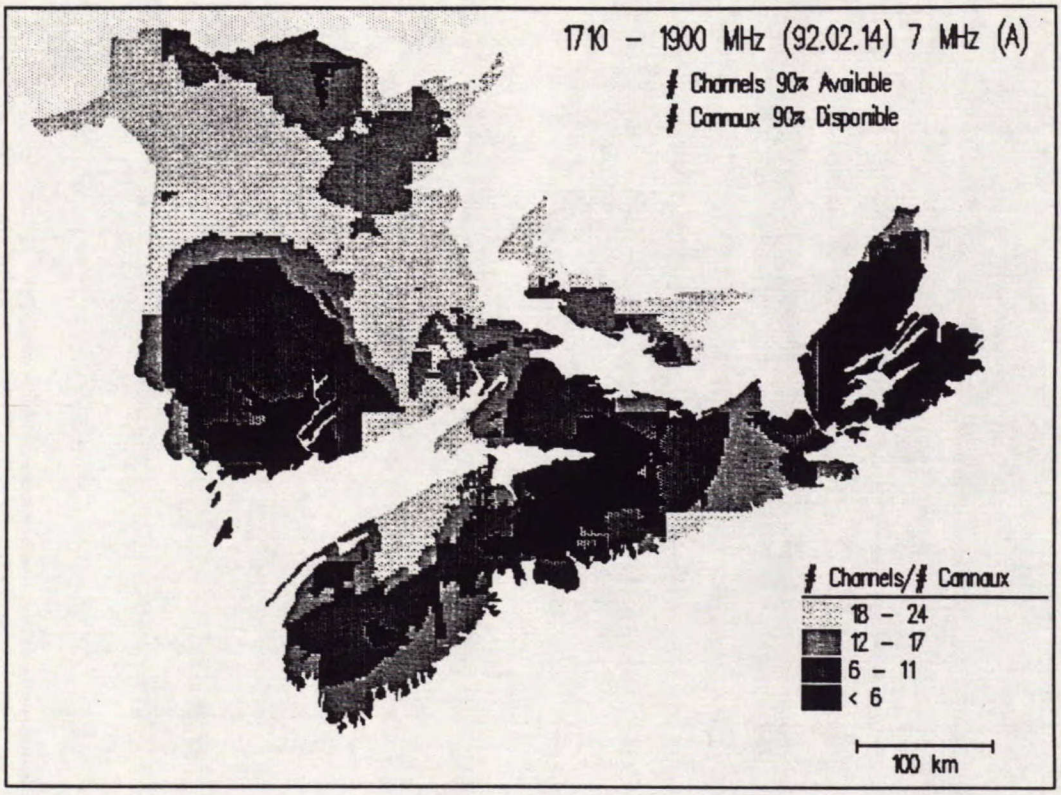
6.4a Current Use: SRSP

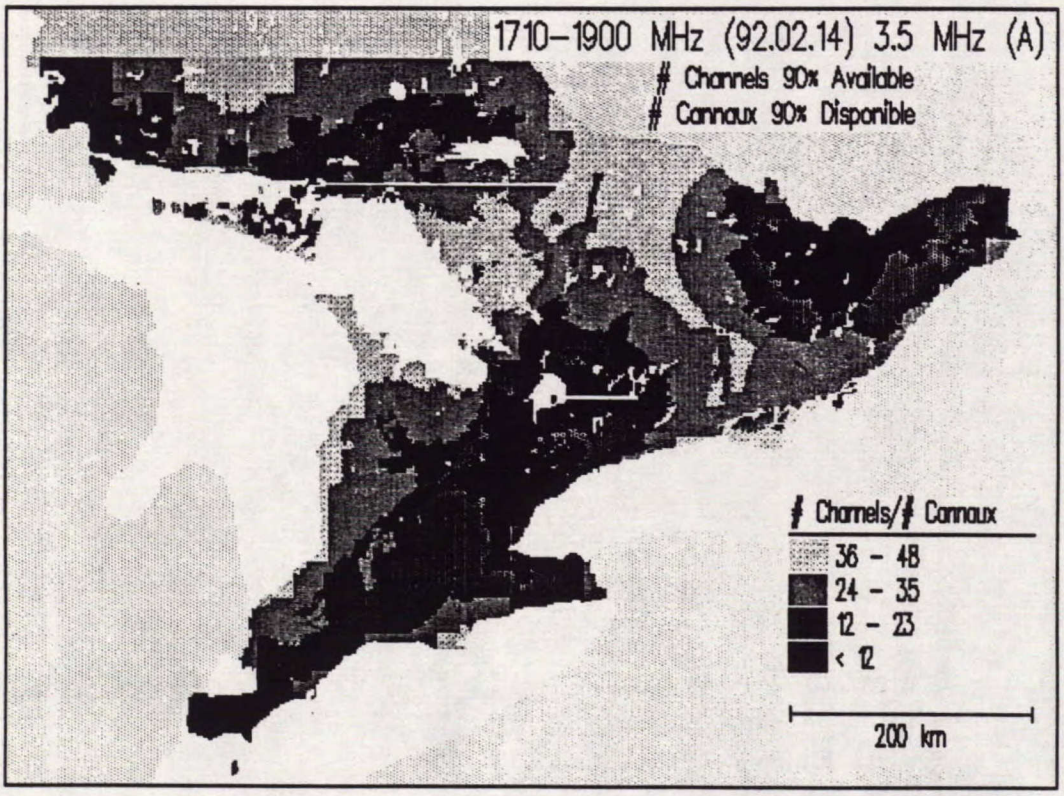
Band (MHz)	Sound STL	TV Pick-ups	Temp TV Links	TV STL	MHV	VHCM
	SRSP Channel Bandwidth/No. of Channels					
1700-1710	0.125/80					
2450-2500		17/3	17/3			
6590-6770				20/9		
6930-7125		20/10	20/10			
8275-8500					18.75/12	
12700-13200						6/80 12.5/40
13150-13200		25/4				

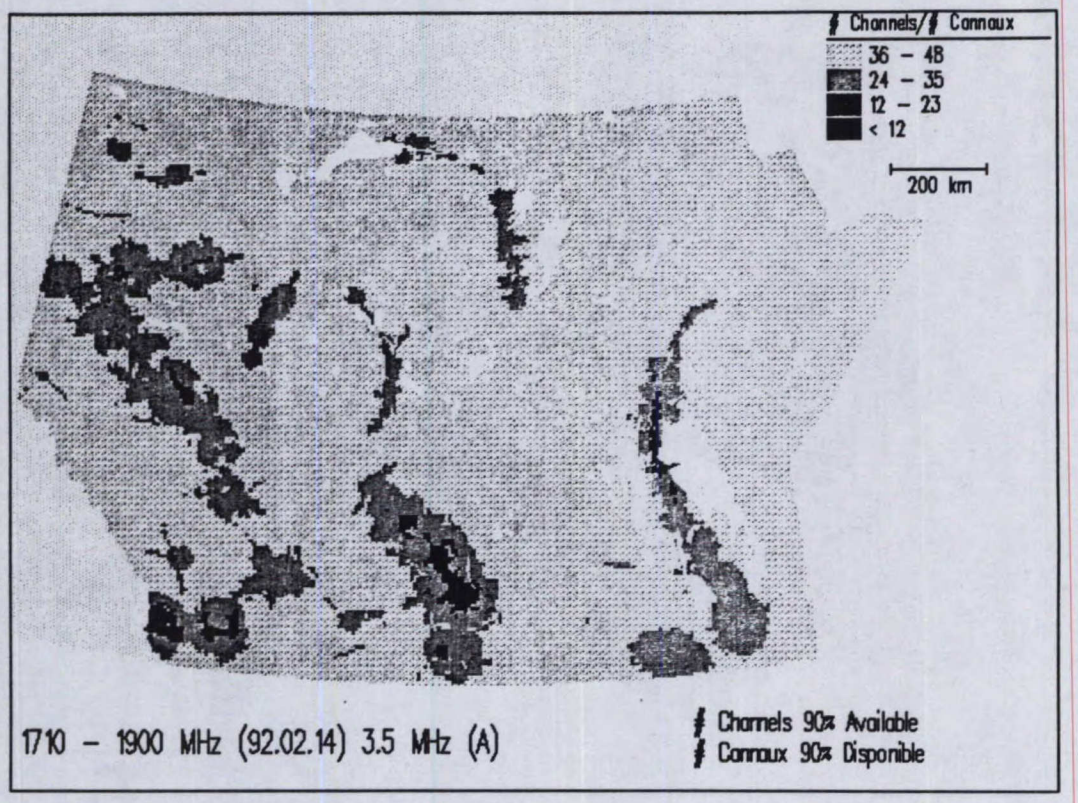
Note: the 15, 18 and 23 GHz bands are also in use for some of these applications

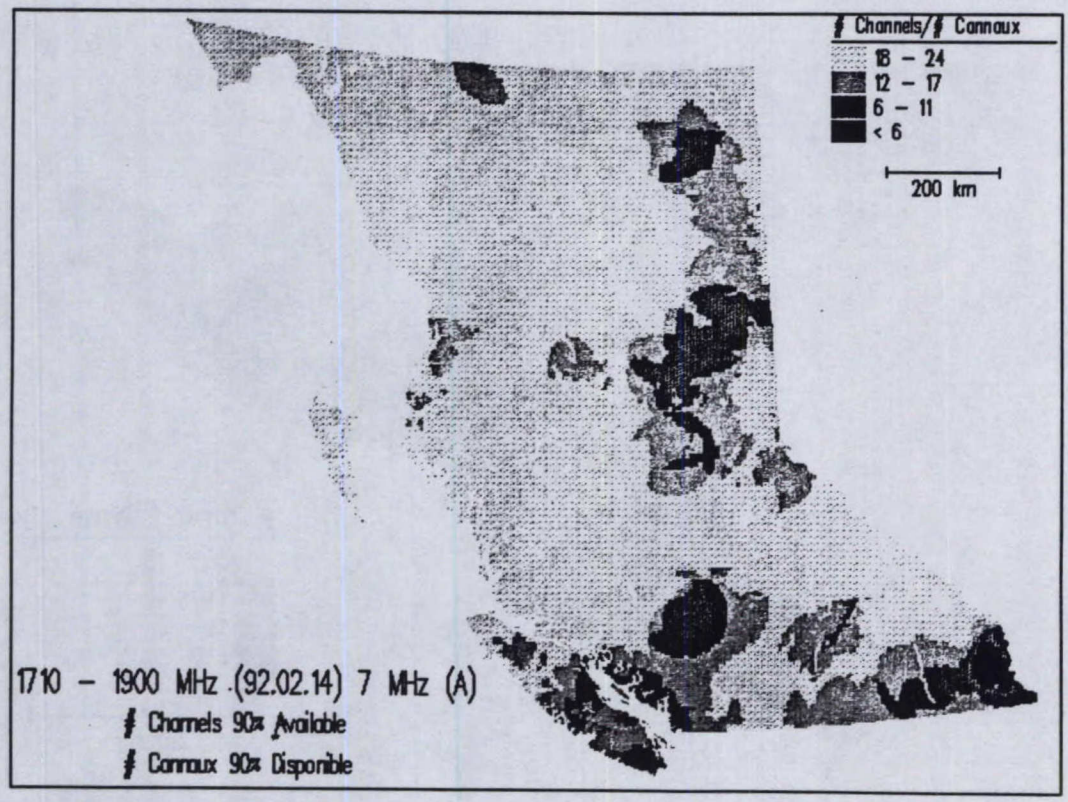
6.4b Current Use: Actual Assignments

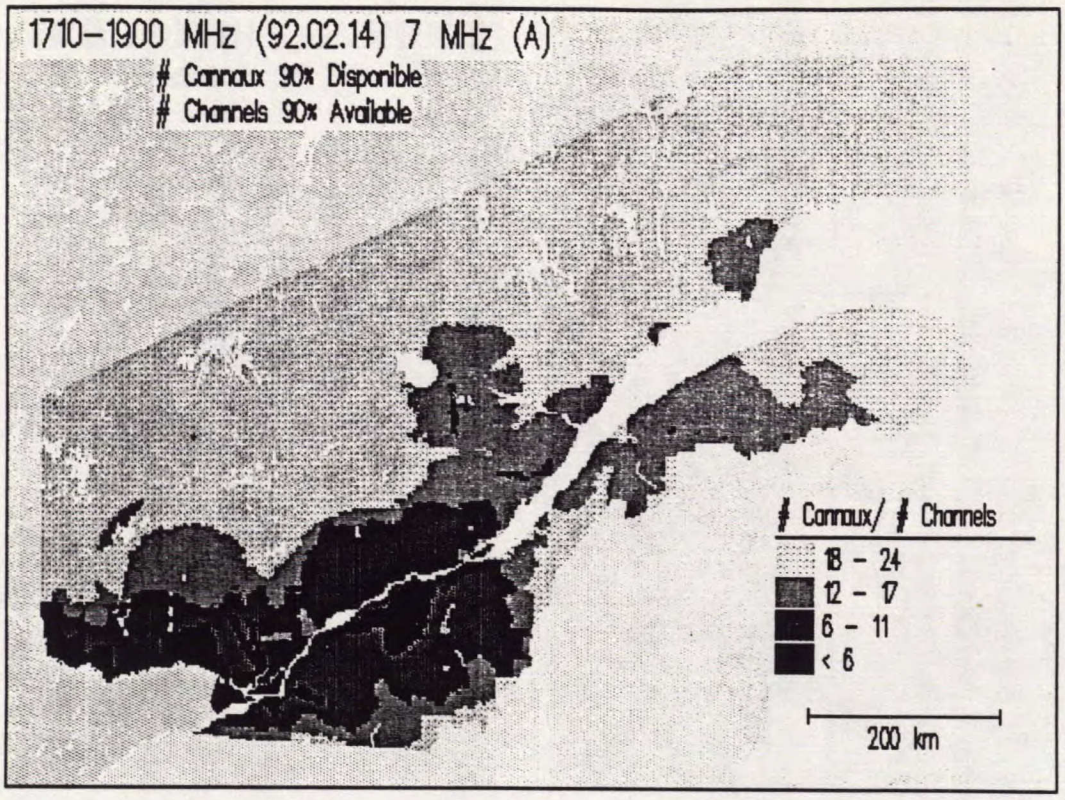
Band (MHz)	VLC	LC	MC	HC/VHC
	Equivalent Digital/Analog (No. of Assignments)			
1700-1710	0/33		0/8	
2450-2500			0/30	
6590-6770			0/207	0/3
6930-7125	0/3	8/3	0/839	0/8
8275-8500	0/5		4/1029	0/204
12700-13200	0/105	0/10	0/ 12,778	0/9
Total	0/146	8/13	4/ 14,891	0/224

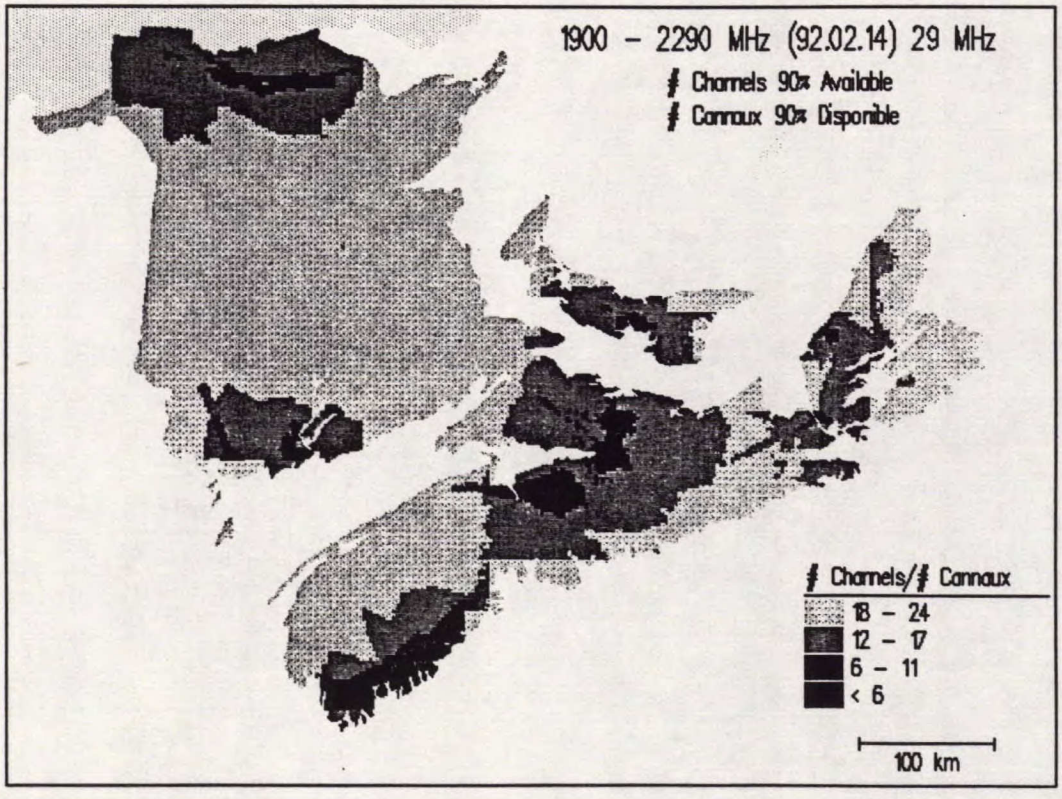

1710 – 1900 MHz (92.02.14) 7 MHz (A)
Channels 90% Available
Canaux 90% Disponible
Channels/# Canaux
18 – 24
12 – 17
6 – 11
< 6
100 km

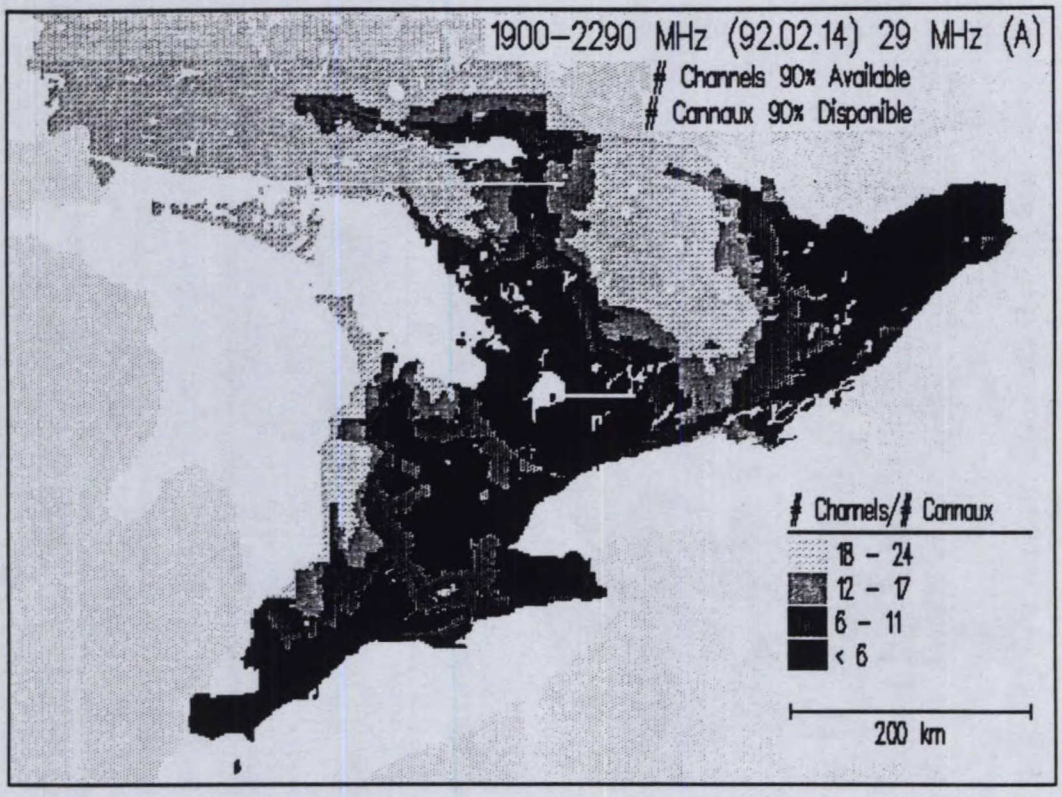

1710–1900 MHz (92.02.14) 3.5 MHz (A)
Channels 90% Available
Canaux 90% Disponible
Channels/# Canaux
36 – 48
24 – 35
12 – 23
< 12
200 km

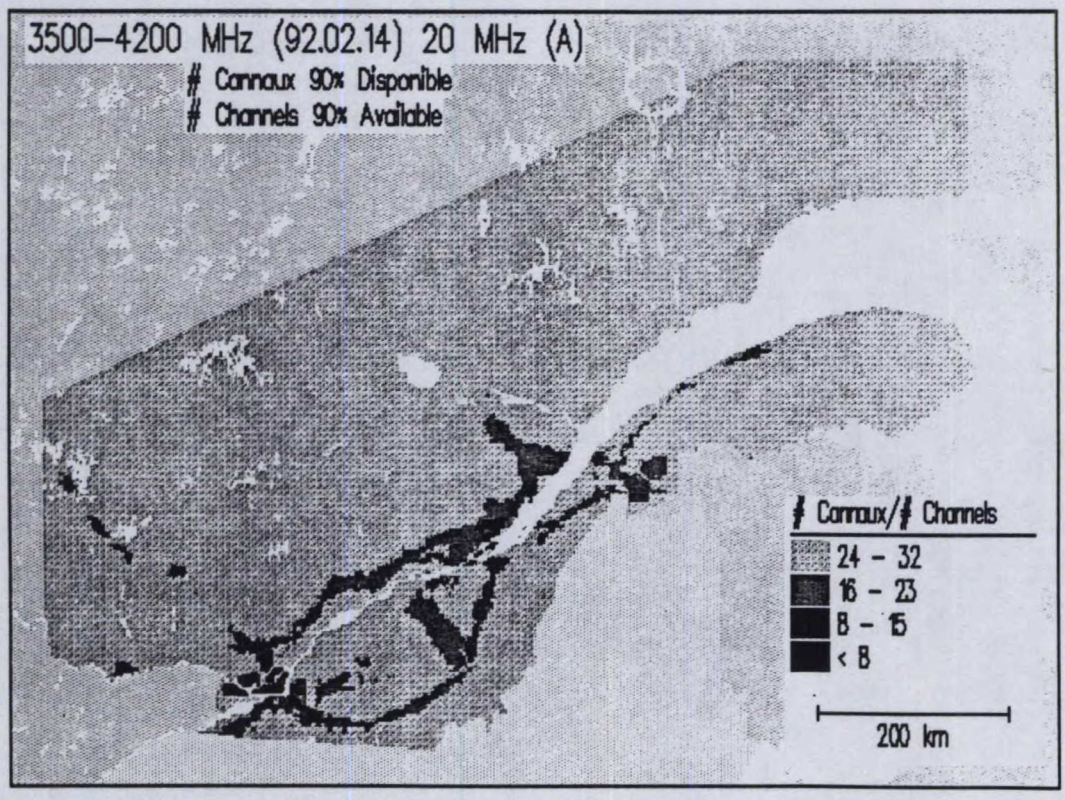

Channels/# Canaux
36 - 48
24 - 35
12 - 23
< 12
200 km
1710 - 1900 MHz (92.02.14) 3.5 MHz (A)
Channels 90% Available
Canaux 90% Disponible


Channels/# Canaux
18 - 24
12 - 17
6 - 11
< 6
200 km
1710 - 1900 MHz (92.02.14) 7 MHz (A)
Channels 90% Available
Canaux 90% Disponible


1710–1900 MHz (92.02.14) 7 MHz (A)
Canaux 90% Disponible
Channels 90% Available
Canaux/ # Channels
18 – 24
12 – 17
6 – 11
< 6
200 km


1900 – 2290 MHz (92.02.14) 29 MHz
Channels 90% Available
Canaux 90% Disponible
Channels/# Canaux
18 – 24
12 – 17
6 – 11
< 6
100 km


1900–2290 MHz (92.02.14) 29 MHz (A)
Channels 90% Available
Canaux 90% Disponible
Channels/# Canaux
18 – 24
12 – 17
6 – 11
< 6
200 km


3500–4200 MHz (92.02.14) 20 MHz (A)
Canaux 90% Disponible
Channels 90% Available
Canaux/# Channels
24 – 32
16 – 23
8 – 15
< 8
200 km

DEPARTMENT OF COMMUNICATIONS
RADIOCOMMUNICATION ACT
NOTICE NO. DGTP-005-93/SMEP-006-93

PROPOSED SPECTRUM UTILIZATION FOR CERTAIN SERVICES ABOVE 1 GHz

As a result of new frequency allocations made by the 1992 World Administrative Radio Conference (WARC-92) and the ongoing evolution of the use of radio in Canada, a number of changes are proposed to existing spectrum utilization policies in bands above 1 GHz. In addition a number of new spectrum policies are proposed to accommodate emerging radio services.

A document entitled **Proposed Spectrum Utilization for Certain Services Above 1 GHz** is being released for public comment to assist the Department in the development of spectrum policies to serve a range of services for the next 10-20 years.

In addition to specific proposals for bands and services, a number of broad issues are raised for comment. At this time, any other issues related to the utilization of bands above 1 GHz may also be addressed. Proposals are presented for the transition process for the displacement of existing users and the accommodation of new services within the frequency bands which are proposed for change.

The Department of Communications invites interested and affected parties to provide their views and comments on Part 1 of the document.

Copies of the subject document are available from Information Services, Department of Communications, 300 Slater Street, Ottawa, Ontario K1A 0C8, (Telephone (613) 990-4900) or from the Department's Regional Offices in Moncton, Montreal, Toronto, Winnipeg and Vancouver.

Submissions should be addressed to the Director General, Telecommunications Policy Branch, Department of Communications, 300 Slater Street, Ottawa, Ontario, K1A 0C8 to be received on or before November 1, 1993. All representations should cite the Canada Gazette Part I Notice publication date, title, and the Notice reference number.

Written comments received in response to this Notice will be made available for viewing by the public two weeks after the closing date of this Notice, during normal business hours, at the Department of Communications Library, 300 Slater Street, Ottawa and at the Regional Offices of the Department at Moncton, Montreal, Toronto, Winnipeg and Vancouver for a period of one year.

Also, approximately two weeks after the close of the comment period, copies may be obtained, by mail order or over-the-counter, from ByPress Printing and Copy Centre Inc., 300 Slater Street, Unit 101A, Ottawa, K1P 6A6 (Telephone (613) 234-8826). Reasonable costs of duplication will be charged.

Dated at Ottawa this 28th day of May, 1993.

Michael Helm
Director General
Telecommunications Policy Branch

Nisar Ahmed
Director General
Engineering Programs Branch

List of Terms and Abbreviations

AM	Amplitude Modulation; also broadcasting stations in the band 540-1705 kHz
ABSOC	Advanced Broadcast Systems of Canada (committee)
ADD	Additional item
APC	Aeronautical Public Correspondence
ANIK	Satellites of Canada's domestic fixed-satellite network; Inuit for "friend"
ATM	Asynchronous Transfer Mode
ATPC	Automatic Transmitter Power Control
B-ISDN	Broadband Integrated Services Digital Network
B	Broadcasting (Service)
Bits/sec/Hz	Spectral efficiency in bits per second for each Hertz of spectrum used
BSS	Broadcasting-Satellite Service
Canadian Table	Canadian Table of Frequency Allocations
C-band	Frequency range around 4 - 6 GHz
CATV	Cable TV
CCIR	International Radio Consultative Committee, or Comité consultatif international des radiocommunications (of the ITU)
CCITT	International Telegraph and Telephone Consultative Committee, or Comité consultatif international télégraphique et téléphonique (of the ITU)
CD	Compact Disc
CDMA	Code Division Multiple Access
CEPT	European Conference of Postal and Telecommunications Administrations
CISPR	International Special Committee on Radio Interference
CRTC	Canadian Radio-Television and Telecommunications Commission
Department	Department of Communications
DAB	Digital Audio Broadcasting
DRB	Digital Radio Broadcasting
DRNAC	Digital Radio National Advisory Committee
DS-0	Digital Signal, Level 0: 64 kbit/s one digital voice channel, with signalling
DS-1	Level 1: T1 1.544 Mbit/s 24 DS-0
DS-2	Level 2: T2 6.312 Mbit/s 96 DS-0
DS-3	Level 3: T3 44.736 Mbit/s 672 DS-0
dB	Decibel (ratio of powers expressed in $\log_{10}$)
DBS	Direct Broadcasting-Satellite
DECT	Digital European Cordless Telecommunications
E-s	Earth-to-space
EC	European Community
EHF	Extremely High Frequency (30 - 300 GHz)
EIA	Electronics Industry Association
EMC	Electromagnetic compatibility
ENG	Electronic News Gathering
ETSI	European Telecommunications Standards Institute

F	Fixed (Service)
FCC	Federal Communications Commission (USA)
FM	Frequency Modulation, also broadcast stations operating in 88-108 MHz
FPLMTS	Future Public Land Mobile Telecommunication Systems
FOTS	Fibre Optic Transmission Systems
FSS	Fixed-Satellite Service
GHz	GigaHertz = 1000 MegaHertz
Glonass	an MSS network operated by the Russian Federation
GSM	Global System for Mobile communications (European digital system)
GSO	Geostationary-Satellite Orbit
HDTV	High Definition Television
HC	High Capacity (2 DS-3 and above)
ICAO	International Civil Aviation Organisation
IEC	International Electro-technical Commission
IFRB	International Frequency Registration Board
IMO	International Maritime Organisation
INMARSAT	International Maritime Satellite Organisation
INTELSAT	International Telecommunication Satellite Organization
International Table	International Table of Frequency Allocations (ITU)
ISDN	Integrated Services Digital Network
ISM	Industrial, Scientific and Medical Equipment
ISO	International Standards Organization
ITU	International Telecommunication Union
ITU Table or International Table	International Table of Frequency Allocations contained in Article 8 of the Radio Regulations of the ITU.
ITV	Instructional Television (fixed service)
Ka-band	Frequency range near 20 - 30 GHz
Ku-band	Frequency range near 11 - 14 GHz
kHz	kiloHertz = 1000 Hertz
L2 GHz	Lower 2 GHz band 1710-1900 MHz
LAN	Local Area Network
L-band	Frequency range near 1500 MHz
LC	Low Capacity (transmission capacity) 1 DS-1 to 3 DS-2
LEO	Low Earth Orbit
Long Term	beyond 10-15 years
M	Mobile (Service)
MAN	Metropolitan Area Network
MC	Medium Capacity (transmission capacity) 3DS-2 to 2 STS-1
Mbit/s	Megabits/sec (millions of bits per second)
Medium Term	5-10 years
MHz	MegaHertz = 1000 kiloHertz
MMSS	Maritime Mobile-Satellite Service

MSS	Mobile Satellite-Service
MSAT	the MSS network(s) operated in Canada and the US
MCS	Multipoint Communication Systems (Fixed)
MDS	Multipoint Distribution Systems (Broadcasting)
MUSAT	Multi-purpose UHF Satellite (an early DOC mobile satellite program.
NASA	National Aeronautics and Space Administration (USA)
No.	reference to an ITU RR
NOC	No Change
NOI	Notice of Inquiry (USA)
Non-GSO	Orbits other than GSO
NPRM	Notice of Proposed Rulemaking (USA)
NTSC	National Television Standards Committee (standard for North American TV)
OC-1	Optical Carrier, Level 1: STS-1 51.84 Mbit/s 672 DS-0
OC-3	Level 3: STM-1 155.52 Mbit/s 2,016 DS-0
OC-48	Level 48: 16 STM-1 2.48832 Gbit/s 32,256 DS-0
PABX	Private Automatic Branch Exchange
PCS	Personal Communications Service
PFD	Power flux-density
PIN	Personal Identification Number
P-P	Point to point radio (fixed service)
P-MP	Point to multipoint radio (fixed service)
PNO	Public Network Operator
PSTN	Public Switched Telephone Network
RA	Radio Astronomy (Service)
RABC	Radio Advisory Board of Canada
RAM	Random Access Memory
RDSS	Radiodetermination-Satellite Service
Region 2	ITU Region 2 (the Americas)
REC	Recommendation (typically of the CCIR or of CEPT)
RES	Resolution (typically of the ITU or of ETSI)
RF	Radio Frequency
RLAN	Radio Local Area Network
RNSS	Radionavigation-Satellite Service
RR	Radio Regulations (of the ITU)
S2 GHz	Super 2 GHz band 2290-2450 MHz
s-E	space-to-Earth
SDH	Synchronous Digital Hierarchy
SG	Study Group (of the CCIR or of the CCITT)
SHF	Super High Frequency (3 - 30 GHz)
Short Term	0-5 years
SNG	Satellite News Gathering
SONET	Synchronous Optical Network
SP	Spectrum Utilization Policy

SP-GEN	SP-General Information
SRS	Subscriber Radio System (used to connect remote areas to PSTN)
SRSP	Standard Radio System Policy
SSB	Single Side Band modulation
Standard system	System which conforms to an SP and an SRSP
STL	Studio-Transmitter Link
STS-1	OC-1 51.84 Mbit/s 672 DS-0's
STM-1	OC-3 155.52 Mbit/s 2,016 DS-0's
SUP	Suppression of the item
Table	Canadian Table of Frequency Allocations
TDMA	Time Division Multiple Access
TFTS	Terrestrial Flight Telecommunications System
TG	Task Group - CCIR
TV	Television
U2 GHz	Upper 2 GHz band 1900-2290 MHz
U4 GHz	Upper 4 GHz band 4400-5000 MHz
UHF	Ultra High Frequency (300 MHz- 3 GHz)
VHCM	Very High Capacity Microwave (for CATV distribution)
VHF	Very High Frequency (30 - 300 MHz)
VLC	Very Low Capacity (transmission capacity) equal to or less than 1 DS-1)
VSAT	Very Small Aperture Terminal
W	Watt
WRC	World Radiocommunication Conference (replaces WARCs in 1993)
WARC	World Administrative Radio Conference (of the ITU)
WARC-92	the WARC held in 1992

PART 2

TECHNICAL CONSIDERATIONS FOR THE IMPLEMENTATION OF RADIO COMMUNICATION SYSTEMS IN THE FIXED SERVICE

ENGINEERING PROGRAMS BRANCH
DEPARTMENT OF COMMUNICATIONS

TECHNICAL CONSIDERATIONS FOR THE IMPLEMENTATION OF RADIO COMMUNICATION SYSTEMS IN THE FIXED SERVICE

Table of Contents

List of Terms and Abbreviations

BS	Broadcasting Service
BSS	Broadcasting-Satellite Service
CCIR	International Consultative Committee on Radio*1
CTFA	Canadian Table of Frequency Allocations
Department	Department of Communications
DRB	Digital Radio Broadcasting
E-s	Earth-to-space
EHAAT	Effective Height Above Average Terrain
eirp	Effective Isotropic Radiated Power
EMC	Electromagnetic Compatibility
FOTS	Fibre Optic Transmission Systems
FS	Fixed Service
FSS	Fixed Satellite Service
GSO	Geostationary Satellite Orbit (approximately 36,000 km above equator)
HC	High Capacity
LC	Low Capacity
MC	Medium Capacity
MS	Mobile Service
MSS	Mobile-Satellite Service
MCS	Multipoint Communication System
PCS	Personal Communication Service
P-MP	Point-to-Multipoint
P-P	Point-to-Point
pfd	Power Flux-Density
RF	Radio Frequency
RR	Radio Regulations (of the ITU)
s-E	space-to-Earth
SP	Spectrum Policy Document
SP-GEN	SP-General Information
SRS	Subscriber Radio System (Point-to-Multipoint)
SRSP	Standard Radio System Plan
SSS	Space Science Services
STL	Studio to Transmitter Link
T/R	Transmit/Receive Translation Frequency
VHC	Very High Capacity
VLC	Very Low Capacity
WARC	World Administrative Radio Conference
WRC	World Radiocommunications Conference

*1 Under the new ITU restructuring, technical issues are now dealt with by Radiocommunications Study Groups (RSG), the term CCIR is retained in this document.

PART 2

TECHNICAL CONSIDERATIONS FOR THE IMPLEMENTATION OF RADIO COMMUNICATION SYSTEMS IN THE FIXED SERVICE

EXECUTIVE SUMMARY

This document addresses the consequential changes to the technical standards of a number of frequency bands, which may be required to implement the policy proposals contained in Part 1. In the 1-3 GHz band, the changes are largely a result of specific allocation modifications made at WARC-92 such as the new bands for personal communications and digital audio broadcasting. Above 3 GHz, the bands were revised to provide spectrum for fixed systems which may be displaced from the 1-3 GHz range. Furthermore, the advances in digital technology and the development of more adaptable microwave equipment also make this a good time to update the fixed service bands.

Part 2 attempts to outline how the policy proposals may be implemented. A number of factors were considered including frequency channel arrangements, band sharing with other radio services, and transition plans. Also included is a section on general theme issues which covers various topics common to many fixed service bands such as spectral efficiency, relocation to higher frequency bands, congestion, performance issues, new channelling concepts and area licensing for multipoint services. The theme issues are fundamental to moving forward with industry in the development of a cohesive technical strategy which can act as a guide to revising the technical standards for the fixed service.

Each section deals with a specific fixed service band where there are significant policy changes such that changes to the technical standards are warranted. A technical strategy is developed around the existing usage profile, available microwave equipment technology and both inter and intra service sharing considerations. The technical proposals in this document should not be viewed as definitive 'take it or leave it' but rather as a starting point subject to enhancement and/or alternate proposals.

The following highlights outline the key technical proposals addressed in this report:

Section 1: 1350 - 1525 MHz Subscriber Radio Systems

In view of the sharing difficulties associated with the introduction of digital radio broadcasting (DRB) in the band 1452-1492 MHz, both terrestrial and satellite delivery, and possibly the mobile-satellite service (space-to-Earth) in the band 1515-1525 MHz, consideration of a new channel arrangement for the subscriber radio services to avoid these services is warranted.

A revised channelling plan for subscriber radio systems is proposed for the remaining sub-bands, 1427-1452 MHz and 1492-1517 MHz. The new plan uses the two 25 MHz bands which accommodate seven 3.5 MHz wide, point-to-multipoint channel pairs with a translation frequency of 65 MHz. The two 25 MHz bands do not overlap the DRB allocation. This arrangement provides exclusive frequency bands to the SRS and the DRB systems and also provides 0.5 MHz guard bands adjacent to the DRB band.

It is proposed that existing point-to-point systems be accommodated in other frequency bands.

Section 2: 1700 - 1900 MHz Low Capacity Point to Point

Personal communication services are proposed in the 1870-1900 MHz portion of this band. Fixed service sharing with these services could be difficult in the same geographical area. To accommodate the new PCS systems, two channelling arrangements are suggested:

- Expand the 1710-1900 MHz band (Lower 2 GHz) to include the 1700-1710 MHz band which permits three new 3.5 MHz channel pairs. This expansion partially offsets the potential loss in some areas of ten channel pairs where the 'return' channels in the 1870-1900 MHz band are overlapped by the proposed mobile services. Impacted existing systems could re-tune to these new channels. It may be necessary for all systems in proximity to the mobile services to change their filtering arrangements to accommodate the extension band and to reject emissions from the mobile stations.

- Make available to future systems a new block channelling arrangement which takes advantage of more spectrally efficient technology and makes full use of the available spectrum to provide up to twenty-four 3.5 MHz channel pairs and twelve 7 MHz pairs. This arrangement subdivides the band 1700-1870 MHz into eight blocks of 21 MHz, each block accommodating six 3.5 MHz channels (or three 7 MHz channels).

It is expected that the personal communications systems will exhibit fairly rapid growth in metropolitan areas and moderate growth in rural areas. These mobile systems are still in a concept stage and estimates of commencement dates, demand and technical parameters vary considerably.

Section 3: 1900 - 2290 MHz Medium Capacity Point to Point

In this band, personal communication services and the mobile-satellite service (both directions) have been allocated and the status of the space science satellite services has been raised to primary. Consideration of the sharing constraints between the fixed service and these new services have resulted in the identification of the core bands 2025-2110 MHz and 2200-2290 MHz where fixed systems may operate virtually unrestricted by the new services. The proposed channelling plan for this band consists of two arrangements.

- Reduce the channel bandwidth from the present 29 MHz to 14.5 MHz. Twelve channel pairs can be accommodated with the same translation frequency as at present. Inherent in this proposal is the need to increase spectral efficiency to make up the capacity. The top five pairs of this channel plan overlap into the core bands and therefore should only be used in uncongested areas.

- In congested areas, a 10 MHz channelling plan confined to the core bands provides nine channel pairs. Utilization of an efficient modulation scheme such as 64 QAM permits adequate capacity.

The 14.5 MHz channel plan may be viewed as a 'stop-gap' measure for systems which may be retired in short to medium term. However, given that it is likely that the mobile and mobile satellite services will occupy their respective allocations in this band and taking note of proposed footnote C AAE which

potentially relegates the fixed service to secondary in the mobile and mobile-satellite bands, the longer term solution is the 10 MHz channel plan.

Alternatively, some operators may choose to relocate to higher frequency bands or to different media. From a purely technical point of view, there does not appear to be any major obstacle to the utilization of alternate frequency bands at least up to about 10 GHz where precipitation fading starts to become significant.

Section 4: 2290 - 2500 MHz Subscriber Radio Systems and Low Capacity Point-to-Point

It is proposed to re-arrange the fixed service in this band to provide for additional point-to-point (P-P) low capacity spectrum in congested areas and to increase the allocation to telemetry. Consequently, the total spectrum currently available to point-to-multipoint (P-MP) systems is reduced. The new P-P bands are 2290-2342 MHz and 2398-2450 MHz and the P-MP bands are 2314-2342 MHz and 2422-2450 MHz. The P-P systems may use the P-MP bands only in cases where the high levels of congestion prevent the use of the 2290-2314 MHz and 2398-2422 MHz bands.

The proposed P-P plan is an extension of the existing plan noting that the 'return' band has been shifted up by 8 MHz. The P-MP plan provides 8 channel pairs in a modified arrangement which uses the centre frequencies of the existing channel plan except in the 'return' band where the channels have been shifted down by 8 MHz.

It is proposed that existing fixed systems may continue to operate subject to the geographical differences policy. Existing systems may expand under the present channelling arrangements provided that expansion is limited to the new sub-band allocations for MCS and point-to-point systems.

Section 5: 2500 - 2596 MHz TV Pickups, Multipoint Communications Systems and Low Capacity Point to Point

The 2500-2596 MHz band is currently lightly used for multipoint communications systems (MCS). It is proposed to add non-channelled TV pick-ups to this band and to facilitate two way video MCS systems. In addition, low capacity point-to-point systems are added to the band.

The mobile-satellite service (space-to-Earth) was allocated in the band 2500-2520 MHz at WARC'92 and is subject to coordination if the power flux-density levels specified in Radio Regulation 2566 are exceeded. Studies have shown that sharing between the MSS (space-to-Earth) and point-to-point stations will be difficult particularly with non-geostationary MSS satellites.

Two groups of five 6.0 MHz channels for MCS operation are proposed allowing for both one-way and two-way systems in the 2500-2530 MHz and 2566-2596 MHz bands. A flexible channelling arrangement for low capacity point-to-point systems is suggested to accommodate a full range of equipment and channel bandwidths. This plan specifies only a range of channel bandwidths up to 6 MHz which may be used on any of the 90 available centre frequencies.

Section 6: 3500 - 4200 MHz Medium and High Capacity Point to Point

The proposed change to this band is the addition of medium capacity fixed service in the sub-band 3500-3700 MHz. This sub-band can support twenty contiguous 10 MHz channels. Medium capacity systems may have access to up to 8 RF channel pairs. The centre frequencies are offset 5 MHz to facilitate sharing with the existing 20 MHz high capacity channels in this band. In order to provide some flexibility, it is proposed that three go/return channel separations be available, viz; 80 MHz, 120 MHz and 160 MHz. The channels are divided into five blocks of four channels. Each four channel block may be paired with at least two other blocks depending on the translation frequency and the go/return block spacing requirements. The use of high performance antennas, particularly near high capacity systems is recommended in order to provide for better sharing and to reduce the potential of restricting the number of RF channels on the high capacity routes. Since no changes are proposed to the existing services, the implementation date for the additional medium capacity resource is dependent only on the demand for this resource and the availability of suitable equipment.

Section 7: 4400 - 5000 MHz Low and High Capacity Point to Point

There are several narrow residual sub-bands in this band that are currently unused. It is proposed that these residual sub-bands be assigned to low capacity systems. These residual bands provide a total of 110 MHz of spectrum. Given the fragmented nature of these bands, it may be useful to consider a more relaxed channelling arrangement allowing for a variety of equipment types to adjust into these band segments. Furthermore, some of the residual bands are adjacent to the high capacity bands. This may result in need for additional frequency separation between low and high capacity systems to avoid interference. The following flexible plan is proposed:

- Maximum channel bandwidth 1 MHz.
- Minimum efficiency for digital systems 1 bits/sec/Hz.
- Centre frequency selected from a uniform set of frequencies spaced 0.5 MHz apart provided the channel bandwidth does not fall outside the allotted bands.
- The go/return translation frequency is governed by the choice of the return band.

Since no changes are proposed for existing high capacity services, the implementation date for the additional low capacity resources is dependent only on the demand for these resources and the availability of suitable equipment.

Section 8: 5850 - 7125 MHz Low, Medium and High Capacity Point to Point, TV Pick-ups, STL's

This band accommodates a number of fixed service bands. The proposed policy and technical changes are as follows:

- include MC point-to-point systems in the 5850-5915 MHz,

- extension of the HC capability to span the band 5915-6930 MHz, and
- sharing of the 6425-6930 MHz band between HC, MC and TV-STL systems.

The suggested modifications in the band 5850-7125 MHz should be implemented as soon as possible to accommodate the new systems presented in the policy proposal. Since existing channelling plans are maintained, no modifications to present systems are warranted.

Addition of Low and Medium Capacity Systems in the 5850-5915 MHz Band

This band was the subject of a recent review within the Radio Advisory Board of Canada (RABC). The RABC suggested a number of amendments to the current channelling plan to accommodate a variety of point-to-point systems. As these amendments are consistent with the policy proposal to have this band support low and medium capacity systems, it seemed reasonable to consider them as part of the technical strategy. Accordingly, the proposed channelling plan for this band consists of the following arrangements.

A;	18	1.75 MHz channel pairs,
B;	9	3.5 MHz channel pairs,
C;	6	5.25 MHz channel pairs,
D;	2	10 MHz channel pairs, or
E;	1	20 MHz channel pair.

Extension of High Capacity Systems in the 5915-6930 Band

It is not proposed to change the existing channelling plan at this time given that it supports high capacity systems which are consistent with the proposed policy. However, it is important to recognize that new highly spectrally efficient equipment is available for high capacity digital systems. This equipment, capable of carrying 6 DS-3 bit streams, typically requires 40 MHz channels. Therefore it is proposed that a new sub-plan be overlaid on this band to support the use of 40 MHz channels. In order to provide sufficient channels to allow systems to complement the capacity of fibre optic facilities, it would seem reasonable to create 12 channel pairs, matching the number of channel pairs in the 4 GHz bands.

Medium Capacity Systems and TV STL's in the 6425 - 7125 MHz Band

Medium capacity systems should continue to use the present channelling plan until there is a need to expand into the 6590-6770 MHz band.

The current STL channel plan uses 20 MHz channels and is exactly in step with the medium capacity (20 MHz) sub-plan found in the adjacent bands. Consequently, it is suggested that STL's should have access to the 20 MHz sub-plan in the 6425-6590 MHz and 6770-6930 MHz bands. In order not to prevent unnecessary coordination problems, the new STL's should operate on the highest available channel in the medium capacity bands.

Section 9: 7125 - 7725 MHz Low, Medium and High Capacity Point to Point

The policy proposal suggests including high capacity point-to-point digital systems in this band while restricting future deployment of VLC, LC, MC, and HC analogue systems. Furthermore, the proposal divides the band into two pairs of sub bands accommodating LC systems in one sub-band and MC/HC in the other. The current channelling plan will be in effect for existing systems and any subsequent expansions of these systems.

The differences between the current and the proposed band arrangements are significant and warrant the development of a new channelling plan for the LC and MC/HC systems. Consequently, the following channelling arrangement is suggested, noting that the channel bandwidths have been maintained:

- 7125-7250 MHz paired with 7450-7575 MHz providing 125 MHz of spectrum in each direction for low capacity digital systems compared to 28 MHz in the existing plan. The new bands will support thirty five 3.5 MHz channels.

- 7300-7450 MHz paired with 7575-7725 MHz providing 150 MHz of spectrum in each direction for medium capacity and high capacity digital systems compared to 234 MHz in the existing plan. These bands support fifteen 9.75 MHz channels and seven 19.5 MHz channels arranged in an overlay fashion. Note that more conventional channel bandwidths such as 10 MHz and 20 MHz may also be applicable.

Section 10: 7725 - 8275 MHz Medium and High Capacity Point to Point

The proposed policy is to include medium capacity line-of-sight digital radio systems in the band 7725-8275 MHz. It is proposed that the existing channelling plans will be used to support high capacity digital radio systems for the foreseeable future. However, new high capacity digital systems are expected to have improved spectral efficiency in the order of 4 bits/sec/Hz and above. The current minimum spectral efficiency is 2 bits/sec/Hz.

Medium capacity digital radio systems can be supported in narrower channels than provided in the present arrangement. If a spectrum efficiency of at least 2.3 bits/sec/Hz of RF bandwidth on a single polarization is assumed, a 20 MHz channel can support a DS-3 bit stream (45 Mbits/sec). Thus the suggested approach is to split the present 40.74 MHz channels into two 20.37 MHz channels for medium capacity applications. The proposed channel plan provides 12 channel pairs of bandwidth 20.37 MHz overlaid in the existing high capacity go/return bands.

In order to maximize sharing between the existing high capacity and the new medium capacity systems, the medium capacity systems should use high performance antennas in the vicinity of high capacity routes. Other requirements of medium capacity systems could include EIRP levels which are scalable to occupied bandwidth and the use of automatic transmit power control.

TECHNICAL CONSIDERATIONS FOR THE IMPLEMENTATION OF RADIO COMMUNICATION SYSTEMS IN THE FIXED SERVICE

INTRODUCTION

Part 2 was developed to provide some insight on how the policy proposals could be implemented and to identify some transition measures which may be useful. The objectives used in formulating the technical proposals in Part 2 include the following:

- to provide a technical strategy for the policy proposals,
- to introduce new channelling strategies which respond to the need for more flexible arrangements,
- to identify the impact of the policy proposals on the existing systems,
- to identify new initiatives, and
- to attempt to minimize the cost to operators of change over to the new arrangements.

Within Part 2 there are a number of general issues which apply to many fixed service bands. These issues are grouped together in the section entitled 'Theme Issues'. The theme issues examine fundamental band management practices, technology evolution and the spectrum environment. For example, a number of frequency bands have multiple channel plan overlays. Should overlays be continued in the future or should other approaches be considered such as partitioning bands into parcels of single channel bandwidths?.

The balance of Part 2 addresses the consequential changes to the technical standards of a number of fixed service bands resulting from the policy proposals contained in Part 1. In 1-3 GHz band, the changes are largely a result of specific allocation modifications made at WARC-92 such as the new bands for personal communications and digital radio broadcasting. Above 3 GHz, the bands were revised to provide spectrum for fixed systems which may be displaced from the 1-3 GHz range. Furthermore, the advances in digital technology and the development of more adaptable microwave equipment also make this a good time to update the fixed service bands.

In the fixed service bands above 8275 MHz, no major changes in technical standards are proposed at this time. In general, the proposals above 8275 MHz indicate an evolution of spectral efficiency. Since these bands are not heavily used at present, market demand should indicate when such higher efficiencies and possibly other changes such as additional channel bandwidths should be introduced.

The Department has conducted a number of inter and intra service sharing studies and has attempted to consider to the extent possible the existing technical standards and congestion levels in developing the various technical strategies for each band. These proposals should not be viewed as definitive 'take it

or leave it' but rather as a starting point subject to enhancement and/or consideration of alternate proposals.

THEME ISSUES

In the course of the policy review, several common theme issues were identified. These issues draw attention to some of the traditional practices used to develop channelling arrangements and other technical standards commonly found in the Department's radio systems plans. Given the advances in digital technology, the demands for additional radio facilities, the need to accommodate new services, and limited spectrum resources, it is timely to review these practices to determine if changes are needed to maintain the maximum possible usage of the radio spectrum.

The following sub-sections present the significant theme issues identified in the course of this review.

1 MULTIPLE OVERLAYS OF CHANNEL PLANS

Overlay channel plans are channelling arrangements which share frequency bands by using common or interstitial centre frequencies. Usually, these plans are made up of a number of sub-plans where each sub-plan employs a channel bandwidth which is a multiple of the minimum channel bandwidth in the plan in order to achieve a constant offset between sub-plans. It has been the practice to place the sub-plans over the full band, rather than to identify portions of the band for exclusive or priority use by specific bandwidth systems.

There are overlay plans based on multiples or sub-multiples of 1.5 MHz, 2.5 MHz and 3.5 MHz channel bandwidths. For example the 1710-1900 MHz band currently has 0.875 MHz, 1.75 MHz, 3.5 MHz and 7.0 MHz sub-plans and the 2290-2500 MHz band has 1.5 MHz, 3.0 MHz, 4.5 MHz and 6.0 MHz sub-plans. It may be more efficient to consider segmenting bands into smaller parcels each containing channels of single channel bandwidth, or to designate single channel bandwidths to entire bands. In the course of this major review, a grid approach has been proposed in some cases where centre frequencies are selected from a set of uniformly distributed closely spaced frequencies, typically 500 kHz apart. This approach permits any channel bandwidth, within a limited range, providing even greater flexibility to the service provider. Examples of this approach can be found in the 2500-2596 MHz and 4400-5000 MHz bands.

Other approaches are also feasible, for example, in some bands it is possible to divide one or two wideband channels into many narrower channels to support lower capacity systems.

It should be noted that coordination of multiple bandwidth systems does not pose a significant technical problem since current coordination practices do not involve channelling plans but instead rely on the centre frequency and the power spectral density emission characteristics.

2 CHOICE OF CHANNEL BANDWIDTH

At the present time, a large number of different channel bandwidths are supported in the various frequency bands as shown in Table 1. Consideration of a set of standard channel bandwidths, noting the standardized digital hierarchy, may be useful at this time. As microwave digital transmission technology continues to increase the data rates carried by less and less spectrum, the need to offer a greater variety of channel bandwidths has grown. Also as channels are loaded with higher data rates the susceptibility to interference increases, resulting in higher C/N and C/I ratios being used in the coordination process.

A typical fixed service band accommodates channel bandwidths which are multiples of a base bandwidth (1.5 MHz, 2.5 MHz, etc.). However, as indicated in the previous section, the base channel bandwidth varies considerably from band to band. Therefore, the use of a standardized channel bandwidth throughout a significant portion of the fixed service allocations could have some advantages, such as the following:

- Standardized coordination criteria.
- Less costly transition from one band to another.
- Better use of the available spectrum

Table 1: Different Channel Bandwidths Currently In Use In Canada

Frequency Band	Channel Bandwidths Presently Supported (MHz)					
1427-1525 MHz	P-P	7.0	3.5 P-MP			
1700-1710 MHz	Audio-STL	0.125	0.375			
1710-1900 Mhz	P-P	0.875	1.75	3.5	7.0	
1900-2290 MHz	P-P	29.0				
2290-2450 MHz	P-P	1.5	3.0	4.5	6.0	3.5 P-MP
2500-2596 MHz	MCS-video	6.0				
3500-4200 MHz	P-P	20.0	40.0			
4400-5000 MHz	P-P	20.0	40.0			
5850-6425 MHz	P-P	29.65				
6425-7125 MHz	P-P	10.0	20.0	30.0		20.0(STL)
7125-7725 MHz	P-P	3.5	9.75	19.5		
7725-8275 MHz	P-P	40.74				
8275-8500 MHz	P-P	18.75	37.5			

3 FEASIBILITY OF USING HIGHER FREQUENCY BANDS

The 1-3 GHz band is in high demand by a variety of services because of the favourable propagation conditions and the availability of equipment. Several new service allocations were agreed at the WARC'92 for this band. These new services introduce some difficult sharing situations and place an additional demand on the spectrum. These concerns may possibly only be accommodated by the frequency re-location of some of the existing fixed services.

One of the primary concerns in re-locating fixed services is that the hop lengths and availability in the re-location band be commensurate with the values in the vacated band so that the existing routes can be retained. Table 2 presents a summary of hop length statistics for the 1-10 GHz fixed service frequency bands. It indicates that frequency re-location from the 1-3 GHz band to one or more of these higher bands should not be a problem as the hop lengths are generally consistent in the 1-10 GHz range.

Table 2: Summary of Hop Length Statistics for 1-10 GHz Bands

Band (MHz)	Minimum (km)	Maximum (km)	Average Hop Length (km)
1427-1525	1	97	22
1700-1710	3	58	22
1710-1900	1	104	37
1900-2290	1	111	40
2290-2450	8	197	38
2500-2686	5	45	12
3500-4200	3	115	46
4540-4900	26	71	51
5915-6425	5	147	41
6425-6590/ 6770-6930	3	127	39
6590-6770/ 6930-7125	1	150	24
7125-7725	1	131	38
7725-8275	1	118	45
8275-8500	1	150	39

There are several other considerations associated with relocating an existing radio system to another frequency band such as the following:

- Frequency Considerations;
  Fresnel Zone Clearance
  Possible lower antenna heights or sub-optimum clearance
  Propagation
  Usually compensated by higher gain antennas
  Probability of Multipath Outage
  Sources of reflections and refraction are frequency dependent

- Coordination Factors in the New Frequency Band;
  Avoidance of the GSO
  Coordination with Earth stations
  Existing fixed services

4 GENERAL SHARING ISSUES

As the result of several sharing studies conducted by the Department and other Administrations, the following general conclusions can be drawn:

FS/BS	Sharing possible assuming fairly large separation distances.
FS/BSS	Sharing very difficult based on currently available transmission parameters for of BSS.
FS/MS	Geographic sharing possible, separation distances range from 10's of kilometres to 100's of kilometres depending upon the type of MS.
FS/MSS↑	Geographic sharing may be possible assuming that the MSS is able to assign uplink frequencies by location.
FS/MSS↓	Sharing very difficult based on currently available transmission parameters of MSS.
FS/SSS↑	Sharing feasible with geostationary orbit (GSO) avoidance; coordination with fixed and tracking earth stations in the space sciences service is required.
FS/SSS↓	Pfd limits makes sharing feasible; GSO avoidance provides additional protection if needed; possible interference from non-geostationary satellites is short term in nature; coordination required with receiving earth stations which may be either fixed or tracking.
FS/FSS↑	Sharing feasible with GSO avoidance; coordination with transmitting earth stations required.
FS/FSS↓	Pfd limits makes sharing feasible, GSO avoidance provides additional protection if needed, coordination with receiving earth stations required.

5 CURRENT FREQUENCY CONGESTION

Annex 1 indicates the geographic areas where congestion is moderate to high for the fixed service in the 1-3 GHz range. This information is based on studies done within the Department using the criteria outlined in the geographical differences policy. It is possible for radio services to share spectrum by exploiting the geographical differences in spectrum usage. For example, terrestrial digital broadcasting may, initially be concentrated in urban areas while subscriber radio systems tend to be implemented in sparsely populated areas.

The areas of congestion indicated in Annex 1 are from geographical sampling models developed by the Department to examine the extent the channels used in a band are available for future use. The output of the models are plotted on maps which provide a clearly defined boundary of areas of different levels of congestion. Furthermore, the maps show the characteristic of the congestion. This characteristic changes according to the performance parameters of the transmission systems deployed in a band. For example we see the congestion areas in the 3500-4200 MHz band as small narrow strips reflecting the use of high performance antennas. In other bands, such as the 1710-1900 MHz band the antenna patterns are less directive resulting in much more dispersed areas of congestion.

6 ANTENNA PERFORMANCE

It is possible to obtain some relief of frequency congestion through upgrades to antenna performance characteristics. Sharing with other services or with other types of fixed systems, for example LC/MC with HC systems in the 5850-7125 MHz band, may also be improved by adopting higher antenna standards. In cases where coordination is very difficult, the use of upgraded antennas may present a cost effective option compared to moving to another frequency band.

Geostationary orbit avoidance of 2° is typically applied in shared space/terrestrial bands. This avoidance angle is predicated on achieving adequate discrimination from the antenna. Typically, between 15 and 18 dB discrimination has been assumed. In bands where geostationary space services have been introduced, the implementation of orbit avoidance should include consideration of this level of antenna discrimination.

7 SPECTRAL EFFICIENCY

Increased spectral efficiency is called for in most frequency bands considered in this review. In general, an increase in spectral efficiency also dictates increase in carrier to noise and carrier to interference ratios. To increase the carrier to noise ratio, either the carrier power must be increased or the noise power decreased or both. Increased carrier power can cause increased self interference and increased interference into other systems and services. One way of reducing these impacts is by adopting automatic transmit power control (ATPC) so that the minimum carrier to noise ratio is maintained during faded conditions but, for unfaded conditions, the excess transmit power is reduced.

In areas of moderate to high frequency congestion it may necessary to look for ways to accommodate new systems and the future growth of existing systems. ATPC may prove to be a very practical solution to this situation.

8 ELIMINATING OR REDUCING GO/RETURN BAND SPACING

The go/return band spacing is determined by filtering and intermodulation factors and it is unavailable to channel assignment thus limiting the total capacity of the band. With a number of fixed service bands declining in size while at the same time accommodating an increasing number of systems and variety of systems, the absolute use of all available spectrum is becoming imperative. In cases such as the 1710-1900 MHz band where the band size may be reduced by approximately 30 MHz, the channelizing of the remaining portion will require the reduction or elimination of the go/return band spacing in order to regenerate lost channels.

The filtering and intermodulation requirements should be carefully assessed to minimize the size of the separation band. In the proposed new lower 2 GHz band (1700-1870 MHz), a block frequency plan is suggested that eliminates the go/return band spacing and restores the original number of channels. This approach requires multiple versions of the input filters which may be a small price considering the potential benefits.

9 ADJACENT SERVICE BAND ISSUES

The introduction of a service requiring high transmit powers in a band adjacent to a service which has traditionally employed low transmit powers can cause unique interference problems. While the level of unwanted emissions of the adjacent service that fall in to the band of the affected service is usually constrained by standards, the presence of a high power signal near the band edge of the affected system may cause detrimental effects such as front-end overload, capture, breakthrough etc. It is generally the responsibility of the service affected to provide adequate protection from such effects. This may be accomplished by a combination of retuning to another channel further removed in frequency, improved filtering, better linearity, and signal processing.

10 SCALING EIRP TO CHANNEL BANDWIDTH

If the eirp is related to bandwidth in such a way as to provide more consistent power densities than at present, coordination between different bandwidth systems could be eased. This approach of scaling the eirp levels to a uniform power density level may be very beneficial, if not essential, in successful coordination of systems operating in a multiple overlay channel plan scheme.

11 AREA FREQUENCY ASSIGNMENT PRACTICES

For multipoint systems, the concept of area assignments offers great flexibility and ease of coordination. Under this concept, the service areas and corresponding interference areas are coordinated assuming a standard set of parameters for the out-stations in a point-to-multipoint system. At present, every individual link between the central station and an associated out-station must be considered for coordination. In the area assignment concept, it is not necessary to identify the locations of the out-stations at the time of licensing so that future growth within the service area is automatically accommodated.

The concept could possibly be extended to include point-to-point systems sharing a point-to-multipoint band. Further studies on this subject are required.

SECTION I

THE FREQUENCY BAND 1350 - 1525 MHz

1.1 INTRODUCTION

The band 1350-1525 MHz currently supports a variety of services including three new services, broadcasting, broadcasting-satellite and mobile-satellite, as a result of decisions at WARC-92. This band is comprised of three sub-bands, 1350-1400 MHz, 1400-1427 MHz and 1427-1525 MHz.

In the ITU allocations the radiolocation service has a primary status in the 1350-1400 MHz band. In Canada, this band is heavily used by Government radars. It is proposed to modify the Canadian Table of Frequency Allocations to include the fixed service on a primary basis for the exclusive use of the Government of Canada in this band.

The Radio Regulations prohibits all emissions in the 1400-1427 MHz band in order to protect spectral line observations of the radio astronomy community. In Canada, the Dominion Radio Astrophysical Observatory is operated as a national facility by the National Research Council of Canada. The observatory is located near Penticton, British Columbia in mountainous terrain with natural shielding at elevation angles below 4 degrees in most directions.

SRSP-311 sets out the current rules for the sharing of the band 1427-1525 MHz between the following fixed systems:

- Low capacity point-to-point systems employing digital modulation techniques with a capability of at least 6 Mbit/sec. These systems use 7 MHz wide channels and account for only a small percentage of the assignments in this band.

- Point-to-multipoint subscriber radio systems (SRS) occupying 3.5 MHz wide channels with a go/return channel spacing of 49 MHz. These systems consist of a central hub station with either an omnidirectional or a wide angle antenna serving a number of out-stations. The out-station antenna are generally directional. The central station operates either in frequency or time division duplex while the out-stations operate frequency or time division multiple access modes.

Nationally there are approximately 300 stations (including out-stations) of which the vast majority operate as part of a SRS system. Half of all current assignments in this band are within or overlapped into the DRB allocation at 1452-1492 MHz. An examination of the spectrum availability for the band 1427-1525 MHz indicated that Nova Scotia and the rural prairies have the greatest number of point-to-point and point-to-multipoint (SRS) systems. The omni-directional characteristics of the central stations and the typically wide beam width antennas of the out-stations create fairly large congestion areas with only a few systems.

At WARC'92, digital radio broadcasting (DRB) employing both satellite and terrestrial delivery was allocated in the band 1452-1492 MHz. In addition, the mobile-satellite service (space-to-

Earth) was allocated in the band 1492-1525 MHz. The upper 10 MHz of this band, 1515-1525 MHz, is proposed for allocation to the MSS(s-E) in Canada.

Accordingly, the main objective is to accommodate the new broadcasting and mobile-satellite services while ensuring a continued use of this band for SRS systems with a minimum of transitional adjustment.

1.2 SHARING CONSIDERATIONS

Sharing between the fixed service and the digital radio broadcasting services, the mobile-satellite service and the radio-astronomy service is discussed in the following sections.

1.2.1 Sharing Between the Digital Radio Broadcasting (DRB) Services and SRS or Point-to-Point Radio Communications Systems

National or regional DRB programming will likely be delivered by satellite and local programs will be received from terrestrial transmitters. The DRB satellites are planned to operate in (or near) geostationary orbit (GSO). Sharing with these satellites would be very difficult in view of the following factors;

- The high power flux-densities (pfd) from the satellite necessary for individual reception.
- The low off-axis antenna discrimination of the satellite.
- The fairly low off-axis discrimination of antennas typically found in this band.
- the impossibility of avoiding the GSO with an omnidirectional or wide angle SRS central receiving station antenna.
- The difficulty of avoiding the GSO by the MCS out-stations.

The net result of these factors is that large separation distances, as indicated in Table 1-2, would likely be required, depending on the satellite beam parameters.

Table 1-2: Minimum required separations distance from boresite for a 1° satellite beam

Boresite elevation angle	Maximum dimension of service area from boresite (km)	Minimum hub station separation in direction of satellite horizon (km)	Minimum dimension of service area from boresite (km)	Minimum hub station separation in direction of satellite nadir (km)
10°	1100[1]	1100[1]	1280	1500
20°	1720	2200[1]	830	830[3]
30°	730	3200[1,2]	610	610[3]
40°	550	500[4]	500	500[3]

1 This distance corresponds to the satellite horizon.
2 The interference margin is slightly positive between 1890 km and 2540 km from boresite.
3 This distance corresponds to the edge of service area.
4 For high elevation angles, fixed systems operation just within the DRB satellite service area is possible.

Geographical sharing with the terrestrial delivery of DRB may be more feasible with separation distances as shown in Table 1-3.

Table 1-3:
Required separation distance from a terrestrial DRB transmitter to a fixed service hub station at 1.5 GHz to protect point-to-multipoint systems.

DRB ERP (kW)	DRB EHAAT[1] (m)	Required separation (km) (1 dB margin degradation)	Required separation (km) (3 dB margin degradation)
1	75	100	70
10	150	160	120
100	300	250	200
1000	300	310	270

[1] Equivalent height above average terrain of the DRB antenna

For point-to-point fixed systems, additional antenna discrimination is possible due to the directional beam and to possible site selection flexibility. Thus off-axis separation distances will, in general, be smaller than for point-to-multipoint systems where adequate off-axis avoidance is impossible. Due to the gain of a point-to-point antenna, if the main beam points at the terrestrial DRB transmitter, the required separation distance becomes much larger than those of point-to-multipoint systems.

The allocated 40 MHz DRB spectrum, 1452 - 1492 MHz, directly impacts channels A3, A4, A5, A6, A1', and A2' of low capacity point-to-point systems (Table 1.1) and channels S10, S5, S6, S1', S2', S3', S4', and S7' of MCS systems. Taking account of the paired channels, under the present channelling arrangement all six channel pairs of the current point-to-point systems and eight out of ten of the channel pairs for the SRS systems would be impacted.

In view of the sharing difficulties between the fixed service and the broadcasting services and the fact that Canada intends to introduce digital radio broadcasting in the 1452 - 1492 MHz band (field trials are already underway), re-channelling to partition this band is in order.

1.2.2 Sharing Between the Mobile-satellite Service (Space-to-Earth) and SRS or Point-to-point Systems

Since communication with small portable units in addition to vehicular mounted stations is the principle aim of both the DRB service and the mobile-satellite service, the power flux-densities at the surface of the Earth for the mobile-satellite downlink may be similar to that of the DRB satellite. Consequently the required separation distances could be similar, thus, sharing between the mobile-satellite downlink and the fixed services would also be difficult.

The mobile-satellite service may deploy satellites in either geostationary orbit or in non-geostationary orbit. In general, sharing with point-to-point systems may be particularly difficult at low angles of arrival even with avoidance of the geostationary orbit by 4° to 6° (resulting in about a 30% reduction in azimuth flexibility at mid latitudes). At high angles of arrival, the use of high performance antenna in the point-to-point systems improves the sharing potential. In the case of SRS systems sharing is only marginally feasible due to the omni-

directional antennas on the central stations and the typically wide beam widths of the out-station antennas.

At the present time, coordination is triggered if the power flux-density from the mobile- satellite exceeds -152 dBW/m^2/4 kHz for angles of arrival less than 5° or -142 dBW/m^2/4 kHz for angles of arrival greater than 25° on territories of other administrations (linear between these two points). These values are currently under review in the CCIR. It should be emphasized that these values are not limits but trigger levels and the fixed service is expected to operate successfully in levels below these values. Satellites may operate at higher power flux density levels if these levels can be successfully coordinated.

1.2.3 Adjacent Band Considerations

It will be necessary to take into account possible adjacent channel effects from the high power emissions from terrestrial DRB transmitters operating near the band edges of the 1452-1492 MHz band. With respect to out-of-band emissions from DRB transmitters, not withstanding regulatory limits, it is anticipated that suitable guard bands and filtering will be in place.

However, even if the broadcast emissions were entirely contained within the allocated bands, the presence of an adjacent high power signal could have a detrimental impact on the front end of a radio communications receiver due to non-linear effects. Thus, channels S7 and S1' may be vulnerable to adverse adjacent channel effects unless adequate precautions are taken.

The flux of a terrestrial broadcasting transmitter drops off rapidly with distance. Thus, to achieve adequate service levels at edge of coverage, quite high flux levels are experienced in the immediate vicinity of such a transmitter. Locating such a transmitter near the central station of a SRS system and close in frequency could place heavy demands on the filtering of both services.

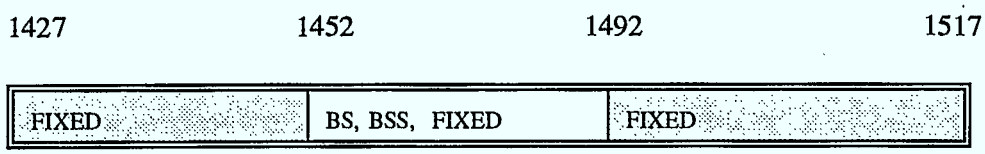
Since there is a more uniform distribution of energy in a satellite service area, the filtering requirements for the subscriber radio systems and both the broadcasting-satellite and the mobile-satellite services are not as severe as in the terrestrial broadcasting case. Furthermore, some antenna discrimination at the fixed service receivers (even for omnidirectional antennas) will be obtained thus reducing the level of the adjacent band signal.

1.2.4 Coordination With Radio Astronomy

The Department is currently considering coordination guidelines for other radio services, such as the fixed service, which are proposed to operate in the vicinity a radioastronomy site. Note that the Radio Regulations do not allow any emissions in the 1400-1427 MHz band.

1.3 PROPOSED TECHNICAL STRATEGY

The introduction of DRB in the band 1452-1492 MHz divided the existing MCS band of 1427-1525 MHz into three portions as shown below.



A revised channelling plan for subscriber radio systems is proposed for the sub-bands, 1427-1452 MHz and 1492-1517 MHz. The new plan, shown in Table 1-4, uses the two 25 MHz bands which accommodate seven 3.5 MHz wide point-to-multipoint channel pairs with a translation frequency of 65 MHz. The two 25 MHz bands do not overlap the DRB allocation. This arrangement provides exclusive frequency bands for the SRS and the DRB systems and also provides 0.5 MHz guard bands adjacent to the DRB band.

Table 1-4:

Channel carrier frequencies for subscriber radio systems (SRS) operating in the bands 1427 - 1452 MHz and 1492 - 1515 MHz

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
S1	1428.75	S1'	1493.75
S2	1432.25	S2'	1497.25
S3	1435.75	S3'	1500.75
S4	1439.25	S4'	1504.25
S5	1442.75	S5'	1507.75
S6	1446.25	S6'	1511.25
S7	1449.75	S7'	1514.75

Channel S7' overlaps the potential mobile satellite band 1515 - 1525 MHz and is therefore subject to special coordination conditions.

1.3.1 Transition Strategy

In order to facilitate the proposed technical adjustments described above it will be necessary to consider a transition strategy which address both the existing and new services in this band. The following suggestions are intended to foster discussion and provide an initial view on this matter:

1. Point-to-point systems become non-standard in this band. Most of these systems are in the rural areas and therefore operators could expect to continue to operate for a number of years, given the likely DRB implementation time frame. Also, there is the possibility that some point-to-point systems may have to find alternate bands in order to accommodate the spectrum needs of new SRS systems or existing SRS systems moving to the new chanelling plan.

2. The upper band 1492-1517 MHz will be allocated to the central station transmitters and the lower band 1427-1452 MHz to the out-station transmitters. This arrangement will maintain a maximum frequency separation to the DRB station emissions for as long as possible. This will allow time to develop suitable solutions for any adjacent channel problems and it would be suitable for both the terrestrial and the satellite delivery of DRB.

3. Referring to the channel arrangement in Table 1-4, loading will start from S6/S6' and proceed downwards to provide maximum separation from DRB assignments. Depending upon the characteristics and intended usage of the mobile-satellite service, sharing of the downlink band by point-to-multipoint radio may be marginal. Therefore, the upper carrier frequencies S7/S7' may be reduced to a secondary status in the event that the mobile-satellite service is implemented in Canada in the band 1515 - 1525 MHz.

4. Existing SRS systems may be re-tuned to the bands 1427 - 1452 MHz and 1492 - 1517 MHz. Re-tuning would, in all probability, be a factory operation. A large multipoint system with many out-stations may present significant logistics challenges if system down time is to be minimized during the re-tuning process. The timing of the retuning or reassignment in the new channelling plan would require close coordination with DRB implementation timing, noting that SRS stations in or near metropolitan areas will likely be the first to be affected by the introduction of terretrial DRB.

5. No new point-to-multipoint systems conforming to the present channelling plan as standard in the 1427 - 1525 MHz band be authorized when the policy comes into effect. Allow expansion of existing systems under the present channelling arrangements on a non-standard basis subject to the procedures for non-standard systems detailed in SP-GEN. Assign new systems according to the new channelling plan from the date the policy comes into effect. Coordination between old and new systems during the transition period would continue to use the present link by link process. Eventually when all systems conform to the new channelling plan, area wide coordination for multipoint systems could be introduced to speed up the coordination process and to provide greater flexibility in the planning and expansion of subscriber radio systems.

Table 1-1: Channel Arrangements for the band 1427 - 1525 MHz (see SRSP-311)			
Channel No. (SRS Systems)	Frequency (MHz)	Channel No. (Point-to-point Systems)	
S1	1428.75		
S2	1432.25		
S3	1435.75		
	1437.50	A1	
S4	1439.25		
S7	1442.75		
	1444.50	A2	
S8	1446.25		
S9	1449.75		
	1451.50	A3	
S10	1453.25		The band 1452-1492 MHz is allocated for future digital radio broadcasting (DRB).
S5	1456.75		
	1458.50	A4	
S6	1460.25		
	1465.50	A5	
	1472.50	A6	
S1'	1477.75		
S2'	1481.25		
S3'	1484.75		
	1486.50	A1'	
S4'	1488.25		
S7'	1491.75		
	1493.50	A2'	
S8'	1495.25		
S9'	1498.75		
	1500.50	A3'	
S10'	1502.25		
S5'	1505.75		
	1507.50	A4'	
S6'	1509.25		
	1514.50	A5'	The band 1515-1525 MHz may be allocated to MSS(s-E)
	1521.50	A6'	

SECTION 2

THE FREQUENCY BAND 1700 - 1900 MHz

2.1 INTRODUCTION

The 1710-1900 MHz band currently supports very low, low and medium capacity (VLC, LC, MC, respectively) analogue and low capacity digital systems. In the 1700-1710 MHz band, sound broadcasting studio-to-transmitter links are supported. The 1710-1900 MHz band is extensively used in all regions of the country for a variety of applications. The favourable propagation characteristics and the availability of a wide range of equipment have helped promote the use of this band. Consequently, the Department recognizes the need to re-accommodate as many existing systems within the band itself and the importance of promoting the use of spectrally efficient equipment.

The major change proposed is the introduction of the high density mobile systems in the 1870-1900 MHz portion of the band. This could include personal communication systems in the urban and near-urban areas with radiated power levels of a few milliwatts (FPLMTS) to 100's of watts (PCS) depending on the application. Therefore a key objective of this exercise is to consider ways to re-accommodate the microwave systems which operate in the 1870-1900 MHz portion of this band.

The current channelling arrangements (SRSP 301.71) provide a range of bandwidths from 0.875 MHz to 7.0 MHz to accommodate VLC, LC and MC systems. Table 2-1 describes these channel plans.

Table 2-1: Current Channel Plans

PLAN	Channel Bandwidth (MHz)	Go/Return Bands (MHz)	No. of Chan.	Min. Efficiency (bits/sec/Hz)
A	0.875	1710-1791/1818-1900	93	1
B	1.75	1708-1791/1818-1899	46	1
C	3.5	1711-1796/1820-1905	24	1
D	7.0	1710-1794/1818-1903	12	1

In practice, the 0.875 MHz and the 1.75 MHz channels are seldom used, primarily due to a lack of equipment and user demand. The 3.5 MHz and 7.0 MHz channels are both very heavily used across the country resulting in moderate to high congestion in many urban and rural areas. Given the reduction in available spectrum in this band in the urban areas and the operators preference to use the wider bandwidth channels, it would seem reasonable to focus the re-channelling efforts

on the 3.5 MHz and the 7.0 MHz channels. If necessary, the narrow band 0.875 MHz and 1.75 MHz channels could be derived as subsets of the 3.5 MHz channels on a case by case basis.

There are approximately 600 stations across Canada which have microwave equipment using frequencies in the 1710-1900 MHz band. All provinces have extensive areas of frequency congestion, particulary near urban centres. For example, Southern Ontario is heavily congested except in the less populated areas north of Barrie and north of Trenton.

2.2 SHARING CONSIDERATIONS

The fixed service and the mobile service are proposed to be allocated co-primary in the 1870 - 1900 MHz band. As the operating parameters of the new mobile service in this band are not yet identified it is very difficult to specify the required separation distances between the fixed and mobile services. However, Table 2-2 indicates typical coordination distances for various base station power levels.

Table 2-2: Typical Coordination Distances Between Point-to-Point Radio Stations and PCS/FPLMTS Base Stations

Mobile Base Station EIRP (W)	Coordination Distance	Comments
<1.0	10 km in back-lobe of FS station 120 km in main beam of FS station	FPLMTS low power micro-cell concept under study by the CCIR
10	200 km from base station	PCS typical urban base station for medium sized cell concept per the FCC initiative
1000	425 km from base station	PCS base station for large cell concept per the FCC initiative

FPLMTS: Future Public Land Mobile Telecommunication System
PCS : Personal Communication System

Impacted point-to-point systems should be considered for re-accommodation in view of the above coordination constraints.

2.3 TECHNICAL STRATEGY

The Department has examined a number of channelling options ranging from a simple extension of the existing plans to more elaborate arrangements such as combining the 1700 - 1900 MHz band with the 1900 - 2290 MHz band into one homogenous plan. It appears that it may be possible to offer two procedures in the 1700 - 1900 MHz band;

- Procedure 1, expanding the band to include the 1700 - 1710 MHz band (and a

corresponding 'return' band 1809.75 - 1820.25 MHz) and allowing existing systems to use the same channel arrangements as at present in these expanded bands until such time as the demand for spectrum for the mobile services materializes, and

- Procedure 2, making available to future systems a new channelling arrangement which takes advantage of more spectrally efficient technology.

The advantage of the two procedure approach is that it will allow immediate transition within the 'existing' plan while providing a more efficient plan for new applicants. Eventually all systems would adhere to Procedure 2 as the equipment becomes due for replacement.

2.3.1 Procedure 1 Channel Plan

Procedure 1, as shown in Tables 2-3 and 2-4, is an extension of the existing channelling plan providing three new 3.5 MHz channel pairs and one extra 7.0 MHz channel pair.

In the 3.5 MHz plan (Table 2-3), the potentially displaced channel pairs C15/C15' to C24/C24' may be recovered by re-tuning equipment to the existing C1/C1' to C14/C14' channel pairs or alternately to the new C0/C0' to -C2/-C2' channel pairs. Similarly the 7.0 MHz plan (Table 2-4) offers channel pairs D0/D0' to D7/D7' as replacements for potentially displaced channel pairs D8/D8' to D12/D12'.

It is proposed to maintain all other conditions within the current SRSP 301.71 (Issue 3) as they apply to the 3.5 MHz and 7.0 MHz plans. Displaced systems which operate on the 0.875 MHz and 1.75 MHz channel plans and have channels operating in the range 1870 to 1900 MHz may be accommodated on channel pairs below 1870 MHz from the existing plan as described in SRSP 301.71 (i.e., chose a new 0.875 MHz pair from A1/A1' to A58/A58' and a new 1.75 MHz pair from B1/B1' to B29/B29').

> *Note that Procedure 1 applies only to the existing systems that may have to re-tune to avoid using the 1870 - 1900 MHz band and to new systems that would be deployed in uncongested areas as defined by the Geographical Differences Policy.*

2.3.2 Procedure 2 Block Channel Plan

Procedure 2 reflects an attempt to include the orphaned portion of the band, 1762.5 - 1794.0 MHz, which was lost in Procedure 1 in areas where PCS or FPLMTS would operate.

Under these conditions, it may be possible to consider a modular sub-band approach. Considering, for example, a 21 MHz sub-band that could support a maximum of six 3.5 MHz channels (or three 7.0 MHz channels) in one direction. This would be paired with another 21 MHz sub-band for the other direction of transmission. If the total band is wide enough, it may be possible to overlap the 'go' and 'return' bands. This approach results in a requirement

for several versions of the input band-pass filter to provide sufficient isolation between sub-bands. Since it is unlikely that a low capacity system would utilize more than two or three RF channels, with appropriate pairing of sub-bands there would still be sufficient gap between the occupied RF channels to provide adequate filter transition bands between the pass band and the stop band.

If filter transition bands of 21 MHz (equivalent to six 3.5 MHz RF channel widths) are assumed either side of the 21 MHz pass band (so that the next adjacent sub-band is fully attenuated) and if the 1700 - 1870 MHz is subdivided into 48 (3.5 MHz) RF channels grouped into eight blocks of six RF channels, a set of eight band-pass input filters with upper and lower transition bands and pass bands equal to six RF channel widths (see Figure 2-2) would provide adequate filtering. In the case of go/return band overlap, the mid band filters would be used in both the 'go' direction for one set of channel pairs and in the 'return' direction for another set of channel pairs (see Figure 2-1).

This eight input filter configuration compares with the two input filters (one for the 84 MHz 'go' band and one for the 84 MHz 'return' band where the band separation is 14 MHz) in the present lower 2 GHz system. The eight filters in the Procedure 2 concept all have the same pass band to stop band ratio (33% [1]) which is less stringent than the pass band to stop band ratio of the present filters (75% [2]).

One pair of six channel blocks should provide sufficient flexibility to permit a single licensee to implement up to three 3.5 MHz channel pairs in a four-channel route plan (without frequency diversity) and up to two 3.5 MHz channel pairs in a four-channel route plan with frequency diversity. Similarly, for 7 MHz channels, up to two channel pairs in a two-frequency route plan with frequency diversity can be accommodated in one block.

Three alternative go/return translation frequencies are considered;

- 63 MHz — e.g., block 1 paired with block 4 etc.,
  (blocks 4 and 5 overlap in the go and return directions, see Figure 2-1(b)); this arrangement offers thirty 3.5 MHz channel pairs,
- 84 MHz — e.g., block 1 paired with block 5 etc.,
  (no overlap, see Figure 2-1(a)); this arrangement matches the 24 channel pair capacity (3.5 MHz channel) of the present channel plan, or
- 105 MHz — e.g., block 1 paired with block 6 etc.,
  (no overlap, blocks 4 and 5 would not be paired in this arrangement, see Figure 2-1(c)); this arrangement offers 18 channel pairs (3.5 MHz channel).

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[1] Pass band = 21 MHz, stop band = lower transition + pass band + upper transition = 63 MHz.

[2] Pass band = 84 MHz,
stop band = lower transition + pass band + upper transition = 14 + 84 + 14 = 112 MHz.

The block channelling plans for these alternatives are shown in Table 2-5 and Figure 2-1. The three go/return translation options provide operators with more flexibility to use the available channels and facilitates balanced loading of each frequency block noting that each block is used three times in these three options.

The new concept channel plans would apply to new digital systems and optionally to digital systems which would have to be re-accommodated due to the introduction of mobile services. It would thus be necessary to coordinate with present systems that are not impacted by the mobile services. The narrower band filters suggested herein should ease coordination with both existing systems conforming to the present channelling scheme and with future systems conforming to Procedure 2.

Coordination between systems in Procedure 1 and systems in the Procedure 2 concept should not be any more challenging than present coordination since EMC analyses are conducted on each transmitted frequency.

2.3.3 Transition Strategy

The following may facilitate a reasonable transition for the potentially affected point-to-point radio communications systems:

1. Potentially affected fixed systems can be defined as operating within or near the coordination distances of the above land mobile services (PCS and FPLMTS) and having channels overlapping the 1870 - 1900 MHz band. Detailed EMC analysis could be used to determine the degree of impact once the parameters of the mobile system are known or can be estimated.

2. The actual timetable for ceasing operation on the overlapped channels is in accordance with the policy directives to be developed after public consideration of these proposals.

3. If a fixed service system is identified as a potential victim of harmful interference from, or the potential cause of harmful interference into, a PCS or FPLMTS installation and if alternative accommodation is deemed appropriate, operators have a number of options to re-accommodate a displaced channel(s), for example:

    - Re-tune affected channel pair to an available pair in the lower portion of the band (1700 - 1870 MHz). See §2.3.1 on channelling plan options.

    - Re-configure the affected channel pair (or link) to operate in an alternative frequency band.

    - Increase the capacity on the remaining channel pair(s) to make up the lost throughput.

    - Reduce or eliminate any diversity channels and re-configure the system to a two-frequency route plan.

Procedure 1, which is a modification of the present channelling plan, would allow existing systems to continue and expand but with fewer channels to choose from (17 pairs compared to 24 pairs). In addition, if the three additional channel pairs -C2/-C2', -C1/-C1', and C0/C0' are adopted, it will be necessary to modify all input filters to accommodate the new 'go' and 'return' bands 1701.25 MHz to 1760.75 MHz and 1809.75 MHz to 1869.25 MHz, respectively [3]. As a minimum, even if the three additional channels are not adopted, the 'return' band filters may have to be modified in some cases to reject the PCS band 1870 - 1900 MHz.

The Procedure 2 block plan arrangement for new systems implies up to eight versions of input filters and re-tuning or re-design to accommodate the new centre frequencies and translation frequencies.

With respect to timing, it is expected that the personal communications systems will exhibit fairly rapid growth in metropolitan areas and moderate growth in rural areas. These mobile systems are still in concept stage and estimates of commencement dates and demand vary.

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[3] Pass band to stop band ratio = 59.5/(59.5 + 2x49) = 38%; band separation = 49 MHz; translation = 108.5 MHz.

Table 2-3: Procedure 1; Modified 3.5 MHz Channel Arrangement

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
-C2	*1703.0*	*-C2'*	*1811.5*
-C1	*1706.5*	*-C1'*	*1815.0*
C0	*1710.0*	*C0*	*1818.5*
C1	1713.5	C1'	1822.0
C2	1717.0	C2'	1825.5
C3	1720.5	C3'	1829.0
C4	1724.0	C4'	1832.5
C5	1727.5	C5'	1836.0
C6	1731.0	C6'	1839.5
C7	1734.5	C7'	1843.0
C8	1738.0	C8'	1846.5
C9	1741.5	C9'	1850.0
C10	1745.0	C10'	1853.5
C11	1748.5	C11'	1857.0
C12	1752.0	C12'	1860.5
C13	1755.5	C13'	1864.0
C14	1759.0	C14'	1867.5
C15	1762.5	C15'	1871.0
C16	1766.0	C16'	1874.5
C17	1769.5	C17'	1878.0
C18	1773.0	C18'	1881.5
C19	1776.5	C19'	1885.5
C20	1780.0	C20'	1888.5
C21	1783.5	C21'	1892.0
C22	1787.0	C22'	1895.5
C23	1790.5	C23'	1899.0
C24	1794.0	C24'	1902.5

Italic Additional Channel Pairs

Potentially Displaced Channel Pairs

Table 2-4: Procedure 1; Modified 7.0 MHz Channel Arrangement

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
D0	*1706.5*	*D0'*	*1815.0*
D1	1713.5	D1'	1822.0
D2	1720.5	D2'	1829.0
D3	1727.5	D3'	1836.0
D4	1734.5	D4'	1843.0
D5	1741.5	D5'	1850.0
D6	1748.5	D6'	1857.0
D7	1755.5	D7'	1864.0
D8	1762.5	D8'	1871.0
D9	1769.5	D9'	1878.0
D10	1776.5	D10'	1885.0
D11	1783.5	D11'	1892.0
D12	1790.5	D12'	1899.0

Italic Additional Channel Pairs

Potentially Displaced Channel Pairs

Table 2-5: Procedure 2; Block Plan Arrangement

1	2	3	4	5	6	7	8
A1-A6 B1-B3	A7-A12 B4-B6	A13-A18 B7-B9	A19-A24 B10-B12	A25-A30 B13-B15	A31-A36 B16-B18	A37-A42 B19-B21	A43-A48 B22-B24

An = 1698.25 + 3.5n n = 1...48
Bn = 1696.5 + 7.0n n = 1...24

Figure 2-1: Procedure 2; Alternative Go/Return Arrangements

(a) T/R Translation 84 MHz

GO	RETURN
1	5
2	6
3	7
4	8

(b) T/R Translation 63 MHz

GO	RETURN
1	4
2	5
3	6
4	7
5	8

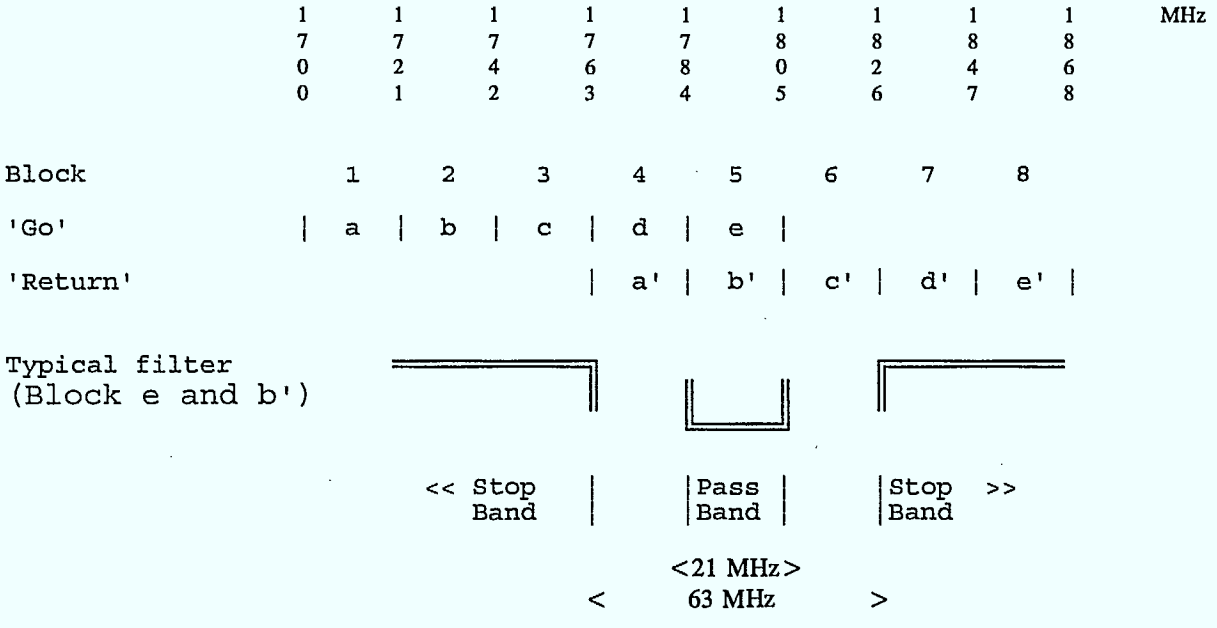
(c) T/R Translation 105 MHz

GO	RETURN
1	6
2	7
3	8

Maximum Capacity (no. of 3.5 MHz channel pairs);

24 30 18

Figure 2-2: Procedure 2; Typical Filter Characteristic



pass band to stop band ratio 33%

SECTION 3

THE FREQUENCY BAND 1900 - 2290 MHz

3.1 INTRODUCTION

The current use of the 1900-2290 MHz band by the fixed service is limited to high capacity analogue and medium capacity digital line-of-sight radio systems. These systems operate in accordance with a 29 MHz channelling plan which provides up to 12 channel pairs.

As per the policy proposal, this band will be shared with other services such as the mobile service (personal communication systems), mobile-satellite service and scientific satellite services. Consideration of the sharing constraints between the fixed service and these other services have resulted in the identification of the core bands 2025-2110 MHz and 2200-2290 MHz where fixed systems may operate virtually unrestricted by these other services.

The existing channelling plan, as shown in Table 3-1, consists of two overlapping sub-plans, each of six pairs of 29 MHz channels. The 1900-2290 MHz band supports the following standard uses:

1. High capacity analogue systems, typically using FM modulation with RF channel loading from 600 to approximately 1260 SSB-FDM telephony channels or equivalent, including a television channel.

2. Medium capacity digital systems.

3. On a case by case basis, systems carrying wideband radar video information using analogue or digital modulation.

The band is extensively used across Canada and, based on the 29 MHz channels, it can be deemed as moderately to highly congested in several areas notably; Southern Quebec, Southern Ontario, Calgary-Edmonton area, greater Kamloops area and greater Vancouver area.

The band 2110-2120 MHz is used by the space science community for deep space transmissions (Earth-to-space). Deep space facilities do not currently exist in Canada. However, in the U.S.A., NASA operates a deep space uplink in New Mexico. In the event that Canada would develop a deep space facility, coordination with the fixed service is feasible.

Table 3-1: Existing Channel Plan

Group A CHANNEL CARRIER FREQ.		Group B CHANNEL CARRIER FREQ.	
Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	1922.0	B1	1907.5
A2	1951.0	B2	1936.5
A3	1980.0	B3	1965.5
A4	2009.0	B4	1994.5
A5	2038.0	B5	2023.5
A6	2067.0	B6	2052.5
A1'	2135.0	B1'	2120.5
A2'	2164.0	B2'	2149.5
A3'	2193.0	B3'	2178.5
A4'	2222.0	B4'	2207.5
A5'	2251.0	B5'	2236.5
A6'	2280.0	B6'	2265.5

3.2 SHARING CONSIDERATIONS

Three services share the 1900-2290 MHz band with the fixed service (see proposed revision of the Canadian Table of Frequency Allocations);

- Mobile service (personal communications systems (PCS) and future public land mobile telecommunications systems (FPLMTS); geographic sharing possible in uncongested areas),
- Mobile-satellite service (space-to-Earth and Earth-to-space directions; satellites in either geostationary orbit or non-stationary orbit; sharing in the downlink is difficult, sharing in the uplink may be possible with geographic restrictions), and
- Space science services (space-to-Earth, Earth-to-space and space-to-space directions; satellites predominantly in non-geostationary orbit but some geostationary orbit applications exist; sharing feasible)

3.2.1 Mobile Services (1900 - 2025 MHz and 2110 - 2200 MHz)

At this time, the type of mobile service which will occupy these bands has not been identified. However, the typical coordination distances indicated in Section 2.2 (1700-1900 MHz) would most likely also apply in this band.

3.2.2 Mobile-Satellite Service (MSS) (1970-2110 MHz (Earth-to-space), 2160-2200 MHz (space-to-Earth)

The MSS, both in geostationary orbit and in non-geostationary orbit could be developed by Canada and the United States. Studies have indicated the following sharing constraints:

- Limited sharing between the fixed service and geostationary MSS systems is possible in the uplink band 1970-2110 MHz assuming adequate orbit avoidance and some geographical/frequency constraints on the mobile Earth stations.

- Sharing with MSS downlinks (geostationary or non-geostationary satellites) in the band 2160-2200 MHz is difficult due to the high levels of power flux-density required for communication with portable MSS terminals. Orbit avoidance of up to 6° and use of high performance antennas in the fixed service may make sharing in the downlink feasible for geostationary MSS.

- Sharing between MSS uplinks to non-geostationary satellites and fixed systems is difficult since orbit avoidance is not possible. Thus, the satellites may be susceptible to interference as they pass through the beams of the fixed stations. With respect to interference into the fixed stations from distributed mobile Earth stations (geostationary or non-geostationary satellites), uplink control mechanisms such as frequency assignment by location, which are necessary for the operation of the MSS, may be able to provide some protection to the fixed service.

Per Radio Regulation 46, at the present time MSS must coordinate with other services when the power flux-density at the surface of the earth exceeds;

-152	dBW/m^2/4 kHz for angles of arrival less than 5°
-152 + 0.5(δ-5)	dBW/m^2/4 kHz for angles of arrival 'δ' between 5° and 25°
-142	dBW/m^2/4 kHz for angles of arrival greater than 25.°

These trigger levels are currently under review in the CCIR. Other mitigative measures e.g., interference cancellers, dynamic frequency allocation by area for the MSS, use of low power spread spectrum techniques by the MSS, are also under study.

3.2.3 Space Science Services (2025 - 2110 MHz, 2200 - 2290 MHz) (deep space 2110 - 2120 MHz)

At WARC-92, the space research, space operation and Earth-exploration satellite services were given a primary status in the bands 2025-2110 MHz and 2200-2290 MHz. Sharing studies

performed by Canada and other administrations indicate that the fixed service and the space science services can share the band very effectively with a minimum of restrictions to either service. In fact, this sharing arrangement has been in practice for many years as both services have substantial installed plant in these bands.

In order that the fixed service and the space science services may continue to make effective use of this spectrum, the following power flux-density (pfd) limits and fixed service station antenna pointing restrictions were agreed to at WARC-92:

1. The maximum pfd level from space science spacecraft (both geostationary and non-stationary) at the surface of the Earth is (per Radio Regulation 2557):

-154	dBW/m^2/4 kHz for angles of arrival below 5° above the horizontal plane.
-154 + 0.5(δ-5)	dBW/m^2/4 kHz for angles of arrival 'δ' between 5° and 25° above the horizontal plane.
-144	dBW/m^2/4 kHz for angles of arrival between 25° and 90° above the horizontal plane.

2. While the majority of the space science spacecraft are in non-geostationary orbits, geostationary data relay satellites are an integral part of the space science services. Based on studies conducted in Canada, the direction of the maximum radiation of any fixed service station should be at least 4° away from the geostationary orbit, taking into account the effect of atmospheric refraction. For their own protection, fixed service receiving stations should also avoid directing their antenna towards the geostationary orbit if the potential for interference exists given the pfd limits of this band.

   The exposure to potential interference at low angles of incidence between a satellite in low Earth circular orbit and a fixed service point-to-point station is short term with respect to both the cumulative percentage of time and the maximum duration of a single exposure for both Earth-to-space links and space-to-space links (grazing incidence between LEO satellite and geostationary data relay satellite). Downlink exposures at high angles of incidence for a satellite in low Earth circular orbit and the tracking beams of data relay satellites are considered long term. Under these conditions, the pfd values required to protect digital systems in the fixed service in both situations are consistent with the limits in RR 2557 (shown above). These pfd limits are under review in the CCIR.

3.3 TECHNICAL STRATEGY

As in the 1700-1900 MHz band, a key objective of the new channelling arrangement for this band is to allow an existing operator, where possible, to migrate the affected channel pairs to new channel pairs within the band while maintaining the existing transmit/receive spacing. However, in examining the existing channel plan for this band, it is apparent that the channel bandwidth will have to be reduced significantly. Even if this band was not effected by the decisions of WARC-

92, the high level of congestion and the relatively few channels available in the plan would warrant the introduction of much smaller bandwidth channels.

The channelling plan arrangement for this band must recognize the need to make very efficient use of the limited spectrum, particulary in the 'core' bands 2025-2110 MHz and 2200-2290 MHz. It should be noted that this is the only band being proposed for medium capacity fixed systems in the 1-3 GHz range.

The proposed channelling plan for this band consists of two arrangements:

- Plan A provides 12 channel pairs over the full range of the band (1900-2290 MHz). Each channel is 14.5 MHz wide.

- Plan B applies only to the 'core' bands (2025-2110 MHz and 2200-2290 MHz) and it supports 9 channel pairs with a channel bandwidth of 10 MHz. Plan B will also use 5 MHz of the deep space uplink band, 2110-2120 MHz, in order to have balanced go/return bands.

3.3.1 Plan A Channel Plan

Plan A (see Table 3-2) is designed to accommodate displaced channel(s) in other portions of the band. For example, fixed systems in the greater Toronto area may find the introduction of PCS services will prevent them from using the 1900-1960 MHz portion of the band. Therefore the operators may elect to re-tune to channel pairs above 1960 MHz (A6/A6' to A12/A12'). This retains the same transmit/receive spacing, while requiring that channel bandwidth be reduced to 14.5 MHz. It should also be noted that the centre frequencies of Plan A are identical to those of the existing overlapping channelling arrangements.

Table 3-2: Plan A Channelling Arrangement

PLAN A - 14.5 MHz CHANNELLING ARRANGEMENT			
GO CHANNELS	FREQUENCY (MHZ)	RETURN CHANNELS	FREQUENCY (MHZ)
A1	1907.5	A1'	2120.5
A2	1922.0	A2'	2135.0
A3	1936.5	A3'	2149.5
A4	1951.0	A4'	2164.0
A5	1965.5	A5'	2178.5
A6	1980.0	A6'	2193.0
A7	1994.5	A7'	2207.5
A8	2009.0	A8'	2222.0
A9	2023.5	A9'	2236.5
A10	2038.0	A10'	2251.0
A11	2052.5	A11'	2265.5
A12	2067.0	A12'	2280.0

The channel pairs A7/A7' to A12/A12' overlap into the 'core' bands and therefore should only be used as transition channels in areas of low fixed service congestion. Channel pairs A1/A1' to A6/A6' may be used in moderate to highly congested areas provided there is no conflict with emerging personal communication systems (PCS).

3.3.2 Plan B Channel Plan

Plan B uses the core bands 2025-2110 MHz and 2200-2290 MHz and 5 MHz of the deep space band from 2110-2115 MHz (See Table 3-3). This provides two 90 MHz go/return fixed service bands. It is proposed that the band pair 2025-2115 MHz and 2200-2290 MHz support nine channel pairs with a channel bandwidth of 10 MHz. As per the policy proposal, this band is designated for spectrally efficient medium capacity systems particulary in areas of moderate to high congestion. Furthermore, existing systems may have to conform to Plan B especially if they currently occupy 29 MHz channels in a congested area.

Table 3-3: Plan B Channelling Arrangement

PLAN B - 10.0 MHz CHANNELLING ARRANGEMENT			
GO CHANNELS	FREQUENCY (MHZ)	RETURN CHANNELS	FREQUENCY (MHZ)
B1	2030	B1'	2205
B2	2040	B2'	2215
B3	2050	B3'	2225
B4	2060	B4'	2235
B5	2070	B5'	2245
B6	2080	B6'	2255
B7	2090	B7'	2265
B8	2100	B8'	2275
B9	2110	B9'	2285

3.3.3 Transitional strategy

The following points may facilitate a reasonable transition for the potentially affected point-to-point radio communication systems:

1. Potentially affected fixed systems can be defined as operating within or near the coordination distances of the land mobile services (PCS and FPLMTS as indicated in Section 2) and having channels overlapping the 1900-2025 MHz and 2110-2200 MHz bands. Detailed EMC analysis could be used to determine the degree of impact once the parameters of the mobile system are known or can be estimated.

2. The actual timetable for ceasing operation on the overlapped channels would be in accordance with policy directives to be developed after public consideration of these proposals.

3. If a fixed service system is identified as a potential victim of harmful interference from, or the potential cause of harmful interference into a PCS or FPLMTS installation and if alternative accommodation is deemed appropriate, operators have a number of options to re-accommodate a displaced channel(s), for example:

    - Re-tune an affected channel pair to an available pair elsewhere in the band according to the new channel plans A or B. See §3.3.1 and §3.3.2 on channelling plan options.

- Re-configure the affected channel pair (or link) to operate in an alternative frequency band.

- Increase the capacity on the remaining channel pair(s) to make up the lost throughput.

- Reduce or eliminate any diversity channels and reconfigure the system to a two-frequency route plan.

Plan A may be viewed as a 'stop-gap' measure for systems which may be retired in short to medium term. However, given that it is likely that the mobile and mobile satellite services will occupy their respective allocations in this band and taking note of proposed footnote C AAE which potentially relegates the fixed service to secondary in the mobile and mobile-satellite bands,. the longer term solution is Plan B.

Alternatively, some operators may chose to relocate to higher frequency bands or to different media. From a purely technical point of view, there does not appear to be any major obstacle to the utilization of alternate frequency bands at least up to about 10 GHz where precipitation fading starts to become significant.

SECTION 4

THE FREQUENCY BAND 2290 - 2500 MHz

4.1 INTRODUCTION

WARC-92 has added new satellite services to the 2290-2500 MHz band. The broadcasting satellite service (sound) and complimentary terrestrial broadcasting service has been allocated to the 2310-2360 MHz band for use in the United States. In the band 2483.5-2500 MHz the mobile satellite service (space-to-Earth) was allocated on a primary basis. The fixed service may be reduced to a secondary status if the MSS allocated to this band is implemented in Canada. The fixed services allocation in the 2290-2500 MHz band has not changed. Furthermore the use of the 2400-2500 MHz band by all services is with the provision that no protection from RF emissions caused by industrial scientific, medical and equipment is available.

In Canada, the existing spectrum usage of the band 2290-2500 MHz is as follows:

- The 2290-2326 and 2390-2426 MHz bands are allocated to point-to-point systems. Frequency channel pairs of 1.5 MHz, 3 MHz, 4.5 MHz and 6 MHz bandwidths are available. The frequency separation between go and return channels is 100 MHz in all cases.

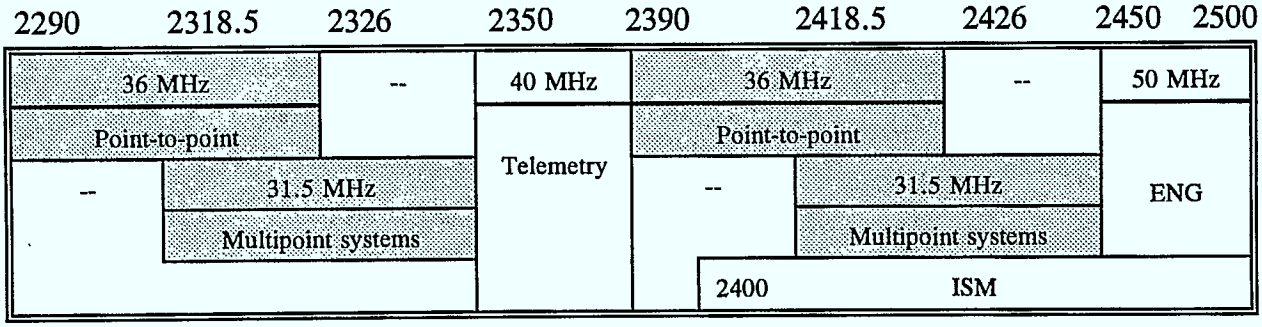
- The 2318.5-2350 MHz and 2418.5-2450 MHz bands are allocated for point-to-multipoint systems (MCS). These bands support nine channel pairs of 3.5 MHz bandwidth with a translation frequency of 100 MHz.

- The overlapping frequency bands 2318.5-2326 MHz and 2418.5-2426 MHz are shared and are accessible to both point-to-point systems and point-to-multipoint systems on a first come, first served basis.

- The use of the band 2350-2390 MHz is limited to mobile telemetry. In addition, this service may also operate in the band 2332-2350 MHz on a non-interference and no protection basis.

- Temporary TV links (ENG) may use the band 2450-2500 MHz.

The existing channelling arrangements per SRSP-302.2 are shown below;



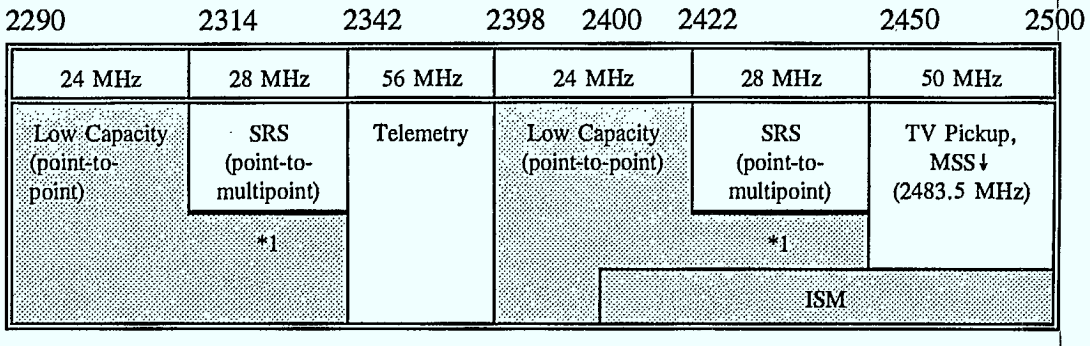
As per the policy proposal, it will be necessary to re-arrange the fixed service bands to provide additional point-to-point capacity in congested areas and to increase the allocation to telemetry. The total spectrum currently available to the point-to-multipoint systems is accordingly reduced.

4.2 SHARING CONSIDERATIONS

The new mobile-satellite allocation 2483.5-2500 MHz is sufficiently removed in frequency from the point-to-point and SRS systems that the adjacent band problems discussed in §1 should not be a sharing factor. In the case of MSS sharing with TV pickups the potential for interference is significant. TV pickup receivers may be exposed to high power flux density levels from MSS (space-to-Earth) transmissions. Furthermore, given the 'event dependent' location of TV pickups, avoidance of the GSO orbit may not be possible.

4.3 TECHNICAL STRATEGY

The proposed sub-band allocation for this band are shown below:



*1 Note that the point-to-point systems may use the MCS bands only in cases where the high levels of congestion prevent the use of the 2290-2314 MHz and the 2398-2422 Mhz bands. These changes respond to the reduction of point-to-point capacity in the 1427-1525 MHz and 1710-1900 MHz bands.

The changes presented in the proposed sub-band block arrangement above are of an incremental nature, building on the existing plan, rather than making wholesale modifications. The expansion of the unshared telemetry band by 16 MHz is made in conjunction with the reduction of the multipoint communications system (MCS) bands and the expansion of the point-to-point bands.

In the proposed channelling arrangement, the number of carrier frequencies for the point-to-point systems is increased from the existing channelling arrangement and the number of carrier frequencies for the point-to-multipoint (SRS) application is reduced. The transmit/receive frequency separation for both point-to-point and point-to-multipoint applications is increased from 100 MHz to 108 MHz. In addition, the spectral efficiency could be increased from 1 bits/sec/Hz to 1.6 bits/sec/Hz to better reflect the performance of current equipment.

4.3.1 Low Capacity Point-to-point Systems

In order to meet the range of equipment which may be deployed in this band, it may be useful to have a number of channel bandwidths to choose from, as in the present channel plan. Therefore, it proposed to maintain the 6.0, 4.5, 3.0 and 1.5 MHz channel options, noting, as per the section on theme issues, that the question of multiple bandwidths overlaid in a single plan needs careful review. The following channelling arrangement proposal is an extension of the existing plan noting that the 'return' band has been shifted up by 8 MHz.

For 6 MHz bandwidth channels:

Go	A(N) = 2287.00 + 6.0N MHz	for N = 1 to 8
Return	A'(N)= 2395.00 + 6.0N MHz	for N = 1 to 8

For 4.5 MHz bandwidth channels:

Go	B(N) = 2287.75 + 4.5N MHz	for N = 1 to 11
Return	B'(N)= 2395.75 + 4.5N MHz	for N = 1 to 11

For 3 MHz bandwidth channels:

Go	C(N) = 2288.5 + 3.0N MHz	for N = 1 to 17
Return	C'(N)= 2396.5 + 3.0N MHz	for N = 1 to 17

For 1.5 MHz bandwidth channels:

Go	D(N) = 2289.25 + 1.5N MHz	for N = 1 to 34
Return	D'(N)= 2397.25 + 1.5N MHz	for N = 1 to 34

where N is the channel number. In order to permit the development of MCS systems, the lowest possible 'go' and 'return' channels should be selected.

4.3.2. SRS: Multipoint Communication Systems (MCS)

The proposed frequency bands for the SRS multipoint communication systems are 2314-2342 MHz and 2422-2450 MHz. The 'central station' channels are the same as in the existing plan, noting the loss of the last channel 2420.25 MHz. The 'remote station' channels have been shifted down by 8 MHz. The result is the following proposed plan of 8 channel pairs, using 3.5 MHz channels:

Central Station	E(N) = 2451.75 - 3.5N MHz	for N = 1 to 8
Remote Station	E'(N) = 2343.75 - 3.5N MHz	for N = 1 to 8

4.3.3 Transition Strategy

The following points outline some transitional considerations:

1. New point-to-point systems should conform to the new channelling plan. Successful coordination with existing fixed systems will be necessary.

2. It is proposed that existing fixed systems may continue to operate subject to the geographical differences policy. Existing systems may expand under the present channelling arrangements provided that expansion is limited to the new sub-band allocations for MCS and point-to-point systems.

SECTION 5

THE FREQUENCY BAND 2500 - 2596 MHz

5.1 INTRODUCTION

The band 2500-2596 currently supports multipoint analogue video communication systems (MCS) which includes instructional television systems (ITV). The proposed allocation changes as a result of WARC-92 include the deletion of the Fixed Satellite (space-to-Earth), Broadcasting Satellite and Broadcasting allocations from the Canadian table. However, it should be noted that Canada may consider, at a future point, the new Mobile Satellite (Space-to-Earth) allocation in the 2500-2535 MHz band.

The proposed changes to the spectrum utilization policy includes the following:

- Addition of TV pick-ups to the 2500-2596 MHz band.
- Addition of low capacity point-to-point systems in 2500-2596 MHz.
- Provide for two-way and one-way MCS video systems in the 2500-2530 MHz and 2566-2596 MHz bands.
- Elimination of the need to consider radiolocation systems in this band.
- No longer necessary to consider broadcast undertakings such as MDS systems in this band.

5.2 SHARING CONSIDERATIONS

The most significant potential sharing situation occurs with the new mobile-satellite (MSS) (Space-to-Earth) in the band 2500-2535 MHz. Presently, coordination is triggered if the power flux-density of the mobile-satellite service exceeds the following levels:

-152	$dBW/m^2/4$ kHz for angles of arrival of less than 5°,
$-152 + 0.5(\delta - 5)$	$dBW/m^2/4$ kHz for angles of arrival 'δ' between 5° and 25°,
-142	$dBW/m^2/4$ kHz for angles of arrival of greater than 25.°

Studies have shown that sharing between the MSS(space-to-Earth) and point-to-point stations will be difficult particularly with respect to satellites in non-geostationary orbits. For satellites in GSO, orbit avoidance is a suitable mechanism for protection against low angle of arrival emissions. Orbit avoidance by the out-stations of an MCS may be difficult to achieve due to the requirement to point towards a central station, whose location is based on coverage of a service area.

5.3 TECHNICAL STRATEGY

Since the mobile satellite allocation in the 2500-2535 MHz band will come into effect in the year 2005, continued use of this band by the fixed service is feasible, with the understanding that in the far future mobile satellite services may have to be accommodated.

The spectrum in the 2500-2596 MHz band may be sub-allocated to the proposed point-to-point and MCS systems as shown in Table 5-1.

Table 5-1: Proposed Allotment for Band 2500 - 2596 MHz

2500	2530	2566	2596
	TV Pickups		
	LC (P-P)		
	MCS(LC)	MCS(LC)	

The TV pickups may operate in the 2500-2596 MHz band provided they do not cause interference to the point-to-point or MCS systems.

5.3.1 Low Capacity Channel Plan

It is suggested that a flexible channelling arrangement be adopted in these bands to accommodate a full range of equipment and channel bandwidths. The elements of such an arrangement are as follows:

1. The maximum channel bandwidth is 6 MHz.

2. The minimum efficiency for digital systems is 1 bits/sec/Hz.

3. The centre frequency is selected from a uniform grid of frequencies spaced 0.5 MHz apart provided the channel bandwidth does not fall outside the band 2500-2596 MHz:

$$A(N) = 2500.0 + 0.5N \quad \text{for } N = 1 \text{ to } 90$$
$$A'(N) = 2550.5 + 0.5N \quad \text{for } N = 1 \text{ to } 90$$

4. The go/return translation frequency is as specified by the manufacturer.

5. The go/return band separation is as specified by the manufacturer.

The above frequency plan provides for the many channelling options which are in use today. For example, there are plans based on multiples of 1.5 MHz, 2.5 MHz and 3.5 MHz channel bandwidths. This approach would allow displaced LC systems to relocate in this band without having to change their channel bandwidth, provided it was less than or equal to 6 MHz.

Coordination of multiple bandwidth systems should not pose a problem as current coordination practices use only the discrete frequency and its power spectral characteristic.

5.3.2 Multipoint Video Communications Systems Channel Plan

Ten channels of 6 MHz bandwidth can be accommodated in two groups of five in the two 30 MHz sub-bands. These channels may be used in a one way mode or, in pairs, in a two way mode (e.g., for full motion video conferencing). The centre frequencies of the proposed channel plan for the multipoint video communications systems are as follows:

$$C(N) = 2497.0 + 6.0N \quad \text{for } N = 1 \text{ to } 5$$
$$C'(N) = 2563.0 + 6.0N \quad \text{for } N = 1 \text{ to } 5$$

The new channelling plan uses the existing channels which currently occupy the 2500-2530 MHz and 2566-2596 MHz bands. The MCS channels can support either analogue video or digital video or data signals. As per SRSP-302.5, the channels of multichannel systems should normally be arranged in next adjacent channels. Thus, for one way systems, up to six channels can be assigned, three in each sub-band. For two way systems, a maximum of three channel pairs can be accommodated.

5.3.3 TV Pickups

No channel plan is proposed for TV pickups since equipment is tunable and operational flexibility could be advantageous. Coordination with the point-to-point and MCS stations is required.

5.3.4 Transition Strategy

The following points may facilitate a reasonable transition of potentially affected MCS video systems:

1. Existing analogue systems may continue to use the band on a standard basis. However, it is suggested that systems replacing or upgrading transmission equipment convert to the new MCS channels.

2. The existing systems operating outside of the 2530-2566 MHz band may continue to operate until such time that the equipment must be replaced. At this time, the system should conform to the new channelling arrangement and other technical requirements which may be in place.

SECTION 6

THE FREQUENCY BAND 3500 - 4200 MHz

6.1 INTRODUCTION

No modifications or new frequency allocations were made at WARC'92 in the 3500-4200 MHz band. However, given the need to find replacement spectrum for medium capacity fixed systems, the policy proposal suggests that the lower portion of this band, 3500-3700 MHz, may be suitable for such systems. Accordingly the main objective of the technical strategy is to introduce medium capacity systems in this band.

This band is used extensively across Canada for long haul, high capacity fixed systems. Systems in this band provide the backbone of the long distance telephone network. With the introduction of the new fibre optic networks, these systems will likely be upgraded with high capacity digital equipment which will compliment and back-up the fibre systems. Currently there are approximately 3000 assignments in this band and, according to congestion studies done by the Department, the main routes have in general consumed most of the available frequencies. However, off the narrow tracks of the main routes there is plenty of spectrum available for new systems.

The current technical requirements for line-of-sight radio systems in the band 3500-4200 MHz include the following:

- Multihop fixed systems carrying HC digital or VHC analogue traffic. The channel plan provides sixteen 20 MHz channel pairs and eight 40 MHz channel pairs.
- Digital systems must have the capability of achieving a spectral efficiency of at least 4.5 bits/sec/Hz.
- A maximum of one protection channel for one to seven working channels and two protection channels for eight to fourteen working channels is permitted.
- Where 40 MHz working channels are intermixed with 20 MHz channels, separate protection channels for each of the 20 MHz and 40 MHz channels may be used.

U.S. radars may operate in the band just below 3500 MHz. Consequently Canadian fixed services proposing to operate in the 3500-3610 MHz band near the Canada/U.S. border or coastal areas, are subject to satisfactory coordination with the U.S.

6.2 SHARING CONSIDERATIONS

The fixed service in the 3500-3700 MHz band shares with the radiolocation (secondary) and the fixed-satellite service (space-to-Earth) (primary).

6.2.1 Radars

The band 3500 - 3700 MHz has been used for high capacity point-to-point systems primarily in areas removed from the Canada/U.S. border due to potential interference from radars operated by the United States.

The two 20 MHz channel pairs 1/1' and 2/2' (frequencies 3550, 3570, 3590, and 3610 MHz) and the 40 MHz channel pair 1/1' and channel 2 (frequencies 3540, 3580 and 3620 MHz) may be exposed to possible interference from radars. These channels may be used, subject to satisfactory coordination arrangements, either as protection channels or, after the channels in the remainder of the band have been exhausted, as working channels.

As stated in SRSP-303.5, channels centred on 4190 MHz may incur sporadic adjacent channel interference from airborne radio altimeters.

6.2.2 Fixed Satellite Service (Space-to-Earth)

The 3500-4200 MHz band is allocated to fixed satellite downlink and, since this allocation is exercised extensively, it is recommended that receiving fixed service stations should avoid pointing at the geostationary satellite orbit by at least 2° taking into account atmospheric refraction.

The 3500-4200 MHz band is shared with equal rights with the fixed satellite service (space-to-Earth). Thus proposed fixed service transmitting stations must be coordinated with receiving Earth stations under the rules of RSP 114.

6.3 TECHNICAL STRATEGY

The interference potential due to emissions from radars operating below 3500 MHz has caused the 3500-3700 MHz band to be more lightly used by fixed systems than the remainder of the 3500-4200 MHz band. This creates an opportunity to include medium capacity systems in this 200 MHz band without major intra-system coordination difficulties, however, coordination with the U.S. radar systems will be required. Furthermore, the 3500-4200 MHz band in general is heavily used only along the very narrow corridors of the major routes, leaving considerable available spectrum in the remaining areas.

The 3500-3700 MHz band can support twenty contiguous 10 MHz channels. As shown below in Tables 6-1 and 6-2, medium capacity systems in this band could have access to up to 8 RF channel pairs of 10 MHz channel bandwidth. The centre frequencies are offset 5 MHz from the 20 MHz high capacity channels in this band. This may help facilitate the sharing potential between medium and high capacity systems in the same area.

In order to provide some flexibility, it is proposed that three go/return channel separations be available; 80 MHz, 120 MHz and 160 MHz. The channels are divided into five blocks of four channels as shown in Table 6-1. Each four-channel block may be paired with at least two other blocks depending on the translation frequency and the go/return block spacing requirements. This arrangement provides flexibility to meet equipment specifications and additional channelling

options which may be useful in resolving coordination problems. Typical filter characteristics are shown in Figure 6-1.

The use of high performance antennas, particularly near high capacity systems would be required in order to provide for better sharing and to avoid restricting the number of RF channels on the high capacity routes. As noted above, coordination of channels where all or part of the channel is below 3610 MHz is required near the Canada/US border or coastal areas.

Table 6-1: Block Plan Arrangement for 3500-3700 MHz Band

Block	1	2	3	4	5
Channels Frequency Band	A1-A4 3500-3540	A5-A8 3540-3580	A9-A12 3580-3620	A13-A16 3620-3660	A17-A20 3660-3700

$An = 3505 + 10n \qquad n = 1...20$

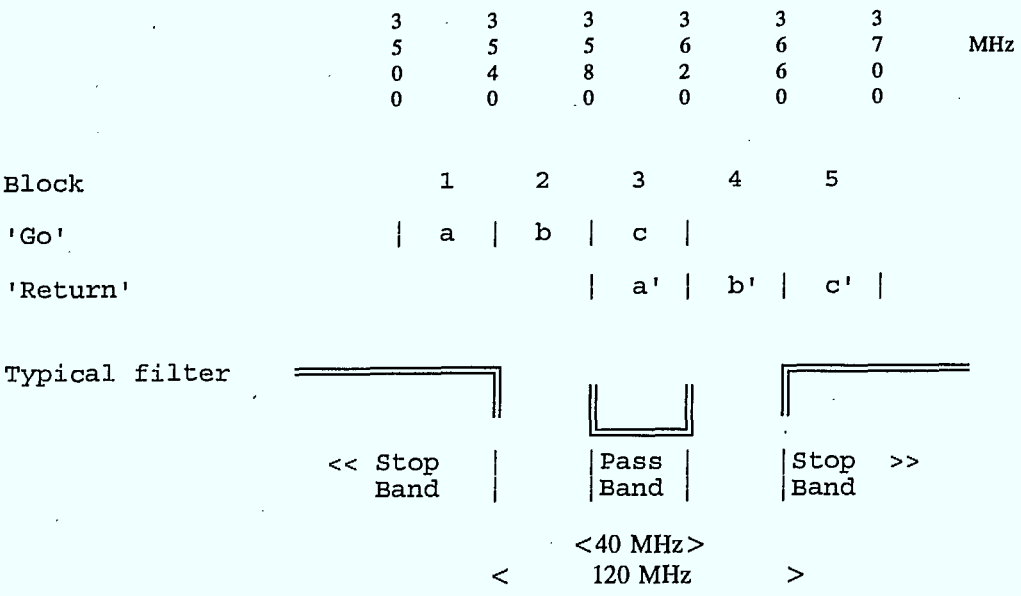
Table 6-2: Possible Block Pairings

'Go' Block	'Return' Block	Translation Frequency (MHz)	Go/Return Block Spacing (MHz)
1	3	80	40
1	4	120	80
1	5	160	120
2	4	80	40
2	5	120	80
3	5	80	40

6.4 Transition Strategy

Since no changes are proposed to the existing services, the implementation date for the additional medium capacity resource is dependent only on the demand for this spectrum and the availability of suitable equipment.

Figure 6-1: Typical Filter Characteristic



SECTION 7

THE FREQUENCY BAND 4400 - 5000 MHz

7.1 INTRODUCTION

The results of WARC'92 have no direct effect on the service allocations in the band 4400-5000 MHz in Canada. Given there are currently a number of narrow residual sub-bands in this band which are lightly used or not used at all, the policy proposal suggests opening these bands to low capacity point-to-point systems. The objective is to develop a channelling strategy which makes optimum use of the residual bands for low capacity systems.

In Canada, the existing spectrum usage of the band 4400-5000 MHz can be summarized as follows:

a) High capacity fixed digital systems in the band 4540-4900 MHz (see SRSP-304.5, Issue 1).

b) Troposcatter fixed systems operated by the Government of Canada are limited to the use of the bands 4460-4540 MHz and 4900-4990 MHz.

c) In addition to these fixed services, various sub-bands are allocated to mobile (Government of Canada), fixed-satellite, radio astronomy and space research services. Each radio service may use the spectrum allocated on a first-come, first-served basis in accordance with its status in the Canadian Table of Frequency Allocations.

Table 7-1: Centre Frequencies for High Capacity Digital Radio Systems

	Plan A (40 MHz Channels)		Plan B (20 MHz Channels)	
N	A(N)	A'(N)	B(N)	B'(N)
1	4565	4755	4555	4745
2	4605	4795	4575	4765
3	4645	4835	4595	4785
4	4685	4875	4615	4805
5			4635	4825
6			4655	4845
7			4675	4865
8			4695	4885

The existing radio frequency channel arrangements provide for the development of multiple hop radio systems transmitting up to four, two-way, 40 MHz RF channels (Plan A) or eight, two-way 20 MHz channels (Plan B). Single hop systems are allowed on a case-by-case basis.

As shown above in Table 7-1, the transmit/receive frequency separation for both Plans A and B is 190 MHz.

The 4540-4900 MHz band was opened only recently in order to accommodate the expansion of high capacity digital routes, which are being upgraded to handle near-fibre capacities. Consequently, at this point the band is lightly used, however near future usage is expected to be high, particularly in the trans-Canada routes.

7.2 SHARING CONSIDERATIONS

The 4500-4800 MHz band is allocated to fixed-satellite service downlink. This band is not currently in use in Canada. As orbital positions for this band are planned (WARC-ORB-88), it may be advisable for receiving fixed service stations to avoid pointing at the geostationary satellite orbit by at least 2° taking into account atmospheric refraction.

The Radioastronomy service has primary allocations in the 4825-4835 MHz and 4950-5000 MHz bands. Fixed systems having emissions in these bands should be sufficiently removed from Canadian radioastronomy sites such that harmful interference does not occur. Presently there is one radioastronomy site in Canada. It is located in Penticton, British Columbia (Latitude 49° 37' 12"). From CCIR Report 224, harmful interference may occur at signal levels 230 dB(Wm^2/Hz) and above. Sharing between the radioastronomy and fixed service is in most cases quite practical due to mountainous terrain surrounding the Penticton site.

7.3 TECHNICAL STRATEGY

As per the policy proposal the residual bands, listed below, should accommodate low capacity point-to-point systems.

4400 - 4460 MHz	(60 MHz)
4540 - 4545 MHz	(5 MHz)
4705 - 4735 MHz	(30 MHz)
4895 - 4900 MHz	(5 MHz)
4990 - 5000 MHz	(10 MHz)

The balance of the band remains unchanged. High capacity point-to-point systems continue to operate in the 4545-4705 MHz and 4735-4895 MHz band under the current channelling plan. The Government of Canada use the bands 4460-4540 MHz and 4900-4990 MHz for fixed and mobile applications also is unchanged, noting that the fixed use of the 4460-4540 MHz and 4900-4990 MHz bands is no longer restricted to troposcatter systems.

The residual bands provide a total of 110 MHz of spectrum and are located in the main band as shown in Table 7-2. Given the fragmented nature of these bands it may be useful to consider a more relaxed channelling arrangement, allowing for a variety of equipment types to adjust into the band. Furthermore, some of the residual bands are adjacent to the high capacity bands and Government of Canada fixed and mobile bands. This may result in need for additional frequency separation between these systems and the proposed low capacity systems to avoid interference.

Table 7-2: Proposed Bands for Low Capacity Systems

Bands (MHz)	Bandwidth (MHz)	Pairing
4400 - 4454	54	GO
4454 - 4460	6	RETURN
4460 - 4540	Govt. Fixed and Mobile	
4540 - 4545	5	RETURN
4545 - 4705	High Capacity Systems	
4705 - 4735	30	RETURN
4735 - 4895	High Capacity Systems	
4895 - 4900	5	RETURN
4900 - 4990	Govt. Fixed and Mobile	
4990 - 5000	10	RETURN

The elements of the low capacity channel arrangement are as follows:

1. The maximum channel bandwidth is 1 MHz.

2. The minimum efficiency for digital systems is 1 bits/sec/Hz.

3. The centre frequency is selected from a uniform set of frequencies spaced 0.5 MHz apart provided the channel bandwidth does not fall outside the allotted bands shown in Table 7-1.

GO	C(N)	= 4400.0 + 0.5N	for N = 1 to 107
RETURN	C'(N)	= 4454.0 + 0.5N	for N = 1 to 11
	C'(N)	= 4540.0 + 0.5N	for N = 1 to 9
	C'(N)	= 4705.0 + 0.5N	for N = 1 to 59
	C'(N)	= 4895.0 + 0.5N	for N = 1 to 9
	C'(N)	= 4990.0 + 0.5N	for N = 1 to 19

4. The go/return translation frequency is governed by the choice of the return band.

7.3.1 TRANSITION STRATEGY

Since no changes are proposed for existing high capacity services, the implementation date for the new low capacity systems is dependent only on the demand and the availability of suitable equipment. The different translation frequencies inherent in the proposed low capacity plan imply an easily tunable design e.g., utilization of frequency synthesizers and possibly electronically tunable filters.

SECTION 8

THE FREQUENCY BAND 5850 - 7125 MHz

8.1 INTRODUCTION

No modifications or new frequency allocations were made at WARC'92 in the 5850-7125 MHz band. The existing usage of this band, as shown in Table 8-1, includes low, medium and high capacity multihop systems, TV pick-ups, and TV studio-to-transmitter (STL) links. As per the policy proposal, also shown in Table 8-1, the major changes are as follows:

1. No new analogue assignments, however existing analogue systems are grandfathered.

2. Medium and high capacity digital point-to-point will be permitted in the STL band, 6590-6770 MHz.

3. TV STL's will be permitted to operate in the 6425-6930 MHz band. Currently TV STL's are permitted to operate in the 6590-6770 MHz band.

TABLE 8-1

EXISTING POLICY

5850	5915	6425	6590	6770	6930	7125
Existing SRSP's and SP's	SRSP-305.9 SP-5850	SRSP-306.4 SP-6425	SRSP-306.5 SP-6590	SRSP-306.4 SP-6425	SRSP-306.5 SP-6590	
Capacity	VLC/LC Analog/ Digital; HC/VHC Analog; HC Digital	HC/VHC Analog; MC/HC Digital	TV STL	HC/VHC Analog; MC/HC Digital	TV Pick-ups; Temporary TV links	

PROPOSED POLICY

5850	5915	6425	6930	7125
PROPOSAL	LC/MC (65 MHz)	MC/TV-STL (505 MHz); HC (1015 MHz)	TV Pick-ups (195 MHz)	

The objective of the technical strategy is to facilitate the introduction of new high and medium capacity systems while accommodating the existing users.

8.1.1 The 5850-6425 MHz Band

High capacity/very high capacity analogue or high capacity digital line-of-sight radio systems operate in accordance with a 29.65 MHz channelling plan which provides up to 8 channel pairs.

There are two interstitial channelling plans with a carrier frequency offset of 14.83 MHz (see SRSP-305.9, Issue 3).

The 5850-6425 MHz band is fairly heavily used across the country for a variety of applications. Approximately 4000 transmissions are licensed and systems have an average hop length of approximately 44 km.

8.1.2 The 6425-7125 MHz Band

The 6425-7125 MHz is currently split into two band pairs:

- 6425-6590 MHz and 6770-6930 MHz SRSP-306.4, SP-6425
- 6590-6770 MHz and 6930-7125 MHz SRSP-306.5 SP-6590

The current use of the above bands by the fixed service is limited to medium capacity (up to 103.7 Mbit/sec) and high capacity (up to 155.5 Mbit/sec) digital radio systems and to high and very high capacity analogue radio systems. High capacity digital radio systems exceeding 155.5 Mbit/s are non-standard and are limited to two RF channels. The channel arrangements provide sub-plans for 10 MHz, 20 MHz and 30 MHz channel bandwidths. These sub-plans are overlaid in an interstitial format.

A common 340 MHz transmit/receive (T/R) separation is employed. The spectral efficiency is at least 4 bits/sec/Hz of the RF channel bandwidth on a single polarization. A minimum spectral efficiency of 2.25 bits/sec/Hz may also be permitted as standard on a case-by-case basis in areas where congestion is not anticipated by the Department.

The 6590-6770 MHz band is used for one way, single hop TV STL systems (single channel). STL's are concentrated near populated areas and are generally not found elsewhere. The present channel plan provides nine, 20 MHz channels for use by STL's.

One way TV pick-up and temporary TV links use the 6930-7125 MHz band. As per the existing policy, frequencies above 10 GHz will be used wherever possible for the link between camera and mobile studio, and either the 2450-2500 MHz band or the 6930-7125 MHz band is recommended for the link between the mobile studio and the main studio. The latter band currently has ten, 20 MHz channels for use by TV pick-ups.

8.2 SHARING CONSIDERATIONS

The fixed service and the fixed-satellite service (Earth-to-space) share the 5850-6425 MHz band. Transmitting terrestrial stations having EIRP values exceeding +35 dBW should avoid pointing at the geostationary satellite orbit by at least 2°, taking into account the effect of atmospheric refraction. Where compliance with this limit is impracticable, the maximum EIRP of the stations shall not exceed:

- +47 dBW in any direction within 0.5° of the geostationary-satellite orbit; or

- +47 dBW to +55 dBW, on a linear decibel scale (8 dB per degree), in any direction between 0.5° and 1.5° of the geostationary-satellite orbit taking into account the effect of atmospheric refraction.

The above pointing restrictions also apply to the fixed systems in the 6425-7125 MHz band.

8.3 TECHNICAL STRATEGY

Different strategies apply to the various policy changes proposed for this frequency band.

8.3.1 Low and Medium Capacity Systems in the 5850-5915 MHz Band

This band was the subject of a recent review within the Radio Advisory Board of Canada (RABC). The RABC suggested a number of amendments to the current channelling plan to accommodate a variety of point-to-point systems. As these amendments are consistent with the policy proposal to have this band support low and medium capacity systems, it would seem reasonable to consider them as part of the technical strategy. Accordingly, the proposed channelling plan for this band consists of the following arrangements:

RF Channel Arrangement for Bandwidths of 1.75 MHz

The frequency spacing between a corresponding 'go' and 'return' RF channel pair is 33.5 MHz within a hop. The centre frequencies of the 18 paired channels are expressed by the following relationships:

Go A(N) = 5849.125 + 1.75N for N = 1 to 18
Return A'(N) = 5882.625 + 1.75N for N = 1 to 18

RF Channel Arrangement for Bandwidths of 3.5 MHz

The frequency spacing between a corresponding 'go' and 'return' RF channel pair is 33.5 MHz within a hop. The centre frequencies of the 9 paired channels are expressed by the following relationships:

Go B(N) = 5848.25 + 3.5N for N = 1 to 9
Return B'(N) = 5881.75 + 3.5N for N = 1 to 9

RF Channel Arrangement for Bandwidths of 5.25 MHz

The frequency spacing between a corresponding 'go' and 'return' RF channel pair is 33.5 MHz within a hop. The centre frequencies of the 6 paired channels are expressed by the following relationships:

Go C(N) = 5847.375 + 5.25N for N = 1 to 6
Return C'(N) = 5880.875 + 5.25N for N = 1 to 6

RF Channel Arrangement for Bandwidths of 10 MHz

The frequency spacing between a corresponding 'go' and 'return' RF channel pair is 45 MHz within a hop. The centre frequencies of the two paired channels are as expressed by the following relationships:

Go	D(N)	= 5845.0 + 10N	for N = 1 and 2
Return	D'(N)	= 5890.0 + 10N	for N = 1 and 2

RF Channel Arrangement for Bandwidths of 20 MHz

The frequency spacing between the 'go' and 'return' RF channel is 45 MHz. The centre frequencies of the single paired channel are:

Go	E	= 5860.0 MHz
Return	E'	= 5905.0 MHz

where, in cases A to D above, 'N' is the channel number and A(N)/A'(N), B(N)/B'(N), C(N)/C'(N), D(N)/D'(N), and E/E' are the centre frequencies of paired channels.

Other technical requirements of this band include the following:

1. Radio systems operating in this band should use a two-frequency plan. Where there is insufficient antenna discrimination, additional frequencies may be permitted on a non-standard basis.

2. New low capacity digital radio systems should be able to meet a minimum spectral efficiency of at least 1 bits/sec/Hz within the total channel bandwidth. Similarly new medium capacity digital radio systems should have an efficiency of at least 2 bits/sec/Hz. (Note: these spectral efficiencies are slightly higher than those proposed by the RABC.)

3. Protection channels should not be permitted.

4. The transmitter power delivered to the antenna input for each RF channel should not exceed the following:

   5 watts per 20 MHz channel
   4 watts per 10 MHz channel
   2 watts per 5.25 MHz channel
   1 watt per 1.75 MHz and 3.5 MHz channels

8.3.2 High Capacity Systems in the 5915-6930 MHz Band

The policy proposal indicates high capacity digital systems should be permitted to operate in this band. The existing channelling arrangements offer 29.65 MHz channels in the 5915-6425 MHz

band and 20 MHz or 30 MHz channels in the 6425-6590 MHz and 6770-6930 MHz bands. It is not proposed to change these channelling plans at this time given that they support high capacity systems which are consistent with the proposed policy. However, it is important to recognize that new highly spectral efficient equipment is available for high capacity digital systems. This equipment, capable of carrying 6 DS-3 bit streams, typically requires 40 MHz channels. Therefore it is proposed that a new sub-plan be added to the band to support the use of 40 MHz channels. In order to provide sufficient channels to allow systems to complement the capacity of fibre optic facilities, it would seem reasonable to create 12 channel pairs, matching the number of channel pairs in the 4 GHz bands. The new sub-plan is as follows:

Go D(N) = 5895.0 + 40N for N = 1 to 12
Return D'(N) = 6430.0 + 40N for N = 1 to 12

The transmit/receive spacing is 535 MHz and the 'go' and 'return' bands are separated by 55 MHz. The minimum spectral efficiency should be in the order of 6 bits/sec/Hz (e.g., 512 QAM) and it is expected that high performance antenna will be employed.

8.3.3 Medium Capacity Systems in the 6425-6930 MHz Band

The current channel plan provides 10 MHz and 20 MHz channels for medium capacity systems in the bands 6425-6590 MHz and 6770-6930 MHz. Congestion studies of these bands indicate there is light to moderate use in most parts of the country. Given that there appears to be ample reserves in the existing bands for new systems, it is not proposed at this time to make any changes to the channelling plan. Although it is possible to expand this plan into the current STL band, 6590-6770 MHz, this would result in a change to the transmit/receive spacing, possibly new centre frequencies in the present paired bands and a new go/return band spacing.

Consequently, medium capacity systems could continue to use the present channelling plan until there is a need to expand into the 6590-6770 MHz band.

8.3.4 TV STL's in the 6425-6930 MHz Band

The policy proposal allows TV STL's to operate across the entire 6425-6930 MHz band subject to the coordination rules for fixed systems. The current STL channel plan uses 20 MHz channels and is exactly in step with the medium capacity (20 MHz) sub-plan found in the adjacent bands. Consequently, it is suggested that STL's should have access to the 20 MHz sub-plan in the 6425-6590 MHz and 6770-6930 MHz bands. In order not to prevent unnecessary coordination problems, the new STL's should operate on the highest available channel in either of the medium capacity bands. STL applicants are also encouraged to use the 10 MHz sub-plan, also available in the same bands, as soon as equipment is available.

In either case, STL applicants should only use the 6425-6590 MHz and 6770-6930 MHz bands when the 6590-6770 MHz band is not available. There does not appear to be a need to modify the current STL channel plan recognizing that the addition of a 10 MHz interstitial plan could be considered as soon as equipment is available.

8.3.5. TV Pick-ups in the 6930-7125 MHz

The policy proposal does not suggest any changes or additional types of radio systems to be added to this band with the exception that pre-allotted TV pick-up frequencies will no longer be identified. Noting the exception, it is not proposed to make any modifications to the channelling arrangements.

8.3.6 Transition Strategy

The suggested modifications in the band 5850-7125 MHz should be implemented as soon as possible to accommodate the new systems presented in the policy proposal. Note that existing channelling plans are maintained therefore no modifications to present systems are warranted. However, in the case of analogue systems, the policy proposal indicates that new assignments will not be permitted.

SECTION 9

THE FREQUENCY BAND 7125 - 7725 MHz

9.1 INTRODUCTION

The current usage of this band consists of a variety of fixed systems including very low capacity (VLC), low capacity (LC), medium capacity (MC) and high capacity (HC) analogue systems and LC/MC digital systems. Assignments have been made primarily, but not exclusively, to microwave systems associated with telemetry, control and protection of electric power grids.

The fixed service shares portions of this band equally on a primary basis with the fixed-satellite service (space-to-Earth) in the band 7250-7750 MHz, the mobile-satellite service (no direction specified) in the band 7250-7300 MHz, and the meteorological-satellite service (space-to-Earth) in the 7450-7550 MHz band. The fixed-satellite and mobile-satellite services are restricted to Government of Canada use.

The policy proposal suggests including high capacity point-to-point digital systems in this band while restricting future deployment of VLC, LC, MC, and HC analogue systems. Furthermore, the proposal divides the band into two pairs of sub-bands accommodating LC systems in one sub-band and MC/HC in the other. The current channelling plan will be in effect for existing systems and any subsequent expansions of these systems.

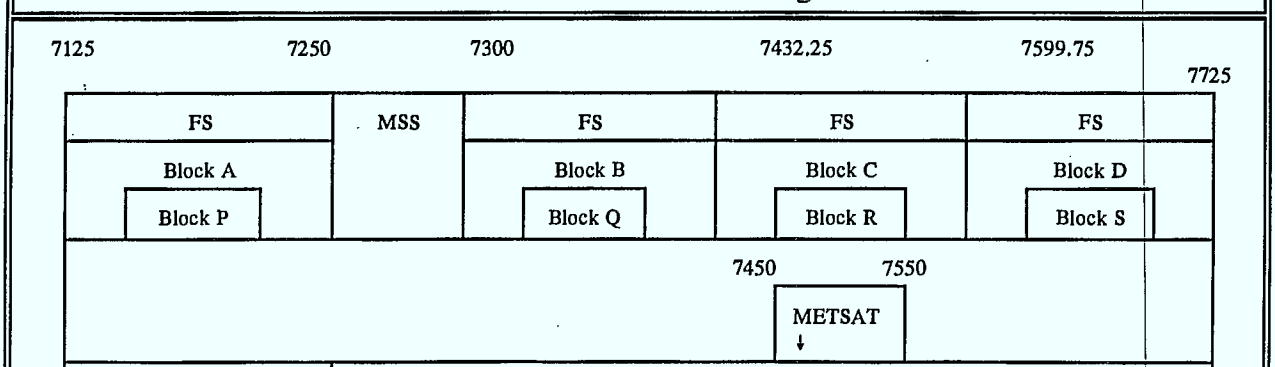
The existing channelling plan (SRSP-307.1) provides three sub-plans for point-to-point systems:

I:	19.75 MHz $\geq$ RF channel bandwidth	$>$ 9.75 MHz;
II:	9.75 MHz $\geq$ RF channel bandwidth	$>$ 3.50 MHz; and
III:	3.50 MHz $\geq$ RF channel bandwidth.	

The above RF channel bandwidths are for both analogue and digital systems. The band 7125-7725 MHz is divided into the sub-bands shown in Table 9-1 where the fixed service occupies four blocks of spectrum.

Each block of fixed service spectrum is channelized to support 3.5 MHz, 9.75 MHz and 19.5 MHz channels in an overlay format. There are four groups (six carrier frequencies per group) of 19.75 MHz channels (sub-plan I), eight groups (six carrier frequencies per group) of 9.75 MHz channels (sub-plan II), and four groups (four carrier frequencies per group) of 3.5 MHz channels (sub-plan III). Go/return pairing is specified for each sub-plan.

Table 9-1: Current Channelling Plan



Blocks A, B, C, D have 19.5 MHz and 9.75 MHz channels.
Blocks P, Q, R, S have 3.5 MHz channels.

In the existing channelling plan, the transmit/receive (T/R) frequency spacing is 167.5 MHz for sub-plans (I) and (II), and 167 MHz for (III). Also, the 50 MHz sub-band 7250-7300 MHz has been reserved exclusively for mobile-satellite services as shown in Table 9-1.

There are approximately 360 very low or low capacity transmissions and 2000 medium, high or very high capacity transmissions in the 7125-7725 MHz band in Canada.

9.2 SHARING CONSIDERATIONS

For their own protection, fixed service stations should avoid pointing at the geostationary satellite orbit by about 2.0°. Meteorological satellites may be either in geostationary or non-geostationary orbits. Both services are required to observe the pfd limits in RR 2566 namely -152 dBW/m^2/4 kHz at low angles of arrival and -142 dBW/m^2/4 kHz at high angles of arrival.

9.3 TECHNICAL STRATEGY

As indicated above, the proposed policy modification will result in the creation of new LC and MC/HC bands as shown in Table 9-2. In reviewing the existing channelling plan to determine if it could be used to support the new sub-bands, the following observations were made:

1. The current channels are grouped into four blocks as shown in Table 9-1. The band limits of block A are identical to the proposal, however blocks B, C and D differ considerably.

2. The current plan has a transmit/receive translation frequency of 167.5 MHz (167.0 MHz for the 3.5 MHz channels). The sub-band pairing in the proposal has a transmit/receive spacing of 325 MHz for low capacity systems and 275 MHz for the medium and high capacity systems.

The differences between the current and the proposed band arrangements are significant and warrant the development of a new channelling plan for the LC and MC/HC systems specified in the proposal. Consequently, the following channelling arrangement is suggested, noting that the channel bandwidths have been maintained:

- 7125-7250 MHz paired with 7450-7575 MHz providing 125 MHz of spectrum in each direction for low capacity digital systems compared to 28 MHz in the existing plan. These bands support thirty five 3.5 MHz channels with 2.5 MHz in reserve.

- 7300-7450 MHz paired with 7575-7725 MHz providing 150 MHz of spectrum in each direction for medium capacity and high capacity digital systems compared to 234 MHz in the existing plan. These bands support fifteen 9.75 MHz channels and seven 19.5 MHz channels arranged in an overlay fashion.

Table 9-2: Proposed Channelling Plan

7125	7250	7300	7450	7575	7725 MHz
125 MHz	50 MHz	150 MHz	125 MHz	150 MHz	
LC	--		LC	--	
--		MC/HC	--	MC/HC	
--	MSS	--			

The following centre frequencies are suggested noting that MC and HC sub-plans are overlaid in an interstitial format:

Low Capacity Systems

A(N) = 7123.25 + 3.5N for N = 1 to 35
A'(N) = 7448.25 + 3.5N for N = 1 to 35

Medium and High Capacity Systems

B(N) = 7298.875 + 9.75N for N = 1 to 15
B'(N) = 7573.875 + 9.75N for N = 1 to 15

C(N) = 7290.25 + 19.5N for N = 1 to 7
C'(N) = 7565.25 + 19.5N for N = 1 to 7

The above arrangement provides a 2.5 MHz and a 3.75 MHz lower and upper guard band, next to the mobile-satellite allocation and a 6.25 MHz unassigned band at 7575 MHz that could possibly be used for other purposes.

Two channel route plans will be supported. As indicated in the current SRSP for this band, when more than one frequency pair is carried on a system, both senses of polarization of each RF carrier should be used to carry two data streams on that single frequency. In special circumstances, other provisions may be considered by the Department if technical and/or economical justification is provided. As per the policy proposal, ring configurations may reduce the need for diversity channels. If diversity channels are to be implemented, such a channel should support a minimum of two working channels.

9.3.1 Transition Strategy

The proposal to reorganize the 7125 - 7725 MHz band is a significant move from the existing arrangement. In view of this, existing systems will be allowed to continue operating under the present arrangements until the equipment is retired. Expansions of existing systems will also be permitted under the present arrangements. All new systems should conform to the new arrangements from the effective date of the revised SRSP covering the 7125-7725 MHz band.

SECTION 10

THE FREQUENCY BAND 7725 - 8275 MHz

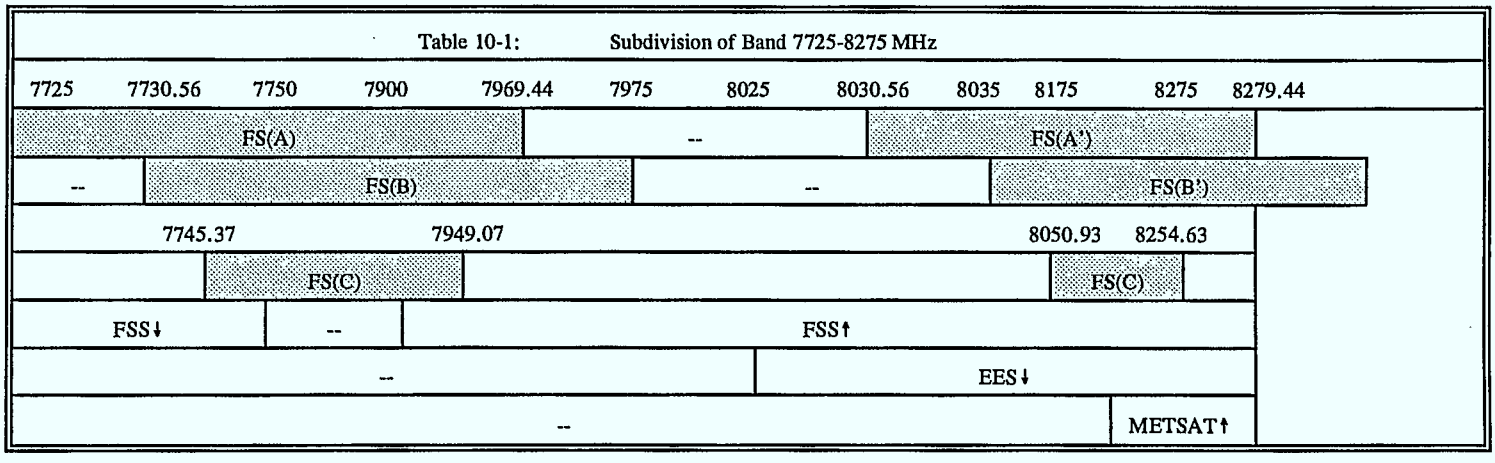
10.1 INTRODUCTION

There were no modifications to the 7725-8275 MHz band at the WARC'92. This band currently supports high capacity point-to-point digital systems and has been used throughout Canada for long haul telecommunication traffic. The systems are generally over-built on 4 GHz routes and employ high performance antennas. The fixed service shares portions of this band equally on a primary basis with;

- the fixed-satellite service (space-to-Earth) in the band 7725-7750 MHz and (Earth-to-space) in the band 7900-8275 MHz,
- the Earth-exploration-satellite service (space-to-Earth) in the band 8025-8175 MHz, and
- the meteorological-satellite service (Earth-to-space) in the band 8175-8215 MHz.

The use of the fixed-satellite and mobile-satellite services in the band 7725-8275 MHz is restricted to use by the Government of Canada. Coordination is required between the fixed terrestrial services and satellite services.

Table 10-1: Subdivision of Band 7725-8275 MHz



The existing radio frequency channel arrangement provides for the development of multi-hop radio systems transmitting up to 12 two-way 40.74 MHz wide RF channels in two overlapping groups of six channels, blocks A/A' and B/B', shown in Table 10-1. The arrangement also provides for an alternate plan of up to 11 two-way 40.74 MHz RF channels where technical or economic justification exists. In this case the A/A' and C/C' blocks are used in a similar overlap arrangement. Currently, digital systems must have a capability of transmitting at least 2

bits/sec/Hz of RF bandwidth on a single polarization. Initial loading has been set to at least 20 Mbits/sec per channel.

The policy proposal suggests that medium capacity point-to-point systems be accommodated in the 7725-7975 MHz and 8025-8275 MHz bands.

10.2 SHARING CONSIDERATIONS

The 2° avoidance of the geostationary-satellite orbit by the main beam axis (direction of maximum radiation) of the antenna should be maintained in the 7900-8275 MHz band to protect the fixed-satellite service (Earth-to-space) in the 7900-8400 MHz band, and the meteorological-satellite service (Earth-to-space) in the 8175-8215 MHz band. For their own protection, fixed systems receiving antennas should also avoid the geostationary orbit by at least 2° in the fixed-satellite service downlink band, 7725-7750 MHz. The power flux-density limits for the fixed-satellite service are as follows:

-152	$dBW/m^2/4$ kHz for angles of arrival less than 5°,
-152 + 0.5(δ-5)	$dBW/m^2/4$ kHz for angles of arrival 'δ' between 5° and 25°,
-142	$dBW/m^2/4$ kHz for angles of arrival greater than 25°.

The meteorological-satellite service may also employ satellites in low-Earth orbit where avoidance is not possible. However, the transit of a satellite through a radio-relay transmit beam is of short duration so that retransmission from data collection platforms is, in general, possible if interference occurs.

With respect to the Earth-exploration-satellite service (space-to-Earth) in the 8025-8175 MHz band, geostationary-satellite orbit avoidance may also be advisable but most of the emissions are from satellites in low-Earth orbit. In the latter case, while avoidance is not possible in general, individual exposures last a few seconds at most and the cumulative exposure falls into the short term performance criteria of the fixed systems. The power flux density limits for the Earth-exploration-satellite service are as follows:

-150	$dBW/m^2/4$ kHz for angles of arrival less than 5°,
-150 + 0.5(δ-5)	$dBW/m^2/4$ kHz for angles of arrival 'δ' between 5° and 25°,
-140	$dBW/m^2/4$ kHz for angles of arrival greater than 25°.

Coordination with Earth stations in all three satellite services is required noting that, for Earth stations serving satellites in non-geostationary orbits, it is necessary to take account of the tracking capability of the antennas.

10.3 TECHNICAL STRATEGY

As indicated in Section 10.1, the proposed policy is to include medium capacity line-of-sight digital radio systems in the band 7725-8275 MHz. It is proposed that the existing channelling plans be used to support high capacity digital radio systems for the foreseeable future. However,

new high capacity digital systems are expected to have improved spectral efficiency in the order of 4 bits/sec/Hz and above. The current minimum spectral efficiency is 2 bits/sec/Hz.

Medium capacity digital radio systems can be supported in narrower channels than provided in the present arrangement. If a spectrum efficiency of at least 2.3 bits/sec/Hz of RF bandwidth on a single polarization is assumed, a 20 MHz channel can support a DS-3 bit stream (45 Mbits/sec). Thus the simplest approach is to split the present 40.74 MHz channels into two 20.37 MHz channels for medium capacity applications. Note that the matter of multiple overlay bandwidths needs further consideration as outlined in the theme section of this document. The proposed channel plan provides 12 channel pairs of bandwidth 20.37 MHz, overlaid in the existing high capacity go/return bands. The overlay offset is interstitial to existing A/A' channels only.

Centre frequencies:

D(N)	= 7714.815 + 20.37N	for N = 1 to 12
D'(N)	= 8020.375 + 20.37N	for N = 1 to 12

Occupied bands:

D(1) to D(12);	7725 MHz to 7969.44 MHz
D'(1) to D'(12);	8030.56 MHz to 8275 MHz

Translation frequency: 305.56 MHz

Go/return band gap: 61.12 MHz

Additional medium capacity channels may be accommodated by overlapping as in the high capacity case.

10.3.1 Transition Strategy

The proposed modifications to the 7725-8275 MHz band are required to;

a) support the introduction of new medium capacity digital systems,
b) meet the traffic loading requirements suggested in the policy proposal, and
c) reflect the current state of technology.

It is recognized that the current channelling arrangement for high capacity systems may pose some technical constraints in increasing the spectral efficiency. This is due to the unique overlap plan which permits growth beyond 6 channel pairs by using the interstitial channels present in the first 6 channels.

Introduction of the proposed medium capacity systems is dependent upon the availability of equipment. Given the need for medium capacity spectrum, an early introduction of these systems into this band should be possible. Present coordination procedures should be capable of handling existing systems, new high capacity systems and new medium capacity systems.

In order to maximize sharing between the existing high capacity and the new medium capacity systems, the medium capacity systems should use high performance antennas in the vicinity of high capacity routes. Other requirements of medium capacity systems could include the following:

1. EIRP levels which are scalable to occupied bandwidth.

2. The use of automatic transmit power control.

ANNEX No.1

AREAS OF MODERATE TO HIGH CONGESTION IN SELECTED FREQUENCY BANDS

Band	Channel Bandwidth (MHz)	Paired Bands (Go Return) (MHz)	No. Channel Pairs	ATLANTIC	QUEBEC	ONTARIO	CENTRAL	PACIFIC	USE
1427-1525	7.0	1434 - 1476 1483 - 1525	6	• Most of Nova Scotia • Moncton - Amhurst • S.E. PEI	• Lac St-Jean - Quebec • Quebec - Ville St-Georges • Greater Montreal area • Chibougamau District	• Parry Sound area • North Bay area	• Winnipeg area • Nelson House area • Flin Flon area • Prince Albert - La Ronge Provincial Park • North Battleford area • Calgary area	• Small area near Nanaimo	Pt-to-pt
	3.5	1427 - 1462 1476 - 1511	10	• Most of Nova Scotia • Moncton - Amhurst • S.E. PEI	• Large area around Quebec, Lac St-Jean, and Chibougamau • Greater Montreal area • Lac Berté area	• Cornwall - Hawkesbury • Parry Sound area • North Bay area	• Winnipeg area • Lake Winnipeg area • Dauphin Lake area • Nelson House area • Flin Flon area • Large area around Prince Albert • Greater Calgary area • Greater Edmonton area • Grande Prairie area	• Nanaimo area • Vancouver area • Dawson Creek area	MCS
1700-1710	125 kHz	1700 - 1710	80 single channels						STL (Sound)
1710-1900	3.5	1711.75 - 1795.75 1816.75 - 1904.25	24	• Most of Cap Breton Isl. • Central Nova Scotia • S.W. New Brunswick	• Large area around St-Lawrence River (Quebec - Montreal) • Large area around Ottawa River (Montreal to Ottawa)	• Eastern Ontario • Windsor - Toronto area • Large area around Lake Simcoe • North Bay - Espanola • Large area around Sault-Ste-Marie	• N.W. side of Lake Winnipeg • Greater Regina area • Lethbridge - Coleman area	• Victoria area • Vancouver • Kamloops area • Large area around Fernie • Nelson area	Pt-to-pt

ANNEX No.1

AREAS OF MODERATE TO HIGH CONGESTION IN SELECTED FREQUENCY BANDS

Band	Channel Bandwidth (MHz)	Paired Bands (Go Return) (MHz)	No. Channel Pairs	ATLANTIC	QUEBEC	ONTARIO	CENTRAL	PACIFIC	USE
	7.0	1710 - 1794 1804.5 - 1902.5	12	• Most of Cape Breton Isl • Central Nova Scotia • Southern Nova Scotia less the coastal areas • The S.W. quadrant of New Brunswick • Small area near Vernon PEI	• Large area surrounding the St-Lawrence River from Quebec to Montreal • Large area surrounding the Ottawa river from Montreal to Ottawa	• Most of Southern Ontario South of Parry Sound and West of Peterborough • Eastern Ontario as far west as Bancroft • Large area north of Lake Nipissing • North Bay to Sault-Ste-Marie corridor	• A corridor from Winnipeg - Grand Rapids York Factory • Greater Winnipeg area • Pembina area • Coleman area • Lethbridge area • Peace River area • Graham Lake area • Greater area around Regina, Saskatoon (south) and Weyburn	• Victoria area • Greater Vancouver area • Courtenay area • Large area around Prince George - Fort St-John • Fort Nelson area	Pt-to-pt
1900-2290	29.0		24	• SE coastal area of Nova Scotia from Lunenburg to Barrington • Small area East of Wolfville • Area around Truro • Charlottetown area • West of Saint John • Campbellton area	• Small area NE of Quebec from Gaspé to Percé • Area around Notre Dame-du-Lac • Most of the area from Sherbrooke to Trois-Rivières • Hull area	• All of NE Ontario • All of central Ontario up to North Bay and North of Lake Nipissing • Southern Ontario except NW coast along lake Huron	• Area between Split Lake and Cross Lake (North of lake Winnipeg) • Winnipeg area • Small area around Prince Albert • Area West of North Battleford to Manito Lake • Calgary area • Small area West of Lac la Biche	• Victoria area • Vancouver area to Garibald Provincial Park • East of Kitsum Kalum Lake • Kamloops and the North area to Adams Lake	
3500-4200	20		32	• Greater Halifax area • Saint John and the South coastal line along Bay of Fundy	• Small area around Ste-Anne-de-Beaupré • Montreal area • Small area around St-Lambert	• Ottawa area • Area West of Cornwall • Most of the NW coast of Lake Ontario • Kitchener area • London area • Area SW of Lake Simcoe	• Along the South border of Manitoba and the US • Regina area • Area North of Lac la Biche • Small area East of Edmonton	• Vancouver area • Narrow area along the Cariboo Mountains	
						• Small area North of Nipissing Lake • Small area West of Whitefish Falls			