CANADA

DEPARTMENT OF COMMUNICATIONS

DISCUSSION PAPER TOWARDS

THE DEVELOPMENT OF CANADIAN PROPOSALS

FOR THE 1983

REGION 2 BROADCASTING-SATELLITE PLANNING CONFERENCE

83 RARC 030
OTTAWA

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DISCUSSION PAPER TOWARDS THE DEVELOPMENT OF CANADIAN PROPOSALS FOR THE 1983 REGION 2 BROADCASTING-SATELLITE PLANNING CONFERENCE

1. PURPOSE

The purpose of this paper is to obtain the views of interested parties within Canada on issues related to the preparation of Canadian proposals and the development of positions for the International Telecommunication Union (ITU) Region 2 (the Americas) Administrative Radio Conference for the planning of the broadcasting-satellite service in the 12 GHz band, and associated feeder links (RARC 1983-BS), which will be held for five weeks starting June 13, 1983. The ultimate aim of the preparations will be to develop plans which will allow the potential for broadcasting-satellites to serve all parts of Canada with a range of existing and new broadcasting services and a varied programming schedule in accordance with the objectives of the Broadcasting Act while taking into consideration the requirements of other countries of Region 2.

2. REFERENCES

See Annex A for a list of the documents cited in this paper along with information on where they may be viewed.

3. BACKGROUND

3.1 WARC 1977-BS

Canadian preparations for the RARC 1983-BS originated with the Final Acts of the World Broadcasting-Satellite Administrative Radio Conference, Geneva, 1977 (WARC 1977-BS) in which the Members of ITU Regions 1 and 3 (comprising all countries outside the Americas) adopted a detailed plan for the broadcasting-satellite service in the 11.7-12.2 GHz band for Region 3 and the 11.7-12.5 GHz band for Region 1. However, the Members of ITU Region 2, believing that further studies would be required before a detailed plan could be accepted, adopted interim provisions, as contained in the Final Acts, pending the development of detailed plans for Region 2 which would be drawn up at a future Regional Administrative Radio Conference (RARC).

WARC 1977-BS also adopted certain criteria for the inter-regional sharing of services which must be observed when framing the detailed plans for Region 2.

3.2 WARC 1979

Subsequently, a WARC for the general revision of the ITU Radio Regulations (WARC 1979) was held in Geneva in

September-December 1979, the Final Acts of which contained Resolution 701 (CH) relating to the convening, no later than 1983, of a RARC for the detailed planning of the broadcasting-satellite service in the 12 GHz band and associated feeder links, in Region 2. It is worth noting that this is a departure from the Final Acts of the WARC 1977-BS which were concerned only with down-links. Pertinent extracts of the resolution (the full text of which may be seen in the Final Acts of the WARC 1979 as noted in Section 2 above) are as follows:

> "resolves
> 1. that the Regional Administrative Radio Conference (RARC) ... be held no later than 1983 to:
>
> 1.1 divide the band 12.1-12.3 GHz in two sub-bands and to allocate the lower sub-band to the fixed-satellite service and the upper sub-band to the broadcasting-satellite, broadcasting, mobile, except aeronautical mobile, and fixed services, all services on a primary basis....;
>
> 1.2 draw up a detailed frequency assignments and orbital positions plan for the broadcasting-satellite service for Region 2 in the band 12.3-12.7 GHz and in that portion of the band 12.1-12.3 GHz which it shall allocate to the broadcasting-satellite service;
>
> 1.3 plan feeder links in a part of the band 17.3-18.1 GHz, of a bandwidth equal to the total bandwidth allocated to the broadcasting-satellite service, for the down-link in the 12 GHz band. However, administrations may use broadcasting-satellite feeder links in frequency bands other than those planned, provided that such use does not necessitate any changes in the Plan;
>
> 1.4 establish procedures to govern the use of the bands specified in paragraph 1.2 of this Resolution by the broadcasting-satellite service and, as necessary, procedures for the corresponding feeder links;"

3.3 Related WARC 1979 Issues

The Final Acts of the WARC 1979 contain a considerable number of references which are relevant to the considerations of the RARC 1983-BS. Some of the more significant of these references relate to the use of the band 12.2-12.7 GHz by the fixed-satellite services; the sharing of the 12.2-12.7 GHz band between the Regions 1 and 3 fixed-satellite service and the Region 2 broadcasting-satellite service; restrictions

in the use of terrestrial services in respect of the broadcasting-satellite up and down links; and, the planning of Regions 1 and 3 broadcasting-satellite service up-links.

Extracts of Article 8 of the ITU Radio Regulations which pertain to the allocation of the frequency bands 11.7 - 12.75 GHz and 15.7 - 19.7 GHz are at Annex B. Annex C contains relevant extracts of the draft Canadian Table of Frequency Allocations which pertain to these bands.

3.4 REPORT OF THE CRTC COMMITTEE ON THE EXTENSION OF SERVICE TO NORTHERN AND REMOTE COMMUNITIES

In the report of the Canadian Radio-television and Telecommunications Commission (CRTC) Committee on Extension of Service to Northern and Remote Communities, "The 1980's; A Decade of Diversity", released July 1980, attention is drawn to the benefits of direct broadcast satellites in a country so widely spread as Canada. The Committee points out that a Direct Broadcast Satellite (DBS) could be optimized to provide broadcast programs of national and regional interest for direct home reception with equipment that is convenient to install at the lowest cost compatible with good picture quality. A large number of channels would be required with several spot beams extending to the far north and responsive to time zones and regional needs.

4. PLANNING FOR THE 1983 CONFERENCE

4.1 Organizational Schedule and Arrangements

In May 1980 the ITU Administrative Council, with the approval of the members of Region 2, agreed that the Conference be held for five weeks starting on 13 June, 1983.

Canadian preparations for the Conference are being conducted by an interdepartmental committee chaired by the Director International Arrangements, Department of Communications and including members from the Departments of Communications, Energy Mines and Resources, External Affairs, Industry Trade and Commerce, the National Research Council, the Canadian Radio-television and Telecommunications Commission, the Canadian Broadcasting Corporation, Teleglobe Canada and Telesat Canada. Additionally, a special government/industry working group of the Committee, the membership of which is still open, is coordinating input from non-government sources. The Committee is charged with recommending to the Department of Communications Canadian proposals for the Conference along with Canadian positions on each identified item of the Conference agenda and on the proposals of other countries.

The following schedule lists principal activities and consultations which are anticipated from the date of this paper to the commencement of the Conference:

May, 1981	-	Availability of discussion paper
May, 1981	-	RARC 1983-BS Seminar held in Ottawa
July, 1981	-	Comments required from the public in response to the discussion paper
September, 1981	-	First draft Canadian proposals announced in the Canada Gazette
May, 1982	-	Second draft proposals (if required) announced in the Canada Gazette
June, 1982	-	ITU (or host country) issues invitations for the Conference
October, 1982	-	Canadian proposals submitted to the ITU
March, 1983	-	ITU disseminates proposals received to all Members.
June 13, 1983	-	Conference opens

4.2 CCIR Meetings

CCIR technical preparations for the Conference are being undertaken by Interim Working Party (IWP) 10-11/2 under a Canadian chairman. The report of this working party is expected to be submitted for review by the Final CCIR Study Group Meetings in the fall of 1981 and then by the CCIR Plenary Assembly in February, 1982. Afterwards, it is probable that a special joint working party of the competent CCIR Study Groups will be formed, not later than August, 1982 to complete the work.

Additionally, CCIR IWP 4/1, and other study groups, are preparing the technical bases for the 1984-85 Space Services WARC. These groups may also have some input for the 1983 RARC.

5. CANADIAN DOMESTIC PLANNING OF THE BROADCASTING SATELLITE SERVICE

5.1 Study Program

Long range planning for a Canadian broadcasting-satellite service is being carried out by the Department of Communications through a comprehensive, multi-disciplinary study program designed to provide the information necessary to support the Canadian proposals for and position at the

1983 RARC, and for making decisions on the implementation of this service in Canada. Complementary to the study activity are pilot projects in television program delivery to small, low cost terminals using the ANIK-B satellite.

The broadcasting-satellite planning studies for the Canadian situation, which will be part of the input to the Committee's work and which are to be completed by the end of 1982, are cast in a socio-demographic, economic, technical, and policy-regulatory framework. Socio- demographic studies include detailed statistics of requirements for improved quantity and quality of television broadcasting services, market surveys to determine an acceptable user cost for this service, studies of requirements for complementary services, such as radio and teletext broadcasting, and studies of the requirement for specialized television services such as pay TV and tele-education. These studies should indicate the number of channels needed for the service to be marketable. Social factors associated with regional needs identified in the studies as well as technical trade-offs will be used in the determination of the number of beams for covering Canada. Of course, economic trade-offs between the space and earth segments, taking due account of the technological state-of-the art in both instances, are necessary to provide information on the likely economic viability of a system. Also necessary are studies of alternatives, comparing satellite delivery direct-to-home vs. community antenna/ terrestrial final distribution systems, to permit informed decisions to be taken regarding the final form of a Canadian system.

An immediate planning issue currently under study within the Department and arising out of the success of the ANIK-B field trials, is the possible use of the ANIK-C system, which has parameters similar to those of ANIK-B, for direct-to-the-home service. An important consideration is the transition from a possible service using ANIK-C to a future, somewhat higher powered satellite operating in the band specifically allocated to the broadcasting-satellite services immediately adjacent to the ANIK-C frequency band. This transition must be accomplished with a minimum cost impact on consumer investment in receiver terminals.

5.2 Direct Broadcasting Satellite Service Experiments and Field Trials[1]

Experiments in broadcasting from a satellite were first carried out with the HERMES satellite which had a

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[1] It should be kept in mind that the down-links used in the field trials of ANIK-B are in a frequency band different from those to be planned at the RARC 1983-BS. However, the down-link is in an adjacent frequency band and the experience will be valuable in developing system concepts and equipment necessary for an operational Canadian broadcasting-satellite system, as well as in the planning of the BSS at the RARC 1983-BS.

boresight equivalent isotropically radiated power (e.i.r.p.) of 59.6 dBW. This high power permitted reception with a receiver using a small antenna, such as would be suitable for individual home reception. The experiment demonstrated that high and consistent quality reception could be achieved with satellite transmission regardless of location, and that in fact satellite e.i.r.p. could be reduced below the HERMES maximum, and the planning value of 60 dBW or more used at the 1977 World Administrative Radio Conference. Annex A refers to reports on the results of the HERMES experiments.

The HERMES experiments confirmed that it would be possible to use the much lower powered ANIK-B satellite 12 GHz transponders for extended field trials of individual reception satellite television. The e.i.r.p. of ANIK-B ranges from 51 dBW to 46.5 dBW within the coverage area of each of its 4 beams. It was expected that a high quality television picture could be provided, in clear weather, with current technology for receiver electronics, using an earth station with either a 1.2 metre antenna within the 49.5 dBW satellite e.i.r.p. contour, or a 1.8 metre antenna within the 46.5 dBW contour. A summary of the results of the experiments can be obtained in reference 5 at Annex A, which was accepted by the CCIR at its Interim Meeting, October, 1980.

Over 100 receivers are being used in ANIK-B field trials, which are expected to yield valuable data on the technical requirements and operational aspects of a broadcasting-satellite system. References at Annex A describe the field trials fully, and discuss some of the results obtained to this time. The results of the field trials with ANIK-B are important input to planning for the broadcasting-satellite service in Canada. Field experience with the installed receivers will provide a practical answer to the margins which must be allocated to account for antenna misalignment and other degradations which can be attributed to the individual receivers. To this can be added the margin required for propagation to meet the selected availability standard. The actual propagation margin required will vary from location to location across Canada, and some reasonable value will be adopted for each service area in association with other link parameters. For example, although an average margin of 3 dB would seem to be adequate for most of Canada, based on an availability of 99.9% of the time, such a margin would have to be made specific to each service area. It is important that transmitted power levels are determined carefully to ensure that they are not in excess of requirements.

5.3 References

See Annex A

6. BASIC SERVICE REQUIREMENTS

This section and those following address issues on which the views of interested parties are particularly solicited, as inputs to the preparation of Canadian proposals and development of positions for the RARC 1983-BS. In some cases, specific questions are posed, but comments need not be limited to these only, and views on any aspect of the broadcasting-satellite service are invited.

6.1 Economic Aspects

The cost of a broadcasting-satellite system is dependent upon its design and the cost of technology at the point in time that it is constructed. It is reasonable to assume that there will be a rapid reduction in the cost of receive terminals, especially when the economies of mass production are reached. It is less probable that there will be a significant decrease in the cost of either the satellites or the equipment required for up-links.

When discussing design parameters e.g. number of service areas, channels per service area, etc., the cost of the various options should be considered. When presenting specific service requirements, it would be beneficial to suggest how the service may be funded among various possible options including advertising, publicly supported, subscriber supported, etc.

6.2 Type of Service - Individual Reception and Community Reception

A broadcasting-satellite system for individual reception will employ high-powered satellites operating in conjunction with small, low cost, receiving terminals. The receiving terminals should be available at a cost and size (antenna diameter of one meter or less-typically 90 cm) which would make it practical for individual household purchase and utilization.

A broadcasting-satellite service designed for community reception would use less powerful satellites and larger, more expensive, earth stations than those used for individual reception. Community reception could result in one or more receive earth terminals positioned in central locations in the community e.g. community centre, or the construction of a local distribution system using off-air rebroadcasting transmitters or cable to relay the signal to each household.

Resolution 701 of the WARC 1979 specifies that the Region 2 plan "shall be based on individual reception, but each administration may use the reception system which best suits its requirements". A higher-powered satellite can provide community-reception service in addition to individual reception while a lower-powered satellite can accommodate community reception only.

6.3 Service Areas

Recent developments in antenna and satellite design along with Canada's geography and location in Region 2 allow some degree of freedom in specifying the size and shape of service areas. The following issues should be considered in commenting upon possible service areas:

a) Operational

- time zone problems in respect of service areas,
- the needs for both regional and national services,
- the need to be able to operate up-links from any part of Canada on some or all channels.

b) Economic

- the identification and geographic distribution of anticipated BSS viewers,
- the market size,
- system costs.

The plans for Regions 1 and 3 generally specify one service area covering the entire country but larger countries such as China, USSR and India have considerably more service areas. For Canada the preliminary estimate of the number of service areas is six, as shown on the map at Annex D. Comment on these proposals would be welcome.

6.4 Number of Channels per Service Area

With regard to the number of channels per service area, it would be useful if respondents were to specify which specific services or types of services should be offered. The following list provides examples:

a) Television

- CBC National English
- CBC National French
- CBC - Second Networks
- National Commercial CTV, TVA
- Regional Commercial
- Local Independents
- Regional Educational
- Pay TV
- House of Commons Debates
- Provincial Legislature Debates
- Multiple audio TV
- Specialized programming

b) Radio

- Various regional and national networks

c) Other Broadcasting-Services

The number of channels which can be provided in each service area will be determined from the technical constraints of spectrum and orbit utilization. As many services on this list are already provided terrestrially, it may not be advisable to utilize broadcasting-satellite service to duplicate services already widely available.

Due to the limited amount of spectrum available, the limited extent of the useable satellite orbit arc to serve various countries, and the need to equitably share this spectrum/orbit resource among the countries of the region, the number of services which can be provided from a broadcast satellite service for any one country is limited. For this reason, respondents to this paper are urged to prioritize their service requirements according to their own needs, interests, financial capabilities, and time frame to implement/marketability.

Some services, for example, interactive TV, teleconferencing, data retrieval (videotex), etc., may more logically be termed fixed-satellite service and may be better accommodated in the fixed-satellite bands. Note that Footnote 3787F of the Final Acts of the WARC 1979 permits the use of the planned broadcast satellite channels for transmissions in the fixed-satellite service as long as such use does not have an impact upon the plan in any way.

6.5 Uplink Terminals and Services

Resolution 701 of the Final Acts of the WARC 1979 also requires the RARC 1983-BS to plan feeder links in a part of the band 17.3-18.1 GHz, of a bandwidth equal to the total bandwidth allocated to the broadcasting-satellite service, for the down-link in the 12 GHz band. However, administrations may use broadcasting-satellite feeder links in frequency bands other than those planned, provided that such use does not necessitate any changes in the Plan.

In planning the types of uplink terminals and services, the following items should be considered:

- should the terminals be fixed or transportable or both?
- what should their antenna characteristics be?
- should there be only one fixed transmitter per region or service area?
- if so where should this be located?
- since attenuation at 18 GHz will be an important factor will site diversity and/or uplink power control be required to meet overall requirements?

7. PRINCIPLES FOR PLANNING THE SPECTRUM/ORBIT RESOURCES

7.1 Time Frame

A fundamental question to be resolved in 1983 is the validity period of the plan for the broadcasting-satellite service in Region 2. Since this is a relatively new service, the potential demand and the anticipated advances in the technology are difficult to estimate. In this regard it may be noted that the validity of the WARC 1977-BS Plan for Regions 1 and 3 extends until 1 January, 1994.

7.2 Orbital Position Restrictions

The number and location of the orbital positions which Canada may receive in the Region 2 plan will have an important influence on the ultimate design of Canadian BSS Systems. Consideration must also be given to elevation angle, service to the far north and possible access to all Canadian satellites from anywhere in Canada.

There are many factors affecting choice of orbital location, only some of which are suitable for Canadian service, some of which are detailed below.

a) Eclipse

The need for higher power on broadcast satellites than that typically required for fixed satellites could conceivably imply that it may be difficult to provide full battery support of the solar panel power source. Without such battery support during periods of eclipse of the satellite by the earth's shadow some services may have to be curtailed. Earth eclipse occurs regularly at both equinoxes and by proper placement of the satellite in the orbit the time of onset of this eclipse can be controlled. Thus, for example, it is possible to design for service to local midnight or some other convenient time.

b) Elevation Angle

A further constraint on the orbital location is the required minimum elevation angle to the satellite. In mountainous areas, urban areas with tall buildings and even in certain wooded and forest areas it will be necessary to ensure relatively high elevation angles. However in the far northern latitudes large elevation angles are impossible.

c) Uplink Service Area

A possible requirement for Canada-wide access to the satellite (or satellites) either places a tight

constraint on the orbital location or calls for a double hop using a satellite with all Canada coverage or the use of intersatellite links should there be more than one satellite each serving a portion of Canada.

d) Pre-Operational Considerations

Program services are currently offered on ANIK-B and could possibly be extended to ANIK-C. The logistics of transferring this service from ANIK-C to a dedicated broadcast satellite would obviously be eased somewhat if the broadcast satellite were co-located. This would also permit the eventual operation of a hybrid satellite having both fixed and broadcast services on a common bus should this prove to be both desirable and technically feasible. The problem arising from the fact that ANIK-B and C operate in a band in which the maximum radiated power of the broadcasting-satellite is severely limited should be kept in mind. In addition, the transfer to a true broadcasting-satellite service would imply changes in frequency bands, polarization and possibly orbit locations and may require modifications to all receivers actually used.

7.3 Service Quality

In terrestrial broadcasting, signal strength diminishes and interference increases the further the receiver is situated from the transmitter and this results in significantly worse reception at the edge of the Grade B contour.

A further characteristic of terrestrial broadcasting signal quality is its dependence not only on the statistics of propagation but, also, on the terrain within the coverage area. This results in a significant variability of reception within the area. Normally, in the case of broadcasting from satellites, the signal strength at the edge of the coverage area is only a few dB less than at its center, and interference is not markedly variable. There is still a variability of service due to terrain, especially at low elevation angles.

Weather influence on propagation is greater due to the much higher frequency of operation. Also, due to the use of frequency-modulated signals, there is a signal strength threshold below which quality of reception deteriorates rather drastically with signal attenuation. Accordingly, the quality of reception, as determined by the signal-to-interference and signal-to-noise ratios and by the availability figure for the latter (as a percentage of the

worst month), influences greatly the planning for a broadcasting-satellite service.

7.4 System Economics

The broadcasting-satellite concept is predicated upon reception by a large number of inexpensive receivers which tends to imply higher satellite transmit e.i.r.p. levels.

This translates into more prime power, high power travelling wave tube amplifiers, and higher capacity heat dissipation systems. Prime power requirements determine to a large extent the size and hence weight of the solar cell panel employed, similarly the other listed requirements all impact on the weight and size of the spacecraft. The launch costs are a direct function of the spacecraft weight and size and, depending upon the complexity of the satellite and the available launch vehicles, it may even be necessary to consider a number of satellites serving Canada. It is generally considered prudent to launch a back-up spacecraft soon after the main satellite is launched to give full or partial service in the event of a failure of the main spacecraft thereby preventing a potentially long service outage resulting from the long lead times required to launch and position a ground spare in orbit.

There is a relationship between the power of the satellite and the size of the receiving earth station which leads to a trade-off between the earth and space segment cost, keeping in mind the need for mass acceptability of this service.

It is not absolutely necessary that the full allotted complement of channels be brought into service right from the beginning but to wait until the spacecraft needs replacing before expanding the service may not be compatible with service requirement (the nominal life of a spacecraft is seven to ten years). This could be another argument for a phased implementation whereby each satellite or set of satellites provides a subset of the total allotted channels. The sparing philosophy is also affected by phased implementation since all satellites at a particular location could, with switched channels, be made identical.

Finally, if only partial battery support is available, the spare satellite could be pressed into service during eclipse periods to provide at least partial service. Operational aspects and timing of implementation also thus affect the space segment cost.

8. TECHNICAL SPECIFICATIONS AND PROCEDURES

8.1. Technical Specifications

There are many technical system parameters which could be specified in planning the broadcasting-satellite service but the objective is to specify only those parameters necessary for the efficient planning of the orbit and spectrum resources. As elsewhere in this document, the emphasis is on technical specifications which would be required internationally over the whole of Region 2, not merely those required in the Canadian context.

At present, there are two fora which have established some of the technical parameters, namely, WARC 1977-BS and the CCIR. The WARC-BS agreed to several technical parameters used in the generation of the plan for Regions 1 and 3, as well as other parameters appropriate to Region 2, possibly only until a plan was developed. In addition, several restrictions were agreed to protect Regions 1 and 3 systems from Region 2 systems and vice versa. The change to allocations at WARC 1979 will necessitate some changes in the criteria due to different sharing scenarios now possible.

The CCIR is in the process of reviewing some of these criteria based on many studies conducted by several Administrations, including Canada. In addition to this normal activity, Canada will chair a special Interim Working Party of the CCIR to collate all the information necessary for the use of the 1983 RARC. This will constitute the basis of the CCIR's input to the RARC.

As for the technical parameters used in the planning of the broadcasting-satellite service, the concepts are fairly straight forward despite being somewhat more difficult to implement. The basic technical parameters are tied into the so-called "link" budget, from the transmitting earth station providing the transmission up to the satellite and back down to the individual or community earth station receivers. The system equations are straight forward once the required signal quality at the output of the receiver has been agreed. A propagation margin is added in line with the percentage of time the signal is required. Various additional margins are included in the budget for component ageing, misalignment, mispointing, etc. The important question is how these margins should be incorporated into the link budget to realize an overall signal quality for a specified percentage of time. It should be realized that there is a direct impact on the satellite power for a given satellite antenna beam size (which usually is influenced by other than only technical considerations). Views are requested whether a power-additive basis should be used to formulate the link budget or whether some other method, which might use a more statistical approach, is more appropriate. This decision will have a significant impact on the satellite cost to the

extent of perhaps changing the total system economics, not to speak of inter-system interference considerations.

The topic of up-links or feeder links has been touched on elsewhere but the size and type of transmitting earth stations have a significant impact on the inter-system interference. For example, from an operational viewpoint, would it be better to have transmitting earth stations at specified fixed points or should the Plan permit the use of transportable earth stations in conjunction with the former? In this regard, it should be noted that the up-link for the broadcasting-satellite service is tentatively planned for the 17.3 - 17.8 GHz band, to correspond in bandwidth with the 12 GHz down-link. (The proposed Canadian Table of Frequency Allocations issued in May, 1980 suggested the use of 12.2 - 12.7 GHz for the broadcasting-satellite down-link.) Further, the 17.7 - 17.8 GHz portion of the uplink would be shared with the terrestrial fixed service and with downlinks for the fixed-satellite service. In order to coordinate these services, it might be desirable that only non-transportable earth stations be used in the 17.7 - 17.8 GHz band, leaving the 17.3 - 17.7 GHz band available for both transportable and non-transportable earth stations as required. Comment would be particularly appreciated on this question.

In general, the increased transmitter power required for the smaller earth station antenna will be relatively inexpensive but such increases in transmitter power will have an impact on inter-system interference. Additionally, the question of the size of the receiving satellite antenna beam has a significant impact on the system's susceptibility to interference. (Operational aspects of up-link service areas are discussed elsewhere.) All-Canada coverage of the up-link satellite antenna will, in general, cause increased sharing difficulties.

Finally, it is the general feeling that broadcasting satellites should use a simple frequency translation type of transponder instead of the more complex re-modulation type.

8.2 Interference Considerations

The planning of broadcasting-satellite systems in Region 2 must take account of the space and terrestrial systems of Regions 1 and 3. Fortunately, Region 2 has a fair degree of isolation due to the oceans, which can be used to advantage. It should be noted that the simple sharing between the Regions developed at the WARC 1977-BS was considerably complicated by the change in allocations at WARC 1979 (see section 3.3 for an explanation of the present allocations).

Sharing between broadcasting-satellite systems is largely limited by what is an acceptable "protection ratio" for the desired television signal quality. Canada and other

countries are studying what constitute acceptable protection both for aggregate as well as single exposure level. Since it is the intent to have the feeder links planned at the same time as the down-links, an appropriate scheme for prorating interference between the two halves of the overall link will have to be determined. This decision is critical for the creation of an efficient orbit/frequency plan.

WARC 1977-BS adopted certain guidelines as contained in the Final Acts for sharing between broadcasting-satellites and fixed-satellite systems, both within and between the Regions. Due to the change in the frequency allocations at WARC 1979, the sharing analysis will have to be extended to protect fixed-satellite systems of Regions 1 and 3.

Within Region 2, all terrestrial services in the band under consideration are effectively on a secondary basis until after the 1983 RARC so that they will not be an impediment to efficient planning. However, broadcasting-satellite systems must share with fixed and mobile systems of the other Regions, especially Region 1 where there are existing terrestrial fixed systems operating in the same frequency band. This requirement to share with other services may impose restrictions on the maximum radiated satellite power in those service areas near the Bering Strait.

Comments are requested on any of the interference/sharing considerations associated with this planning.

8.3 Procedure for Changing an Allotment Under the Plan or Any of the Technical Parameters of the Plan

Without going into the complex details of the Region 1 and 3 plan adopted by WARC 1977-BS, it is important to note that the plan did include some provision for adjustments provided that such modifications do not cause unacceptable interference to the radio services of other Administrations. Thus, minor adjustments can be made to account for changes in technology, although the extent of such adjustments may be very limited depending on the portion of the orbit under question and the "tightness" of the plan. Significant changes in technical parameters would not likely be possible. However, in the Regions 1 and 3 Plan there are a number of orbital positions not planned for use which leaves some flexibility.

It is anticipated that the Region 2 plan would have similar provisions to permit as much flexibility as possible to accommodate changes in technology and/or service requirements.

9. REQUEST FOR COMMENTS WITHIN 60 DAY PERIOD

In preparation for this Conference, the Department will prepare and release a paper containing draft proposals by the autumn of 1981. Comment on the issues specified above, along with other studies and analyses and the results of bilateral and multilateral intersessional meetings, will be taken into consideration in the development of these draft proposals.

The Department now invites submissions from all interested parties or any aspects of this paper and, in particular, on the following questions:

- Costs of a broadcasting-satellite system and how they could be shared between the viewer and the operator of these satellites.

- Type of service, individual or community reception, or which mixture of the two, is best for Canadian needs and the economic implications for each case.

- Number and description of service areas for Canada and the significant characteristics which should be considered in developing service area requirements.

- Number of programmes which Canada should have in each service area.

- Service hours required and operation during eclipses.

- Period of validity and nature of the detailed planning which will be carried out by the Conference of 1983.

- Number and location of preferred Canadian orbital positions.

- Quality and availability of service.

- Implementation schedule, and cost of the individual receiving installation, coupled to space segment cost.

- Considerations of service areas and numbers of channels in the light of the Therrien Report of the CRTC.

- Should high resolution TV be considered as a possible satellite-broadcasting service within the next 10 to 15 years? Should it be considered for this band or in another band?

Submissions should be addressed to the Director International Arrangements, Department of Communications, 300 Slater Street, Ottawa Ontario, K1A 0C8, and should be postmarked not later than 15 July, 1981.

ANNEX A

REFERENCES

I. PUBLICATIONS

1. Radio Regulations, edition of 1976 (updated) Vol.I Radio Regulations, Additional Radio Regulations Vol.II Appendices to the Radio Regulations, Resolutions and Recommendations

2. Final Acts of the World Broadcasting Satellite Administrative Radio Conference (Geneva, 1977) (now incorporated in Reference 3.)

3. Final Acts of the World Administrative Radio Conference, Geneva, 1979

4. Table of Frequency Allocations for Canada

II. OTHER REFERENCES

1. The Applications of Lower Power Satellites for Direct Television Broadcasting J.W.B. Day, N.G. Davies and R.J. Douville, Acta Astronautica, vol.7, pp. 1417-1431, 1980.

2. Direct Broadcast Satellite - the Canadian Experience O.S. Roscoe, Satellite Communication Magazine, Aug. 1980.

3. Planning for a Canadian Direct Broadcasting Satellite System, O.S. Roscoe, paper at the xxx Congress of the International Astronautical Federation, Tokyo, Japan, Sept. 1980.

4. An Evolutionary Approach to the Introduction of Direct Broadcasting-Satellite Service, J.G. Chambers, National Telecommunications Conference Fund, Vol. 4., 1980 Houston.

5. Experiments in Broadcasting from Low to Medium Power Satellites at 12 GHz, doc. 10-11S/58, dated 29 September, 1980, a Canadian Contribution to the CCIR Interim Meeting of Study Groups 10 and 11, October, 1980.

III. VIEWING OF REFERENCES

Copies of the references are held at the following locations and may be seen upon request:

a) Department of Communications Library,
Room 1420, Journal North Tower,
300 Slater Street, OTTAWA

b) Department of Communications Regional Offices in Moncton, Montreal, Toronto, Winnipeg and Vancouver.

GHz
11.7 — 12.75

Allocation to Services		
Region 1	Region 2	Region 3
11.7 — 12.5 FIXED BROADCASTING BROADCASTING-SATELLITE Mobile except aeronautical mobile 838 840	11.7 — 12.1 FIXED 837 FIXED-SATELLITE (space-to-Earth) Mobile except aeronautical mobile 836 839 840 12.1 — 12.3 FIXED 837 FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile BROADCASTING BROADCASTING-SATELLITE 839 840 841 842 843 844 12.3 — 12.7 FIXED MOBILE except aeronautical mobile BROADCASTING BROADCASTING-SATELLITE 839 840 843 844 846 12.7 — 12.75 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE except aeronautical mobile	11.7 — 12.2 FIXED MOBILE except aeronautical mobile BROADCASTING BROADCASTING-SATELLITE 838 840 12.2 — 12.5 FIXED MOBILE except aeronautical mobile BROADCASTING 838 840 845 12.5 — 12.75 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile BROADCASTING-SATELLITE 847
12.5 — 12.75 FIXED-SATELLITE (space-to-Earth) (Earth-to-space)		

ADD 3787A 836 In Region 2, in the band 11.7 — 12.1 GHz, transponders on space stations in the fixed-satellite service may be used additionally for transmissions in the broadcasting-satellite service, provided that such transmissions do not have a maximum e.i.r.p. greater than 53 dBW per television channel and do not cause greater interference or require more protection from interference than the coordinated fixed-satellite service frequency assignments. With respect to the space services, this band shall be used principally for the fixed-satellite service. The upper limit of this band shall be modified in accordance with the decisions of the 1983 regional administrative radio conference for Region 2 (see No. 841).

ADD 3787G 837 *Different category of service:* in Canada, Mexico and the United States, the allocation of the band 11.7 — 12.2 GHz to the fixed service is on a secondary basis (see No. 424).

MOD 3785 405BA 838 In the band 11.7 — 12.5 GHz in Regions 1 and 3 the fixed, fixed-satellite, mobile, except aeronautical mobile, and broadcasting services, in accordance with their respective allocations, shall not cause harmful interference to broadcasting-satellite stations operating in accordance with the provisions of Appendix 30.

MOD 3787 405BC 839 The use of the band 11.7 — 12.7 GHz in Region 2 by the fixed-satellite and broadcasting-satellite services is limited to national and sub-regional systems and is subject to previous agreement between the administrations concerned and those having services, operating or planned to operate in accordance with the Table, which may be affected (see Articles 11, 13, 14 and Resolution 33).

ADD 3785H 840 For the use of the band 11.7 — 12.75 GHz in Regions 1, 2 and 3, see Resolutions 31, 34, 504, 700 and 701.

ADD 3787B 841 The 1983 regional administrative radio conference for Region 2 will divide the band 12.1 — 12.3 GHz into two sub-bands. It will allocate the lower sub-band to the fixed-satellite service and the upper sub-band to the broadcasting-satellite, broadcasting, mobile except aeronautical mobile, and fixed services, all services being on a primary basis.

ADD 3787C 842 *Additional allocation:* the bands 12.1 — 12.3 GHz in Brazil and Peru, and 12.2 — 12.3 GHz in the United States, are also allocated to the fixed service on a primary basis.

ADD 3787E 843 In the band 12.1 — 12.7 GHz, the Region 2 space services, existing or planned before the 1983 regional administrative radio conference for Region 2, shall not impose restrictions on the elaboration of the plan for the broadcasting-satellite service in Region 2 and shall be operated under the conditions set forth by that conference.

ADD 3787D 844 In Region 2, in the band 12.1 — 12.7 GHz, existing and future terrestrial radiocommunication services shall not cause harmful interference to the space services operating in accordance with the broadcasting-satellite plan to be prepared at the 1983 regional administrative radio conference for Region 2, and shall not impose restric-

ADD 3785B 845 In Region 3, the band 12.2 — 12.5 GHz is also allocated to the fixed-satellite (space-to-Earth) service limited to national and sub-regional systems. The power flux-density limits in No. 2574 shall apply to this frequency band. The introduction of the service in relation to the broadcasting-satellite service in Region 1 shall follow the procedures specified in Article 7 of Appendix 30, with the applicable frequency band extended to cover 12.2 — 12.5 GHz.

ADD 3787F 846 In Region 2, in the band 12.3 — 12.7 GHz, assignments to stations of the broadcasting-satellite service made available in the plan to be established by the 1983 regional administrative radio conference for Region 2 may also be used for transmissions in the fixed-satellite service (space-to-Earth), provided that such transmissions do not cause more interference or require more protection from interference than the broadcasting-satellite service transmissions operating in accordance with that plan. With respect to the space services, this band shall be used principally for the broadcasting-satellite service. The lower limit of this band shall be modified in accordance with the decisions of that conference for Region 2 (see No. 841).

ADD 3785A 847 The broadcasting-satellite service in the band 12.5 — 12.75 GHz in Region 3 is limited to community reception with a power flux-density not exceeding −111 dB(W/m²) as defined in Annex 8 of Appendix 30.

MOD 3788 405BD 848 *Additional allocation:* in Algeria, Angola, Saudi Arabia, Bahrain, Cameroon, the Central African Republic, the Congo, the Ivory Coast, Egypt, the United Arab Emirates, Ethiopia, Gabon, Ghana, Guinea, Iraq, Israel, Jordan, Kenya, Kuwait, the Lebanon, Libya, Madagascar, Mali, Morocco, Mongolia, Niger, Nigeria, Qatar, Syria, Senegal, Somalia, Sudan, Chad, Togo, Yemen (P.D.R. of) and Zaire, the band 12.5 — 12.75 GHz is also allocated to the fixed and mobile, except aeronautical mobile, services on a primary basis.

MOD 3789 405BE 849 *Additional allocation:* in the Federal Republic of Germany, Belgium, Denmark, Spain, Finland, France, Greece, Liechtenstein, Luxembourg, Monaco, Norway, Uganda, the Netherlands, Portugal, Roumania, Sweden, Switzerland, Tanzania, Tunisia and Yugoslavia, the band 12.5 — 12.75 GHz is also allocated to the fixed and mobile, except aeronautical mobile, services on a secondary basis.

ADD 3788A 850 *Additional allocation:* in Austria, Bulgaria, Hungary, Poland, the German Democratic Republic, Czechoslovakia and the U.S.S.R., the band 12.5 — 12.75 GHz is also allocated to the fixed service and the mobile, except aeronautical mobile, service on a primary basis. However, stations in these services shall not cause harmful interference to fixed-satellite earth stations of countries in Region 1 other than those mentioned in this footnote. Coordination of these earth stations is not required with stations of the fixed and mobile services of the countries mentioned in this footnote. The power flux-density limit at the Earth's surface given in No. 2574 for the fixed-satellite service shall apply on the territory of the countries mentioned in this footnote.

GHz
12.75 — 13.25

Allocation to Services		
Region 1	Region 2	Region 3
12.75 — 13.25	FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Space Research (deep space) (space-to-Earth)	

GHz
15.7 — 17.7

Allocation to Services		
Region 1	Region 2	Region 3
15.7 — 16.6	RADIOLOCATION 866 867	
16.6 — 17.1	RADIOLOCATION Space Research (deep space) (Earth-to-space) 866 867	
17.1 — 17.2	RADIOLOCATION 866 867	
17.2 — 17.3	RADIOLOCATION Earth Exploration-Satellite (active) Space Research (active) 866 867	
17.3 — 17.7	FIXED-SATELLITE (Earth-to-space) 869 Radiolocation 868	

ADD 3794F 866 *Additional allocation:* in Afghanistan, Algeria, Angola, Saudi Arabia, Austria, Bahrain, Bangladesh, Cameroon, Costa Rica, Egypt, El Salvador, the United Arab Emirates, Finland, Guatemala, India, Indonesia, Iran, Kuwait, Libya, Malaysia, Malawi, Malta, Morocco, Mozambique, Nepal, Nicaragua, Oman, Pakistan, Qatar, Singapore, Somalia, Sudan, Sri Lanka, Sweden, Tanzania, Chad, Thailand, Yemen (P.D.R. of) and Yugoslavia, the band 15.7 — 17.3 GHz is also allocated to the fixed and mobile services on a primary basis.

ADD 3794FA 867 *Additional allocation:* in Israel, the band 15.7 — 17.3 GHz is also allocated to the fixed and mobile services on a primary basis. These services shall not claim protection from, or cause harmful interference to services operating in accordance with the Table in countries other than those included in No. 866.

ADD 3794G 868 *Additional allocation:* in Afghanistan, Algeria, the Federal Republic of Germany, Angola, Saudi Arabia, Austria, Bahrain, Bangladesh, Cameroon, Costa Rica, El Salvador, the United Arab Emirates, Finland, Guatemala, Honduras, India, Indonesia, Iran, Iraq, Israel, Japan, Kuwait, Libya, Nepal, Nicaragua, Pakistan, Qatar, Sudan, Sri Lanka, Sweden, Thailand and Yugoslavia, the band 17.3 — 17.7 GHz is also allocated to the fixed and mobile services on a secondary basis. The power limits given in Nos. 2505 and 2508 shall apply provisionally (see Resolution 101).

ADD 3794H 869 The use of the band 17.3 — 18.1 GHz by the fixed-satellite service (Earth-to-space) is limited to feeder links for the broadcasting-satellite service.

GHz
17.7 — 19.7

Allocation to Services		
Region 1	Region 2	Region 3
17.7 — 18.1	FIXED FIXED-SATELLITE (space-to-Earth) (Earth-to-space) 869 MOBILE	
18.1 — 18.6	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE 870	
18.6 — 18.8 FIXED FIXED-SATELLITE (space-to-Earth) 872 MOBILE except aeronautical mobile Earth Exploration-Satellite (passive) Space Research (passive) 871	18.6 — 18.8 EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 872 MOBILE except aeronautical mobile SPACE RESEARCH (passive) 871	18.6 — 18.8 FIXED FIXED-SATELLITE (space-to-Earth) 872 MOBILE except aeronautical mobile Earth Exploration-Satellite (passive) Space Research (passive) 871
18.8 — 19.7	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE	

ADD 3799A 870 The band 18.1 — 18.3 GHz is also allocated to the meteorological-satellite service (space-to-Earth) on a primary basis. Its use is limited to geostationary satellites and

ADD 3800A 871 In making assignments to stations in the fixed and mobile services, administrations are invited to take account of passive sensors in the earth-exploration satellite and space research services operating in the band 18.6 — 18.8 GHz. In this band, administrations should endeavour to limit as far as possible both the power delivered by the transmitter to the antenna and the e.i.r.p. in order to reduce the risk of interference to passive sensors to the minimum.

ADD 3800B 872 In assigning frequencies to stations in the fixed-satellite service in the direction space-to-Earth, administrations are requested to limit as far as practicable the power flux-density at the Earth's surface in the band 18.6 — 18.8 GHz, in order to reduce the risk of interference to passive sensors in the earth exploration-satellite and space research services.

ANNEX C

PROPOSED CANADIAN TABLE OF FREQUENCY ALLOCATIONS

Allocation to Services
12.1-12.2 Fixed FIXED SATELLITE (space-to-earth) CC16 3785H 3787/405BC
12.2-12.3 FIXED BROADCASTING BROADCASTING-SATELLITE CC17 CC18 CC19 3785H 3787/405BC
12.3-12.7 FIXED BROADCASTING BROADCASTING-SATELLITE CC17 CC18 CC19 3785H 3787/405BC

CC16 In the band 11.7-12.2 GHz, transponders on space stations in the fixed-satellite service may be used additionally for transmissions in the broadcasting-satellite service, provided that such transmissions do not have a maximum e.i.r.p. greater than 53 dBW per television channel and do not cause greater interference or require more protection from interference than the coordinated fixed-satellite service frequency assignemnts. With respect to the space services, this band shall be used principally for the fixed-satellite service.

CC17 In the band 12.2-12.7 GHz, existing and future terrestrial radiocommunication services shall not cause harmful interference to the space services operating in accordance with the broadcasting-satellite Plan to be prepared at the 1983 Regional Administrative Radio Conference for Region 2, and shall not impose restrictions on the elaboration of such a Plan.

CC18 In the band 12.2-12.7 GHz, space services, existing or planned before the 1983 Regional Administrative Radio Conference for Region 2, shall not impose restrictions on the eleboration of the Plan for the broadcasting-satellite service in Region 2 and shall be operated under the conditions set forth by that Conference.

CC19 In the band 12.2-12.7 GHz, assignments to stations of the broadcasting-satellite service made available in the Plan to be established by the 1983 Regional Administrative Radio Conference for Region 2 may also be used for transmissions in the fixed-satellite service (space-to-Earth), provided that such transmissions do not cause more interference or require more protection from interference than the broadcasting-satellite service transmissions operating in accordance with that Plan. With respect to the space services, this band shall be used principally for the broadcasting-satellite service.

Proposed Canadian Table
of Frequency Allocations

Allocation to Services
17.3-17.7 FIXED-SATELLITE (Earth-to-space) 3794H Radiolocation
17.7-18.1 FIXED FIXED-SATELLITE (space-to-earth) (earth-to-space) 3794H

ANNEX D

CANADIAN SERVICE AREAS
(Example)