CSSIF - FISSC

Canadian Satellite and Space Industry Forum
Forum de l'industrie spatiale et satellitaire canadienne

CSSIF06-009 October 27, 2006

Mr. Leonard St-Aubin
A/Director General
Telecommunications Policy Branch
Industry Canada
300 Slater Street
Ottawa, Ontario
K1A 0C8

Subject: **Canada Gazette No. DGTP-006-06 dated June 23, 2006; Proposed Spectrum Utilization Policy, Technical and Licensing Requirements for Wireless Broadband Services (WBS) in the Band 3650-3700 MHz**

Dear Mr. St-Aubin:

Introduction

The Canadian Satellite and Space Industry Forum (CSSIF) is an association of Canadian satellite operators and producers of satellite systems and components. The mandate of the CSSIF is to participate in the development of spectrum policy in areas of interest to the satellite community. As part of its mandate, CSSIF takes an active role in responding to the Department's public consultations on matters of interest to our members. The CSSIF membership includes the following organizations: Air TV Limited, Canadian Space Agency, Cancom, EMS Technologies Canada, Ltd., Globalstar Canada Satellite Co., Mobile Satellite Venture Corp. (Canada), Macdonald, Dettwiler and Associated Ltd, Telesat Canada, and Transcore Links Logistics (Canada).

The CSSIF commends the Department for the release of Canada Gazette Notice DGTP-006-06 ("the Consultation"). The CSSIF supports the Department's goal of facilitating the establishment of spectrum policy and technical regulations for radio systems in Canada which enable Canadians to have the most appropriate facilities available to meet their broadcasting and telecommunications requirements. The CSSIF recognizes its responsibility to provide constructive comments to the Department, assisting the development of sound guidelines and policies to ensure efficient use of the available spectrum and coexistence of a variety of services.

WBS Services in the 3650 – 3700 MHz Band – Canadian Context

The CSSIF urges the Department to seriously consider the potential for WBS services in the 3650 – 3700 MHz band to cause harmful interference to licensed radio services, in particular to satellite services, both in-band and in the adjacent bands.

In regard to the 3500-3700 MHz band, there are currently limited Canadian C-band earth station facilities operating in this band. However, this band is expected to be used by international and intercontinental satellite service providers into the future, allowing expansion of their networks and services in line with their existing operations.

/ p 2…

The 3700 – 4200 MHz FSS band is used extensively across Canada. Canadian C-band satellite networks deployed in the 3700-4200 MHz band provide essential services to all regions of the country and in some cases are the only line of communication between remote communities, enterprises and government installations, and the rest of Canada. Among other uses, C-band earth stations are used for backbone services in the broadcasting, telecommunications and military sectors. C-band earth stations are found within various urban, suburban and rural settings, deployed ubiquitously, all across Canada. Appendix 2 provides a few photos depicting some selected C-band earth stations located within major Canadian cities. All of these stations have been frequency coordinated and licensed in accordance with the Department's policies. Furthermore, there are many thousands of receive-only earth stations in use in Canada receiving various types of services including entertainment, data distribution, etc.

The CSSIF understands the desire of some Canadian manufacturers and telecommunications service providers, to have common spectrum and telecommunications policies throughout North America, since such alignment could provide economies of scale. However, the WBS service should be permitted in the 3650-3700 MHz band in Canada only to the extent that it is compatible with existing and future satellite services in the Canadian environment. It is very important to note that the Canadian environment for the 3700-4200 MHz band is quite different from the United States environment. In the United States, with the exception of Alaska, use of the 3700-4200 MHz FSS band is almost exclusively for broadcast distribution purposes. However, in Canada C-band satellite services cover a wide range of applications, including broadcasting, narrowband carriers, telephony, VSAT type services, etc.

Canada is very different geographically and demographically from the USA. There are vast areas of Canada where satellite networks provide the prime, if not the sole, means of communication. These areas include both "thin rural" areas, areas where there may be terrestrial basic telephone and off-air broadcasting services, but not value-added telecommunication service nor a wide choice of broadcasting services provided by terrestrial means; and truly "remote" areas, where there is no terrestrial provision of telecommunications or broadcasting services other than by HF radio. In thin rural and remote areas, the satellite community provides fixed-satellite, mobile-satellite and broadcasting-satellite services - services which provide Canadians in those areas with a level of telecommunication and broadcast services similar to those available in areas of Canada with a much higher population density. Without such satellite services, the thin-rural and remote areas of Canada would not be as competitive and economically viable as they are now.

Canada's development of its far-North and other remote territories depends on robust communities. Those communities can flourish and grow in the 21st century only if they have at their disposal similar telecommunications and broadcasting services as are available in the higher-populated portions of Canada. Furthermore, providing continued presence in Canada's far-North, and so preventing the encroachment into those areas by other nations, is a major objective of the Canadian government.

To satisfy these national goals, a continued viable satellite communications system is essential. The FSS C-band, in which the 3700 – 4200 MHz band forms the space-to-Earth segment, is a key element – not only in the remote and thinly populated areas, but also in the cities and more densely populated areas where the linkages are made from the rural and remote communities to the backbone of Canada's telecommunications and broadcasting networks.

/ p 3…

Conclusion

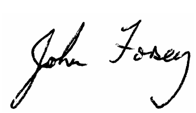
Any proposed use of the 3650-3700 MHz band for WBS must take into account existing Canadian licensed users both within the band and in the adjacent bands. For clarity, the recommendations of the CSSIF have been placed in bold font in the following paragraphs.

It should be noted that mobility is an essential feature of the WBS. This makes case-by-case frequency coordination between WBS and ubiquitously deployed FSS stations in the band 3700-4200 MHz impractical. Hence, **the Department must ensure that adequate technical standards are adopted prior to release of the band for WBS implementation**.

Detailed technical analysis of the potential impact of interference from WBS to FSS services in the 3700-4200 MHz band is provided in Appendix 1. The results of the technical analysis provided in Appendix 1 indicate how the proposed regulations in the Gazette Notice DGTP-006-06 may cause serious problems and degradation of service to earth stations in the 3700-4200 MHz band which are located in proximity to wireless broadband systems. Appendix 1 also contains proposed regulatory approaches to ensure proper protection of incumbent FSS services and the orderly introduction of WBS services in the band 3650-3700 MHz.

CSSIF particularly urges that the **Department review and tighten the proposed technical parameters for the WBS transmitters in the 3650-3700 MHz band, including maximum allowable power density and the out-of-band (OOB) emission limits, to ensure that C-band FSS receivers in the adjacent 3700-4200 MHz band are adequately protected**. Furthermore, **the Department should not authorize introduction of WBS services in the 3650-3700 MHz band in the near future, and a start date of ten years from adoption of the policy is recommended**. In addition, **the Department should put in place operational guidelines, limiting operation of the higher power WBS transmitters to the lower range of frequencies within the 3650-3700 MHz band. It is proposed to adopt a "soft segmentation" approach to the future FSS earth station deployments in the 3650-3700 MHz band, to ensure efficient use of scarce spectrum resources.**

Yours sincerely,



John Forsey
Chairman

APPENDIX 1

For ease of reference, this Appendix uses the same section numbering system as in the Consultation notice.

5.2 Fixed Satellite Service

The Department proposes that FSS receive earth stations located at Weir, Quebec be grandfathered. Operators wishing to establish wireless access systems within a 150 km radius of these earth stations would be required to coordinate with the earth station operators.

The Department further proposes that any future FSS receive earth stations in the band 3650-3700 MHz operate on a secondary basis.

Comments are invited on this proposal.

CSSIF agrees with the protection of the FSS receive earth station located at Weir, Quebec and the proposed coordination requirements within a 150 km radius. The Department should extend this protection and coordination requirement to all other Canadian earth stations currently operating in these bands, including Lake Cowichan facilities in British Colombia, which may have not been identified in this Gazette Notice.

CSSIF opposes the Department's proposal that any future FSS receive stations in this band operate on a secondary basis with respect to other services in the band. The FSS extended C-band range of frequencies could be utilized in the future to supplement conventional C-band FSS capacity in certain areas. Currently Ku-band FSS capacity over North America has become very scarce with very limited opportunities for growth, and it is to be expected that FSS C-band spectrum will see increased usage over North America in the future. At that time, use of extended C-band in remote areas may be a desirable option to expand FSS services. However, a secondary allocation would not be compatible with the level of link availability and reliability that the end-users expect and have been accustomed to in C-band. A change of allocation from co-primary to secondary would unreasonably place the entire operational and investment risk and burden on the FSS community.

CSSIF therefore recommends that future FSS earth stations be operated on a co-primary basis with WBS systems, but with restrictions consistent with a "soft-segmentation" approach. This would allow development of WBS nationally, while still allowing future development of FSS in areas where it is not economically feasible to implement WBS services. Such a policy would be most consistent with efficient use of spectrum, and at the same time make it possible for new services to access new spectrum for provision of their services. The soft-segmentation policy could be achieved by means of similar provisions now applicable to the FSS in the band 3500-3650 MHz under existing footnote C20, namely:

ADD
Cxx "(CAN-xx) In the band 3650-3700 MHz, new fixed-satellite earth-stations to be deployed will be located in areas so as not to constrain the implementation of wireless broadband systems."

7.2 Spectrum Structure and Licensing Options

Comments are invited on the proposed options for exclusive and/or non-exclusive licensing and any other options not outlined in the table, with supporting rationale. Any option could be applied to all or part of the spectrum. In the case of urban/rural service areas, the Department seeks the rationale and criteria for defining urban and rural.

It should be noted that the licensing process and requirement for contention-based protocols will be determined based on the option selected.

CSSIF would like to highlight that it is necessary to protect operation of FSS C-band receive earth stations in the 3700-4200 MHz band against potential interference or saturation of the earth station low-noise block downconverters (LNBs) as a result of operating WBS transmitters in the adjacent band (see *Technical Considerations* below). This protection may be facilitated by restricting operation of higher power WBS transmitters to the lower frequencies in the band 3650-3700 MHz. Consequently, a flexible spectrum block approach may prove to be more accommodating to mitigate interference into FSS receiving earth stations.

9.0 Technical Considerations

The Department invites comments on the proposed technical rules. In particular, will the proposed out-of-band emission limits provide sufficient protection to services operating in adjacent spectrum, including FSS earth stations operating in the conventional C-band (3700-4200 MHz)? How would this compare to the potential impact of in-band WBS emissions below 3700 MHz on FSS receivers?

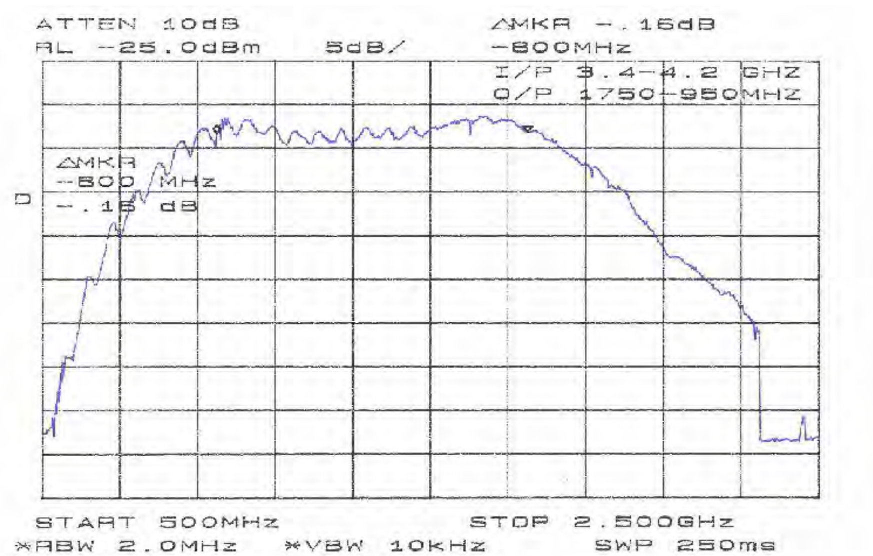
As noted in Section 3.0 of the *Gazette* Notice, the FCC *Report and Order* released on March 16, 2005 in the matter of WBS operation in the band 3650-3700 MHz is still the subject of considerable debate and discussion in the US. A number of Comments, Notices of *Ex Parte* submissions, and a Petition for Reconsideration in relation to "the adopted technical characteristics of the WBS transmitters permitted in-band power levels" and "the adopted Out-of-Band emission limits for WBS transmitters" have been submitted to the FCC. These submissions seek to avoid the possibility of unacceptable interference into FSS earth station receivers in the bands above 3700 MHz that the petitioners believe would occur should the WBS transmitter characteristics adopted by the FCC be maintained.

The potential impact of interference from WBS to FSS services is analyzed and presented below:

a) Impact of the proposed WBS transmitter power level into FSS receiver LNB

The majority of C-band earth stations operating in Canada utilize low-noise block downconverters (LNBs), which amplify and downconvert the 3700-4200 MHz signals to an intermediate frequency (IF) of 950-1450 MHz, for transport via coaxial cable to the demodulator. The majority of the deployed LNBs act as band pass filters and are designed to cover the entire FSS allocated band of 3500-4200 MHz. Their frequency response characteristics, an example of which is shown if Figure 1, do not exhibit any signal rejection towards the 3650-3700 MHz band. Thus, these C-band earth stations are as susceptible to overloading and saturation from transmitters in the 3650-3700 MHz band as they are to in-band transmitters in the 3700-4200 MHz band.

Figure 1. Typical frequency response of a C-band LNB (measured performance of a commonly used Norsat 3120 LNB)*



* Note: The LNB converts and inverts the frequency to the L-band range of frequencies. The two Markers on the plot represent the frequency range 950-1750 MHz (equivalent to 4200-3400 MHz).

The analysis below considers the case of a 4.5 m C-band earth station receiving a 36 MHz fully saturated downlink satellite signal with an EIRP of 41 dBW. Assuming free space loss of 196 dB and an antenna gain of 43.5 dBi, the desired signal at the input to the LNB would be -111.5 dBW. If all 12 transponders of the satellite (in the same polarization) are active, then the total received satellite power at the LNB input will be -100.7 dBW or -70.7 dBm.

Because of the large transmission distances and free space losses between the satellite and the earth, received satellite signals at the surface of the earth have very low power densities. Typical FSS LNBs reach saturation with an input signal of about -55 dBm. At about this level, the LNB would start exhibiting a non-linear behaviour, distorting the satellite signal. The proposed Peak EIRP limits for the WBS devices are given as:

- Fixed and base station = 25 watts/25 MHz
- Mobile station = 1 watt/25 MHz

Assuming the WBS signal is received directly by the earth station LNB, without any amplification by the earth station reflector (0 dBi gain) or obstruction loss, the following table depicts the level of interference into the LNB as a result of Single-Entry interference from one WBS base station or one Mobile station operating over 50 MHz of bandwidth:

WBS Device EIRP (watts)	**Distance (m)**	**WBS signal level at input to LNB (dBm)**
2	100	-51
	160	**-55**
	200	-71
	500	-65
	1000	-71
50	100	-37
	500	-51
	800	**-55**
	1000	-57
	2000	-63
	3000	-67
	4000	-69.5
	5000	-71.5

Thus, a typical LNB exposed to Single-Entry interference from a WBS base station located at a separation distance of 800 meters or less would experience saturation and distortion of its received signals. The same would be applicable in the case of a WBS Mobile transmitter 160 meters or less away from a typical LNB. Note that depending on the angle of arrival of the interfering signal, the impact could be greater due to the gain of the earth station reflector. The effect of multiple entry interference would be additive, increasing the required separation distances. This is obviously a very serious concern to the satellite communications industry and its customers, who rely on their C-band satellite facilities for their services and businesses all across Canada.

It should be noted that even with the installation of a pass band filter (PBF), with a pass band of 3700-4200 MHz, before the LNB, interfering signals that are orders of magnitude stronger than the desired signal and are immediately adjacent to the pass band edge could not be sufficiently attenuated, due to the roll-off characteristics of currently available pass band filters. The feasibility of appropriate pass band filters with the optimum performance characteristics to maximize rejection of the adjacent bands signals, while minimizing the level of signal degradations received by the FSS earth station requires study. Moreover, the filters must be cost effective so that they could practically be installed into thousands of existing FSS earth stations that may be susceptible to interference from new WBS services.

The CSSIF believes that such an undertaking, i.e. the development, manufacture and installation of the required filters, would require a long transition period. Delaying the introduction of WBS services in the 3650-3700 MHz band for a period of at least 10 years would be consistent with past policies in such situations. Furthermore, the CSSIF recommends that, to encourage installation of pass band filters at FSS earth stations to alleviate most of the concerns expressed above, the following two additional interference mitigation techniques be adopted. These techniques are compatible with situations involving allocation of two non-homogenous signals adjacent to each other:

1. To require that the higher power WBS transmitters (25W/25 MHz) be confined to operating only in the lower range of frequencies (channels) within the 3650-3700 MHz band. It is essential that these higher power density carriers be selected in order to provide some degree of isolation from satellite signals which are significantly weaker compared to terrestrial based signals.

2. To reduce the proposed transmit power density for the WBS mobile stations, thereby reducing the level of aggregate interference from them into FSS receivers.

b) Impact of the proposed WBS transmitter OOB emissions into FSS receivers

The *Gazette* Notice proposes that any emissions outside of the authorized band of 3650-3700 MHz, in a measured bandwidth of 1 MHz, must be attenuated by at least 43 + 10 log(P) dB below the transmitter power level P, where P is measured in watts.

Recommendation ITU-R S.1432 contains the allowable degradations to the FSS systems due to interference. This Recommendation states that for all sources of long-term interference that is neither from FSS systems, nor from systems having co-primary status, the allowable interference noise contribution is 1%. This has been expressed in other forums as a required protection criterion of I/N = -20 dB (i.e. $\Delta T/T \leq 1\%$).

A parametric analysis based on WBS system characteristics would show the increase in noise experienced by the FSS earth station, operating in the adjacent band, relative to a predefined FSS system noise temperature, and thus could show which combination of WBS characteristics may cause unacceptable interference in excess of the -20 dB I/N protection criterion. However, to understand the actual impact on the ability of the FSS earth station to properly receive the wanted signals, a C/I analysis is presented here.

This example considers the case of OOB emissions of WBS transmitters into a 4.5 m C-band earth station receiving a 36 MHz fully saturated downlink satellite signal with an EIRP of 41 dBW. Assuming free space loss of 196 dB and earth station antenna gain of 43.5 dBi, the wanted signal level at the input to the LNB would be -111.5 dBW or -81.5 dBm.

The table below compares the signal level at the FSS earth station due to the interferer signal and the wanted signal, at various off-axis angles and from various distances for typical deployment scenarios. The interferer signal is that which would be experienced due to the proposed WBS OOB emission level of -43 dBW/MHz into the band 3700-4200 MHz. The calculations are for the case of Single-Entry interference from one WBS transmitter.

Table C1: Comparison of interferer and wanted signal levels at the FSS earth station for various elevation angles and separation distances for typical deployment scenarios

Separation Distance (m)	Angle of Arrival at FSS antenna (°)	Interferer signal level at FSS antenna LNB (dBm/36 MHz)	FSS wanted signal level at antenna LNB (dBm/36 MHz)	C/I (dB) due to WBS Single-Entry interference
50	5	-63.6	-81.5	-17.9
100	5	-69.6	-81.5	-11.9
200	5	-75.6	-81.5	-5.9
500	5	-83.6	-81.5	2.1
50	15	-72.5	-81.5	-9.0
100	15	-78.5	-81.5	-3.0
200	15	-84.5	-81.5	3.0
500	15	-92.5	-81.5	11.0
50	30	-80.0	-81.5	-1.5
100	30	-86.0	-81.5	4.5
200	30	-92.0	-81.5	10.5
500	30	-100.0	-81.5	18.5

Table C1 shows that in several scenarios the calculated C/I or carrier-to-interference ratio is negative. This means that the power level of the interfering signal is actually greater than the power level of the wanted signal. In this case, the wanted signal would be completely obliterated. In fact, for interference due to co-primary services, C/I values of order of 20 to 25 dB are expected. For an OOB emission, the expected aggregate C/I level due to multiple transmitters must be much greater than the C/I due to other co-primary services. It should be noted that in the case of more than one WBS transmitter in close proximity to a given FSS earth station, the impact of aggregate interference from multiple transmitters would be even worse.

From the right-most column of Table C1 above, it is evident that all of the C/I values are much lower (worse) than the 20-25 dB range expected for co-primary services and far worse than what would be expected for OOB interference. To improve the situation for the FSS earth station, the OOB emission power must be reduced. Taking into account that WBS devices may be expected to operate within 50 to 100 m of an FSS earth station, the results in Table C1 show that the mandated OOB emission level for a WBS operating in 3650-3700 MHz must be reduced by at least 25-30 dB from the proposed -43 dBW/MHz (e.g. to a value of -70dBW/MHz or less) in order to not cause harmful interference into FSS earth station receivers under realistic conditions.

The above analysis concludes that the proposed OOB emission limits for the WBS service are insufficient and would result in harmful interference into FSS earth station receivers. The OOB emission levels of WBS devices need to be sufficiently low in order not to impact FSS services in the 3700-4200 MHz band, as FSS earth stations cannot filter out this in-band interfering signal.

Given the results of the analysis and considering the extensive discussion taking place at the FCC, it is critical that the Department tighten the proposed OOB emission limits for the WBS services in the band 3650-3700 MHz. The proposed OOB emission limit of -43 dBW/MHz leads to significant degradation for the FSS communication links in the adjacent band. Therefore, it is essential to limit the OOB emissions from WBS to a value of no more than -70 dBW/MHz to ensure protection of FSS services operating in the 3700-4200 MHz band.

Appendix 2

Selected Canadian C-band Earth Station Facilities in Urban Areas

The **Department of National Defence (DND)** uses C-band services for deployment and training purposes across Canada. One C-Band service on Anik F2 consists of three in-routes ranging from 256 to 512 kbps. This service consists of two-way links between transportable terminals, and the Ottawa hub station located at a government office complex location in central Ottawa.

Another DND service links a military installation in Nunavut with an earth station located adjacent to a high traffic artery in Ottawa.

Musique Plus Service
Provision of entertainment programs through collection and distribution of programming by many specialty TV programs, such as Musique Plus, with locations in urban centers in major cities across Canada.

GTA (Government Telecommunications Agency) provides a C-Band data service between Ottawa and Iqaluit. It is used to connect government installations in the two capitals. The links operate at data rates of 1536 Kbps and 448 Kbps.

Infosat Telecommunications operates a C band broadband service between a Vancouver hub and 26 remotes sites across B.C. This network is viewed by the Government of B.C. as an important component in promoting economic growth into northern and remote communities. It provides broadband connectivity to allow isolated communities access to Internet and government services.

CTV utilizes a full C band Transponder. The uplink from Toronto is used to distribute television programming to 28 affiliate sites located in urban areas. CTV's broadcasting signals carry a wide range of news, sports, information and entertainment programming.

CBC uses 5 C-band transponders to distribute 15 English television channels and 12 French television channels across the country. The signals are received at the retransmission site for off-air service or by cable companies. CBC also has 8 television channels that are used for contribution. These signals are received by the regional office or by the national office to be included in a regional distribution program. More than 40 radio services are also distributed on C-band across the country. More than 1000 receive earth stations are owned and operated by the CBC.

CBC Hub Site in Montreal

CANCOM operates a broadcast service to thousands of Canadian cable heads ends under a SRDU (Satellite Relay Distribution Undertaking, licensed from the CRTC). Cancom leases three C-band transponders and delivers over 20 video signals to more than 1500 small cable head ends across Canada.

The C-band service for **Bell Canada** comprises a combination of point-to-point links and demand assigned multiple access (DAMA) links. The point-to-point links are of various data rates from between 4.8 kbps up to 1544 kbps, and provide connectivity between the Montreal teleport and 25 remote sites located in Northern Quebec and Northern Ontario. The DAMA links are established with a mesh configuration between these 25 remote sites.

The following photos show three Canadian Teleports providing C-band connectivity to various communities across Canada.

The Montreal Teleport

The Calgary Teleport

The Edmonton Teleport