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Spectrum Management and Telecommunications Policy

Radio Systems Policy

Spectrum and Licensing Policy to Permit Ancillary Terrestrial Mobile Services as Part of Mobile-Satellite Service Offerings

Note: Spectrum and licensing policy principles to permit ancillary terrestrial mobile service in the bands 2000-2020 MHz and 2180-2200 MHz (2 GHz) have been updated and are outlined in Industry Canada's document SLPB-008-14 – *Decision on a Policy, Technical and Licensing Framework for Mobile Satellite Service and Advanced Wireless Service (AWS-4) in the Bands 2000-2020 MHz and 2180-2200 MHz*. As a result, all references that may apply to the 2 GHz band have been removed from this RP-023 document.

Related Documents

SLPB-008-14 – *Decision on a Policy, Technical and Licensing Framework for Mobile Satellite Service and Advanced Wireless Service (AWS-4) in the Bands 2000-2020 MHz and 2180-2200 MHz*

SP 1-3 GHz – Amendments to the Microwave Spectrum Utilization Policies in the 1-3 GHz Frequency Range

RP-007 – Policy Framework for the Provision of Mobile Satellite Service Via Regional and Global Satellite Systems in the Canadian Market

DGTP-002-07 – Consultation on a Framework to Auction Spectrum in the 2 GHz Range including Advanced Wireless Services

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Executive Summary

Satellite communications systems play a strategic role in the Canadian telecommunications infrastructure and satellite services have greatly facilitated the availability of reliable, affordable, and high-quality telecommunications and broadcasting services to Canadians, particularly to those living in remote and northern communities.

Canada has fully opened its satellite telecommunications market to competition to ensure businesses and consumers benefit from a range of advanced communications services at competitive prices. Five regional mobile satellite networks currently serve the Canadian market. A new generation of mobile satellite networks is in the planning stage and promises to bring data-based mobile services with their capabilities approaching, or exceeding, those of the second generation (2G) of terrestrial Personal Communications Services (PCS). An important segment of the Canadian population relies solely on mobile satellites to access mobile communications as terrestrial commercial mobile services are not available in all parts of the country.

A number of satellite operators petitioned Industry Canada for the flexibility to develop an Ancillary Terrestrial Component (ATC) to offer mobile service as an integral part of the mobile-satellite service (MSS) offerings. A main driver in establishing the ATC mobile component is to take full advantage of the assigned MSS spectrum in any given area. This would expand the service coverage into large cities where the satellite signals are blocked by high-rise buildings and where coverage is non-existent inside buildings. Most of the mobile satellite industry is of the view that policy and regulatory rules need to be in place in order to proceed with the development of next generation mobile satellite networks.

In 2004, following a public consultation and an assessment of the satellite communications environment, the Department concluded that providing flexibility for the development of the ATC mobile service as an integral component of the mobile-satellite service will encourage the development of advanced mobile satellites and serve the public interest. Providing flexibility to develop the ATC mobile service under a general set of policy and regulatory principles will serve the public interest as follows: (i) presents the unique opportunity of delivering advanced mobile-satellite services to those areas where commercial mobile services are not available (i.e.. more than 80% of the Canadian land mass); (ii) makes more efficient use of the limited public spectrum resource already assigned; and, (iii) under an opened competitive satellite marketplace, harmonizes the rules within the North American marketplace in order to have affordable services for the benefit of Canadians.

The Department also concluded that the public interest will best be served by establishing a set of spectrum and licensing policy principles to oversee the implementation of the ATC mobile service as an integral part of MSS offerings. These principles will guide the consideration of terrestrial ATC mobile applications in conjunction with MSS networks operating in the L Band and Big LEO satellite spectrum bands. The principles are summarized as follows:

(a) The ATC mobile service will be an integral part of MSS offerings. A substantial level of mobile satellite services will be provided with the ATC service.

(b) The frequencies used for the ATC system will be within the assigned spectrum for a particular MSS network and the ATC service will be limited to the satellite service areas. The use of the MSS spectrum for ATC operation will be subordinate to the spectrum being available for mobile satellite service.

(c) The ATC mobile service will be required to cease operation, within a reasonable period, should the mobile satellite service or network be discontinued.

(d) The ATC operation will be authorized such that it will neither cause harmful interference to, nor claim protection from, MSS and other primary radio services operating in adjacent bands. ATC operations will be subject to technical and operational requirements considered appropriate to mitigate potential interference.

(e) Complete applications as radiocommunication carriers will need to be submitted to seek authorization to operate an ATC mobile system as an integral and indefeasible part of the MSS offerings. Specific information will be required as part of the application to demonstrate adherence to policy, operational and regulatory principles.

(f) Spectrum-area licences will be issued for ATC systems and will be subject to spectrum fees based on a future consultation.

The Department believes that providing flexibility to the mobile satellite industry to develop an ATC mobile component will advance the objectives of the Canadian telecommunications policy in affording all Canadians advanced mobile services.

1. Introduction

This revised document announced in *Canada Gazette* Notice No. SLPB-008-14, enunciates the spectrum and licensing policy principles which will oversee the development of ancillary terrestrial components (ATC) to provide terrestrial mobile service as an integral part of the mobile-satellite service (MSS) offerings in the bands 1525-1559 MHz and1626.5-1660.5 MHz (the "L-band"), and in the bands 1610-1626.5 MHz and 2483.5-2500 MHz (the "Big LEO bands"). The spectrum and licensing policy principles related to MSS/ATC in the band 2000-2020 MHz and 2180-2200 MHz (the "2 GHz band") are now outlined in the document announced in *Canada Gazette* Notice No. SLPB-008-14, *Decision on a Policy, Technical and Licensing Framework for Mobile Satellite Service and Advanced Wireless Service (AWS-4) in the Bands 2000-2020 MHz and 2180-2200 MHz*.

Satellite communications continue to be a core component of the Canadian telecommunications infrastructure and greatly contribute to bringing telecommunications and broadcasting to many dispersed and remote communities. In many situations, satellite communications have ensured that essential telecommunication services at affordable prices are available to Canadians wherever they may live and work.

Mobile satellite networks provide communications to all areas of Canada and have been of particular importance for people in rural and remote areas where terrestrial commercial mobile service is not available. Although commercial mobile services reach approximately 99% of the population, the actual coverage remains a modest portion of the Canadian land mass at approximately 20%. As such, mobile satellites provide the only portable communications to several sectors of the economy having important industrial and government activities in sparsely populated regions of Canada.

Although, for several years, a number of mobile satellites have been authorized to serve the Canadian market, the service uptake has been very low compared to commercial mobile services. The satellite industry has developed new generations of mobile satellites which address some of the issues which have impeded the take-up of first generation mobile-satellite services. These satellites use a series of multi-beam antennas which increase the spectrum efficiency by several fold, are capable of communicating with small portable terminals, and support advanced services approaching or exceeding the second generation of personal communication services.

Large capital investments are required to implement these new satellite networks. The long lead-time from planning to launch of commercial satellite services makes it imperative that any changes in the policy and regulatory environment that oversee the marketplace, be established early so as to provide confidence in moving forward.

Also, it is well known that mobile satellite networks need to gain access to large regional markets such as the North American market and beyond, in order to support these large investments. A main objective of the 1997 World Trade Organization (WTO) Agreement on basic telecommunication services was to open competition worldwide for satellite communications. The Department is committed to continuing to foster competition and investment in the mobile-satellite service market so that Canadians in all parts of Canada may benefit from advanced communications services at affordable prices.

2. Background

In October 2001, the Department received an application from Mobile Satellite Ventures (Canada) Inc. (MSV Canada), currently SkyTerra Canada, for the approval of a second generation mobile satellite system (using a multi-beam design) in the L-band spectrum which is already assigned and licensed to the first generation mobile satellite - the Canadian MSAT. An integral part of the application was the request for approval of an ancillary terrestrial component (ATC) to establish a mobile service in conjunction with the mobile- satellite service offerings.

The deployment of ATC is envisaged in urban areas where the satellite signals are blocked by high-rise buildings as well as potentially extending coverage within buildings. The ATC system would provide terrestrial mobile service coverage as an integral component of the MSS offerings in certain urban centres to extend the coverage of the mobile-satellite service and fully utilize the assigned MSS spectrum within the licensee's service area.

Based on this request, Industry Canada initiated a public consultation process on the ATC proposal by MSV Canada to establish whether approving a terrestrial ATC would serve the public interest and what policies, regulatory, technical and operational considerations would need to be addressed. From the outset, it was anticipated that similar interest to establish ATC would be raised by other mobile satellite operators. Hence, the Department invited comments on the MSV Canada request (to operate terrestrial ATC mobile service as an integral part of the MSS service offerings) and other similar interest.

At the same time, mobile satellite and ATC applications were filed with the US Federal Communications Commission (FCC) to operate with new mobile satellites contemplated in the L-bands (1525-1559/1626.5-1660.5 MHz) and the 2 GHz bands (1990-2025/2165-2200 MHz). Mobile satellite operators in the low Earth orbit (LEO) bands (1610-1626.5/2483.5-2500 MHz) expressed similar interest. These US filings resulted in an extensive public consultation process by the FCC to address the regulatory regime and technical and operational concerns.

In February 2003, the FCC announced its rule making and decision[1] that would permit flexibility for mobile satellite service providers to submit applications to operate an integrated ATC service as part of the mobile satellite service offerings in the three bands mentioned above.

3. Canadian Consultation

Industry Canada's public consultation process sought comments on the public interest, policy, licensing, regulatory and technical/operational issues surrounding the MSV Canada request to operate an integrated ATC mobile service within the assigned mobile satellite spectrum. Although the consultation was focused on a particular request by MSV Canada, the Department recognized that the scope of the request would have to be extended to consider similar interest by other mobile satellite operators. Any decision to provide flexibility for ATC implementation would require the establishment of general policy and regulatory principles to oversee potential interest by operators of other mobile satellite networks.

[1] See proceeding FCC 03-15.

The comments can be summarized under three lines of discussion and argument. Firstly, the respondents in favour of increased flexibility argued the need for the terrestrial component to expand the MSS coverage in city cores and in buildings; the increased spectrum efficiency in using already assigned MSS spectrum for ATC; and the importance of ATC for the future commercial viability of MSS. Due to the subordinate assignment of MSS spectrum for ATC and the required technical constraints imposed on the terrestrial operations to protect the primary services, it would be impractical to establish a stand-alone terrestrial ATC operation that was not closely integrated with the MSS network operation. Also, a MSS network operator licensed in the 2 GHz MSS bands petitioned for similar flexibility to operate an ATC mobile service in those bands in conjunction with MSS offerings, for similar reasons.

Secondly, three of the four PCS carrier respondents were of the view that ATC mobile service could be accomplished from resale arrangements with existing PCS providers and that other parties should have access to the MSS spectrum to develop an ATC mobile service. These respondents indicated, however, that if an ATC operation was to be permitted with the MSS offerings, the authorization should be under similar policy and regulatory requirements as for the PCS cellular services (i.e. spectrum fees and mobile spectrum cap).

Thirdly, other respondents representing a global mobile satellite operator and a priority MSS user, were concerned with the potential interference environment of ATC systems in the L-band. The potential interference could affect MSS satellites serving other regions of the world; mobile satellite terminals operating in adjacent MSS spectrum and in the same service areas; and, the integrity of aeronautical Global Positioning System (GPS) landing systems near airports and of priority access to spectrum for the Aeronautical Mobile Satellite (Route) Service (AMS(R)S) and the Global Maritime Distress and Safety System (GMDSS).

The Department studied these comments and similar comments made in the FCC proceedings. Also, technical studies were carried out regarding the potential impact of ATC operations on other services in the L-band. The Department had extensive discussions with several of the stakeholders to better understand the potential environment.

4. Industry Canada's Findings and Conclusions

The availability of advanced mobile satellite networks with increased data capability is an important element of the Canadian telecommunications system so as to foster advanced and affordable communications services to all regions of Canada. Although the terrestrial commercial mobile networks are serving the majority of the population in cities, southern communities and main highways, an important segment of the Canadian population living and working in sparsely populated regions would greatly benefit from the service offerings of future advanced mobile satellite networks. The Department is of the view that, if the mobile satellite industry is to succeed in delivering advanced satellite services at affordable prices, the industry needs some flexibility to innovate and improve its service delivery and coverage. This would enable the industry to compete in a harmonized North American marketplace and to have the policy and regulatory certainty to plan major satellite investments for new satellite infrastructures.

The Department concluded from this proceeding that the offering of mobile satellite service with an integrated ancillary terrestrial component of mobile service will serve the public interest, in particular:

- it will increase the efficient use of already assigned MSS spectrum, on a beam-by-beam basis;
- it has the prospect of improving the economics of new satellite infrastructure capable of providing a range of advanced services to Canadians, especially those not served by terrestrial commercial mobile networks;
- it recognizes the multi-national nature of the mobile-satellite service and the need to have common marketplace rules;
- it will foster competition, choice of services and more affordable prices, and
- it can be achieved through a reasonable, flexible policy and licensing regime that neither distorts the market forces of competition, nor confers unreasonable advantages to certain wireless carriers.

As such, the Department believes that providing the flexibility to develop a terrestrial mobile service as an integrated ancillary component to the mobile satellite service offerings, with reasonable regulatory and operational oversight, will serve the Canadian public interest and foster Canada's telecommunications policy objectives. In particular, these new mobile satellite networks could provide advanced communications services at affordable prices to rural and remote areas. The development of ATC installations will require no additional spectrum and, with proper technical and operational measures, will operate in a reasonable interference-free environment and co-exist with other MSS networks and other primary services operating in adjacent bands.

5. Decision

The Department will accommodate the development of an ancillary terrestrial component (ATC) mobile service as an integral part of mobile-satellite service offerings under a licensing process guided by a set of spectrum and licensing policy principles. Although the technical and operational discussions were focused on the L-band, in general the policy and licensing principles will oversee any ATC mobile application by mobile satellite networks operating in the L-band and the Big LEO bands[2].These principles are as follows:

(a) **ATC — An Integral Part of the MSS Offerings**

The ATC mobile service can only be offered as part of the MSS service offerings; the ATC service will not be approved as a stand-alone service. A substantial level of MSS offerings (marketing and distribution capacity) must be provided with the ATC mobile service. The ATC operator will use dual-mode terminals capable of communicating with both the mobile satellite network and the terrestrial ATC system, or make use of service and commercial arrangements that ensure that the ATC service is an indefeasible part of the MSS offerings.

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[2] The policy and licensing principles governing ATC in the 2 GHz band are now outlined in SLPB-008-14 — *Decision on a Policy, Technical and Licensing Framework for Mobile Satellite Service and Advanced Wireless Service (AWS-4) in the Bands 2000-2020 MHz and 2180-2200 MHz.*

(b) **Spectrum Status for ATC Mobile Service**

The mobile satellite frequency bands (L-band, 1.5/1.6 GHz; and Big LEO, 1.6/2.4 GHz) are allocated on a primary basis to the mobile-satellite service and designated by spectrum policy as a priority resource for regional mobile-satellite service. The L-band spectrum includes certain allocation provisions to support priority spectrum access and operation of the GMDSS and the AMS(R)S in accordance with the international *Radio Regulations*. Any spectrum assigned as an ancillary terrestrial component will be subordinate to the spectrum needed for the mobile-satellite service.

As such, the ATC mobile system will use all reasonable measures, of design and operation, so as not to cause harmful interference to other mobile satellite network services or to other primary radio services operating in adjacent bands, including GPS and related applications. Furthermore, the ATC mobile service cannot claim protection from other mobile-satellite services and radio services operating in accordance with the international *Radio Regulations*.

ATC systems will have to use spectrum in the assigned frequencies or spectrum blocks authorized to the mobile satellite network with which the terrestrial mobile service is integrated and ancillary. The ATC systems will be limited to operating within the mobile satellite coverage and service areas.

The spectrum made available for the ATC mobile service by the MSS network operator is subordinate to the access of spectrum for MSS. Access by a third party to any part of the spectrum assigned to a particular MSS network operator, for the operation of a terrestrial ATC mobile service, will be based solely on a commercial agreement between the MSS network operator and the ATC operator. Spectrum licences for the ATC mobile service will be conditional on the spectrum being released for existing and new MSS networks, if and when required.

(c) **Licensing and Regulatory Policy**

Separate applications will be required for spectrum-area licences to operate an ATC mobile service as an integral component of the mobile-satellite service offerings. The ATC applicant will need to meet and comply with the applicable eligibility criteria of the *Radiocommunication Regulations* on an ongoing basis.

The following is a preliminary list of information to be submitted in an ATC mobile service application:

(i) the identification of the ATC applicant and its relation to the MSS operator, whether the applicant for the integrated ATC mobile service is:

- the MSS satellite carrier, and/or
- a MSS provider, and/or
- a third party;

(ii) a summary of the commercial, operational and technical arrangements made for the ATC to have access to the MSS spectrum in the relevant area(s), in particular as they relate to the obligation to ensure the integrity of MSS and protect MSS operations;

(iii) a demonstration on how the operation of the ATC mobile service will be an integral and indefeasible component of the MSS offerings;

(iv) the amount and specific frequencies or spectrum blocks proposed for use by the ATC system within the assigned spectrum of the MSS network and associated MSS coverage area;

(v) an indication on how the sharing of spectrum for ATC will not constrain the growth of MSS offerings;

(vi) a demonstration on how substantial mobile satellite service offerings will be available before or at the time ATC service is to begin operation;

(vii) an attestation to the obligations to cease operation if harmful interference were to be caused to other MSS networks or to other primary radio services operating in adjacent bands, until such time as the cause of harmful interference is resolved;

(viii) an attestation to the understanding that the use of MSS spectrum for ATC mobile service is conditional on the spectrum being made available for mobile-satellite service as required, and that the ATC mobile service cannot claim protection from other MSS networks in the band concerned or from primary services operating in adjacent bands in accordance with the international *Radio Regulations*;

(ix) an attestation to the understanding that the use of MSS spectrum for ATC mobile service is conditional on the spectrum being made available for MSS as required, and that the ATC mobile service will cease operation, within a reasonable period, should the satellite service be discontinued, and;

(x) a description of the technical and operational measures to be taken to ensure that any potential interference to other MSS and primary services is mitigated to reasonable levels, including a demonstration on how priority access will be given to the AMS(R)S and other primary services operating in adjacent bands.

(d) **Spectrum Licences and Fees**

Spectrum licences will be issued for ATC mobile systems and will be subject to spectrum licence fees. These fees will be established through a separate public process.

(e) **Technical and Operational Considerations**

In general, the development of the ATC system is envisaged as an integral and ancillary component of the next generation of mobile satellites. These satellites will use a series of multi-beams with high spectrum re-use and will accommodate small customer terminals which will operate on both the MSS and ATC systems. The high spectrum reuse of these MSS networks will provide a reasonable opportunity for ATC systems to reuse the MSS spectrum on a satellite beam-by-beam basis.

The spectrum utilization environment for the mobile satellite service is such that each operator is assigned distinct spectrum (group of frequencies or blocks of spectrum) over large regions such as North America. Each MSS band is partitioned for a specific type of satellite system (i.e. geostationary orbits (GSO) or low Earth orbits (LEO)). Since some mobile satellite systems are global, the same spectrum is reused to support the operation of the same or different satellite operators in other regions of the world, where there is sufficient isolation.

The spectrum is assigned and coordinated between the different mobile satellite operators so as to minimize interference between satellite systems and their terminals. Different scenarios are considered, all of which fall under the category of inter-system interference (i.e. where operation of the ATC of one MSS system interferes with the satellites or the terminals of another MSS operator). The Department did not consider the interference caused by the ATC operation on the MSS system with which it is operating as the level of interference will be self-regulated in order to meet the licence conditions.

The Department also considered the situations where the ATC operations (either the base stations or the mobile terminals) could potentially interfere with the operations classified under other radio services such as the radionavigation-satellite service (RNSS).

The Department's public consultation was based on the request by MSV Canada to allow ATC operation in the L-band (1.5/1.6 GHz). Though the consultation paper focused on the L-band, the Department invited comments on any issue relevant to the consultation. Industry Canada concurs with ICO Canada's comments that such flexibility should be granted to all MSS bands between 1-3 GHz. The technical Annex to this document presents guiding principles which apply to both the L- band Big LEO bands, and some specific technical and operational constrains which apply to the L-band only.. Detailed technical and operational requirements for all MSS bands will be developed and included within the Department's radio equipment and system standards.[3]

To determine if sharing was feasible in the L-band, the Department conducted and commissioned studies, reviewed comments submitted by respondents to the consultation and requested specific interested parties to submit or review further studies. In addition, to determine if sharing was feasible in the other bands, the Department considered the extensive studies submitted to the FCC as part of the proceedings with regard to the MSS bands 1.5/1.6 GHz, 1.6/2.4 GHz and 2.0/2.1 GHz, recognizing that it is important to harmonize the technical and operational requirements as closely as possible within North America to establish similar MSS/terrestrial ATC opportunities.

Studies were undertaken to determine whether, and in what situations, ATC systems operating within the spectrum assigned to a regional MSS system could cause harmful interference to the satellite or terminals of:

(l) a MSS system operating in adjacent spectrum and the same region;
(2) a MSS system operating co-channel spectrum with beams serving areas adjacent to the service area of the MSS system with an ATC underlay;

[3] Standards for the certification of radio transmitters and receivers operating in the mobile-satellite service (MSS), including mobile ancillary terrestrial component (ATC) equipment are found in Radio Standards Specification (RSS)-170 — *Mobile Earth Stations and Ancillary Terrestrial Component Equipment Operating in the Mobile-Satellite Service Bands*.

(3) other radio services in adjacent bands serving the same region.

Scenario 1: Adjacent Spectrum, Same Region

For the first situation, the Department investigated the impact of the ATC base stations overloading mobile earth terminals close to the ATC base station, or interfering with MSS receivers on board ships or aircrafts. In addition, the Department studied the impact on the priority access to spectrum for the Global Maritime Distress and Safety Systems (GMDSS) and the Aeronautical Mobile Satellite (Route) Service systems (AMS(R)S). The conclusions of these studies and the technical and operational constraints on the ATC system are found in the Annex to this document. The Department also studied the aggregated noise from the ATC mobile terminals into another MSS system spacecraft and found that it was negligible.

Scenario 2: Co-channel Spectrum of an MSS Spacecraft Serving an Adjacent Area

With respect to the potential impact on the spacecraft receiver of an MSS system serving an adjacent area with co-channel spectrum, the concern is mainly the aggregate additional noise from the terminals of the ATC systems. Based on the study of a worst-case scenario, the rise in the level of the noise floor is expected to be well below the international level which triggers coordination between operators. The Department concludes that, with emission limits on the mobile ATC terminals, no further measures are required.

Scenario 3: Interference to Other Radio Services

This scenario has to be further broken down into interference to various radio services. Below is a detailed list of the scenarios which were investigated. The results are presented in the Annex to this document.

(i) **Interference to the Radionavigation Satellite Service (RNSS) and the Aeronautical Radionavigation Service (ARNS)**

The Department studied the potential for an ATC system to impact RNSS and ARNS applications for critical services provided at airports for landing and take-off (i.e. the global navigation satellite system (GNSS) of the ARNS service allocation, using the GPS system under the RNSS allocation). The interference to the synchronization of code division multiple access (CDMA)–based cellular base stations using the GPS system was analyzed in addition to interference to the cellular terminals which use GPS for Enhanced 911 (E-911).

(ii) **Interference to SARSAT Receive Stations (Search and Rescue Operations)**

The potential of L-band ATC systems to interfere with search and rescue operations and the protection of the five Canadian Cospas-Sarsat receive stations was studied. The Department of National Defence which operates these stations agreed with the findings of Industry Canada studies and the proposed protection measures.

(iii) **Interference to the Radio Astronomy Service**

Measures will be adopted to protect the radio astronomy service from ATC mobile terminals close to radio astronomy sites. This could include, but is not limited to, ATC mobile terminals not being able to operate close to radio astronomy sites. These measures are applicable to LEO MSS systems operating in the L-band.

Summary of the Department's Technical Findings

The Department concludes that by establishing a number of technical and operational measures, ATC mobile systems can co-exist with other MSS systems and with primary services in adjacent bands, in the above noted MSS bands.
This sharing is considered feasible and reasonable with ATC operating under certain restrictions relating to: (1) the placement of ATC stations; (2) the base and mobile station emission limits; and (3) the operational measures for both base and mobile terminals. In particular, measures are required to protect sensitive areas such as airports, commercial waterways, harbours, radio astronomy sites and SARSAT receive stations. These technical and operational measures will also protect primary services, such as, the radionavigation-satellite service, the aeronautical radionavigation service, and priority access to the spectrum used for safety systems such GMDSS and GNSS. In all cases, ATC operations would only be permitted on a no-interference and no-protection basis.

The Department will establish emission limits and operational deployment constraints. Radio equipment certification and the deployment of ATC systems will be in accordance with radio equipment and system standards as set out in RSS-170 ─ *Mobile Earth Station and Ancillary Terrestrial Component Equipment Operating in the Mobile-Satellite Service Bands* which is based on the technical and operational conclusions in the Annex to this document.

Of the different interference scenarios identified and studied, scenario 2 described above was extensively studied to ensure that Canada met its treaty obligations under the international *Radio Regulations*. The Department commissioned worst-case scenario studies with four L-band MSS systems, each with a fully deployed ATC system, with ATC base stations being distributed over North America. The studies showed that the mobile terminals associated with the four ATC systems would raise the noise-floor in mobile satellite spacecraft receivers serving other regional geographical areas by only a modest amount. This increase in noise level is expected to be well below the internationally recognized level used to initiate coordination between MSS licensees. The use of frequencies which are not co-channel have no measurable impact on the satellite receiver of other MSS systems operating in the Americas and other regions of the world.

In addition, all MSS operators agreed that intra-system interference caused by ATC operations will be more important than inter-system interference. Therefore, ATC operations will be self-limiting in ensuring that their associated MSS network continues to offer significant satellite services as per the conditions of licence for ATC operations.

The Department concludes that there is no need to limit either the number of base stations nor the number of simultaneously operating customer terminals. Canada expects to meet its international obligations and will consider authorizing any number of ATC base stations on a per-MSS-system basis.

The Department does not purport to have considered all potential sharing scenarios with respect to the operation of ATC systems vis-à-vis other primary services or systems. With further technological advances or potential changes to system design, new situations may emerge requiring further studies.

6. Conclusion and Implementation

The Department believes that these policy principles to permit terrestrial mobile services as an integral component of MSS offerings will serve the Canadian public interest and foster Canada's telecommunications policy objectives. In particular, these mobile satellite networks could foster advanced communications services at affordable prices to rural and remote areas.

Applicants wishing to develop a terrestrial mobile service ancillary to the MSS offerings should be guided by the principles and requirements described in this policy document. Industry Canada will release a Client Procedures Circular (CPC) in which procedures will be set out regarding the authorization of ATC mobile systems based on the above-mentioned policy provisions. Also, the Department will carry out a public consultation regarding the spectrum fees to be applied to terrestrial ATC mobile systems. Appropriate technical specifications will be incorporated in the relevant Radio Standards Specification (RSS) and Standard Radio System Plan (SRSP) documents.[4]

General inquiries about the policy provisions may be addressed to the Senior Director, Planning and Projects, in the Engineering, Planning and Standards Branch, 300 Slater St., Ottawa, Ontario, K1A 0C8 (Telephone: 613-990-0813, Facsimile: 613-957-8845, E-mail: Spectrum.Engineering@ic.gc.ca).

Issued under the authorization
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Fiona Gilfillan
Director General
Spectrum Licensing and Policy Branch

[4] Standards for the certification of radio transmitters and receivers operating in the mobile-satellite service (MSS), including mobile ancillary terrestrial component (ATC) equipment are found in RSS-170 — *Mobile Earth Stations and Ancillary Terrestrial Component Equipment Operating in the Mobile-Satellite Service Bands*.

Annex

Technical and Operational Requirements to Support MSS ATC Deployment

In general, the consideration of regulatory changes to allow an additional radiocommunication service in any band requires an analysis of the impact that this new service would have on the existing services and on the operations in that band and adjacent bands. As a matter of principle, the Department supports a pragmatic approach of burden sharing, taking into consideration the relative status and priority of the services in the *Canadian Table of Frequency Allocations*, the Canadian spectrum utilization policies and the international *Radio Regulations*. This approach applies to both inter-service (among different services) and intra-service (among different systems of the same service). Appropriate measures are included through policy, technical and operational measures.

After a full review, the Department concluded that, under certain technical and operational measures, ATC operations will not unduly affect other services and operations in the same bands and adjacent bands. Consequently, there will be some general technical and operational measures applicable to the deployment of ATC systems in the applicable MSS bands (L-band and Big LEO bands[5]), as well as some more specific measures for each of these bands.

[5] L-band: 1525-1559/1626.5-1660.5 MHz ; Big LEO bands: 1610-1626.5/2483.5-2500 MHz

Part A

General Technical and Operational Measures Applicable to MSS ATC Systems in MSS Bands

The following summarizes the technical and operational measures applicable to the MSS bands 1525-1559/1626.5-1660.5 MHz, and 1610-1626.5/2483.5-2500 MHz.

1. ATC Mode of Operation

Satellite operators wishing to implement ATC have submitted different system configurations and modes of operation. These modes of operation included:

- the "forward-band mode": ATC base stations transmit in the satellite downlink band and receive in the satellite uplink band;
- the "reverse-band mode": ATC base stations transmit in the satellite uplink band and receive in the satellite downlink band;
- the "uplink duplex mode": ATC base stations transmit and receive in the satellite uplink band; and
- the "downlink duplex mode": ATC base stations transmit and receive in the satellite downlink band.

The Department's analysis indicates that the last three modes of operation will increase the potential for inter-system interference. Consequently, only the "forward-band mode" will be considered at this time for MSS ATC operation. Hence the ATC base station transmit frequencies will use spectrum allocated in the satellite downlink (space-to-Earth) band and the ATC mobile stations will transmit in the uplink MSS (Earth-to-space) band.

2. Certification of Terminals in Accordance with Radio Standard Specifications (RSS)

The ATC customer terminal will need to be certified in accordance with a future Radio Standard Specification (RSS). These specifications will include, amongst other requirements, out-of-channel and out-of-band emission limits specific to each MSS band of operation and power control requirements. These technical provisions will be put in place to protect other MSS systems and other primary services operating in the same band or in adjacent bands.

3. Standard Radio System Plans (SRSP)

ATC base stations will need to operate within the Effective Isotropic Radiated Power (e.i.r.p.) and Height Above Average Terrain (HAAT) limits and prescribed antenna patterns, which will be established in a future SRSP. In addition, power flux density (pfd) limits will also be imposed on base stations close to airports and harbours. Out-of-band emission limits will apply to base station transmitters as well. These limits may vary with the MSS band. Other technical or operational restrictions may apply such as coordination and power control or pre-emption capabilities.

4. Protection of the Radionavigation Satellite Service (RNSS)

Both ATC base stations and mobile terminals will need to meet the Global Mobile Personal Communications by Satellite (GMPCS) provisions to protect RNSS operations (such as GPS receivers). These provisions consist mainly of a broadband limit of -70 dBW/MHz and a narrowband limit of -80 dBW/700 Hz averaged over 20 ms in the 1559-1605 MHz frequency range.

5. Status of Operation and Responsibility

ATC operations will be authorized on a no-interference and no-protection basis in all MSS bands, even where there is a primary mobile service allocation. This status will help ensure that the spectrum remains available for MSS operations. In view of this status, the MSS ATC operator will need to take appropriate technical and operational measures to mitigate potential interference that may occur to other MSS systems and other services. In case of harmful interference suspected to be from the ATC operation, the operator of the ATC will cease operation immediately until the interference is resolved.

6. Related Information

The US Federal Communications Commission (FCC) also conducted an extensive consultation before deciding favourably on the additional flexibility to permit ATC in these MSS bands. In general, the technical and operational constraints which will be developed in detail in Industry Canada's Radio Standard Specifications (RSS) and Standard Radio System Plans (SRSP) will be similar to those adopted by the FCC. The FCC rules and regulations are codified in Title 47 of the Code of Federal Regulations (CFR). Those relevant to the MSS ATC decisions for the related bands are found in 47 C.F.R. § 25.252, § 25.253 and § 25.254.

However, the approach used by the Department to determine sharing feasibility was somewhat different from that used by the FCC. The Department focused on limiting the potential interference to other users of the spectrum while providing maximum flexibility. In some instances, the Department reached a somewhat different conclusion than the FCC.[6] In particular, the sharing environment for the 2483.5–2500 MHz downlink band is different than in the US, leading to fewer requirements or different constraints in Canada. In general, the technical and operational constraints tobe adopted by the Department in its documents will be similar to those contained in 47 CFR §25.

[6] Examples include: not limiting the number of base stations in the MSS L-band, the approach to ad dress overload of M ET of other systems from ATC base station emissions, or the exact value for pfds around airports and waterways.

Part B

Technical and Operational Measures Applicable to MSS ATC in the 1.5/1.6 GHz GSO Bands

As part of the consultation process, concerns were expressed by some respondents on the potential interference from MSS ATC systems to other MSS systems, in particular, in the L-band. There was also a concern about the potential impact on the priority access to MSS spectrum for the aeronautical mobile satellite (Route) service (AMS(R)S) as stipulated in the international *Radio Regulations*. To better characterize some of these issues and additional concerns identified both in Canada and in the US, the Department analyzed the studies submitted by respondents in both Canada and the US, conducted internal studies and also analyzed the FCC's approach and findings. The Department's approach and findings are as follows:

1. Approach

The Department's approach has been to determine under what technical and operational conditions MSS ATC mobile services could be authorized without causing undue interference to other services. As discussed in Part A, the Department's focus has been on inter-system interference. The Department will provide maximum flexibility to the licensee, considering that ATC operation is ancillary to the provision of a substantial MSS offering.

2. Specific Interference Scenarios

The Department's public consultation raised some technical issues for consideration. A number of technical analyses were performed in order to address the various issues raised. As a result, the Department has decided to impose the following specific constraints on L-band ATC operations linked to geostationary satellite orbit (GSO) MSS systems in addition to the general constraints listed in Part A of this Annex:

i. Interference from the ATC Mobile Terminals into the Satellite Receiver of Another GSO MSS System — Adjacent Beam, Co-channel

The Department studied the risks of space receiver interference by mobile stations connected to the ATC of other satellite systems. The emissions from these mobile stations may raise the noise level of a satellite transponder. Since the same channel is not used by different systems within the same geographic region, the Department studied the noise level perceived by a satellite transponder serving another geographic region than the one served by the mobile stations connected to the ATC of other satellite systems and that uses the same frequencies.

One simple explanation deals with the current L-band frequency arrangement between the regional MSS operators. Generally speaking, the frequencies assigned to an MSS operator are exclusive and not assigned to another operator in the same geographic area.

The Department studied the impact of the aggregate noise from ATC mobile transmitters into the satellite receiver of another MSS system serving an adjacent geographical area but using the same spectrum. The conclusions of the studies indicate that the probability of interference is very low[7]. As previously mentioned, with the current partitioning of the spectrum between the regional MSS operators, the use of a specific band is exclusive to each operator within the same service area; these service areas tend to be very wide geographical areas. Therefore, the interference scenario between co-channel adjacent beams would be limited and the impact on the other MSS operators further reduced.

The Department further believes that the MSS licensee, or another entity authorized to operate the ATC system,[8]will take appropriate measures to curtail interference to its MSS system, recognizing that ATC mobile operations are an integral part of and ancillary to their traditional MSS operations. Moreover, the Department encourages MSS operators to aggregate their spectrum through their regional operating agreements to form contiguous blocks of spectrum over the largest area possible in the Americas, in order to minimize the co-channel adjacent beam interference scenarios.

Based on the analyses, and considering all of the above, the Department will not impose a limit on the number of base stations of ATC systems.

ii. Aeronautical Receivers

In order to protect aeronautical receivers of the mobile satellite service, the aggregate pfd at any point at the edge of the airport must not exceed -68.8 dBW/m2 within the bandwidth of the receiver front end.[9] In addition, the Department establishes a 2 km coordination zone around airports. Propagation studies and system design could facilitate the placement of base stations within this 2 km zone, taking into account terrain data and clutter, but the pfd restriction must still apply.

Should the pfd at the edge of the airport exceed the above limit, ATC operators will be required to immediately reduce the power of the relevant base stations; these may include base stations located farther than 2 km from the airport.

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7 The Department's decisions are based on, among other things, the Comtek The analysis that studied the effects of emissions from mobile stations connected to four ATC systems each with 15,000 base stations. Each base station used 3 carriers of 19.1 dBW over 200 kHz (one channel). The study showed that the emissions from mobile stations increased the noise level of the satellite by only 4.3% ($\Delta T/T$), significantly lower than the international level used to initiate the coordination process between operators. This study of a worst-case scenario is equivalent to a single ATC system with 15,000 base stations, with 12 channels per station for an e.i.r.p. corresponding to approximately 30 dBW spread out over 2400 kHz (12&nsp;channels of 200 kHz each).

8 If the ATC operator is a third party, see Section 5c (ii) of this document.

9 Details of the measurement method will be provided in the SRSP.

The aggregate pfd must be shared equitably by all ATC operators notwithstanding when each ATC system is deployed. As an additional operator plans to deploy, the ATC operators who have already deployed their systems will cooperate with the new operator on the sharing of the allowed power level. Should no such agreement be reached, the different operators will be bound by the Department's decision, limiting each operator to specific power levels to ensure compliance with the pfd at the airport. At the request of the Department, a technical study and/or actual measurements may be required to demonstrate that the above requirements are met.

iii. Maritime Receivers

To protect maritime mobile earth terminals (METs), the maximum pfd at the edge of water of any navigable waterway is -69.3 dBW/m2 within the bandwidth of the receiver front end. At the request of the Department, a technical study and/or actual measurements may be required to demonstrate that this pfd is not exceeded when base stations are located within 4 km of the water edge. This pfd value is based on a set of assumptions such as an elevation angle to the satellite of 15º, an ATC base station antenna height of 30 m above ground, and a maritime receiver antenna height of 7 m above the water. For different elevation angles, the value of the pfd will vary from the one given here. Studies can take into account terrain data and clutter.

Should the pfd at the edge of the waterway exceed the above limit, ATC operators will be required to immediately reduce the power of the relevant base stations; these may include base stations located farther than 4 km from the water edge.

The aggregate pfd must be shared equitably by all ATC operators notwithstanding when each ATC system is deployed. As an additional operator plans to deploy, the ATC operators who have already deployed their systems will cooperate with the new operator on the sharing of the allowed power level. Should no such agreement be reached, the different operators will be bound by the Department's decision, limiting each operator to specific power levels to ensure compliance with the pfd at the waterway. At the request of the Department, a technical study and/or actual measurements may be required to demonstrate that the above requirements are met.

iv. Desensitization of Mobile Earth Terminals (METs) of other MSS Systems by ATC Base Stations

The studies commissioned by the Department showed that desensitization of METs of other MSS systems may occur on the ground within a small radius around an ATC base station, depending on the desensitization level assumed. Noting that the use of ATC is to permit access to mobile satellite services in areas that experience blockage to the satellite, such as urban areas, it is unlikely that the METs of other MSS systems will have a clear view of the satellite. The Department believes that for the MET to suffer from desensitization, the MET would need to have a clear view during communications with its associated satellite, while at the same time being close enough to an ATC base station. The Department believes that such a probability is very low. Therefore, no mitigation measures are deemed necessary. However, the Department stresses that ATC operations are authorized on a no-interference, no-protection basis. Should desensitization be identified as a problem in certain areas, the ATC operator will take measures to mitigate the interference, to the satisfaction of the Department.

v. Protection of AMS(R)S and GMDSS

The MSS licensee who allows ATC to be operated using its MSS spectrum must protect AMS(R)S and GMDSS operations and demonstrate the capability to (1) prioritize and (2) pre-empt active channels automatically and immediately.

While the Department may authorize entities other than MSS licensees to operate an ATC system, ATC and MSS operation must be integrated, so that the Network Control Centre would be able to reallocate the pre-empted resources to the benefit of the priority safety services. This reallocation of the pre-empted spectrum must take the same amount of time whether or not the ATC is operated by a third party or by the MSS licensee.

vi. SARSAT Stations

Canada has five SARSAT stations for search and rescue operations, operated by the Department of National Defence. Industry Canada conducted internal studies and determined that a coordination distance around these stations was necessary (refer to table below). In coordinating stations within this zone, the radio horizon, actual terrain and clutter can be taken into consideration. Actual tests may be required before operating ATC base stations within these coordination zones to verify that the SARSAT stations do not suffer any interference. The conclusion of these coordination activities must be provided to the Department before the commercial operation of these stations. Other arrangements may be considered by both parties, such as the relocation of the SARSAT station.

Table 1 – SARSAT Stations

Station Location	Latitude N (Deg Min Sec)	Longitude W (Deg Min Sec)	Coordination Distance
Edmonton, AB	53 40 43	113 18 54	11 km
Goose Bay, NL	53 18 42	60 28 12	11 km
Ottawa, ON	45 19 43	75 40 28	11 km
Churchill, MB	58 45 30	94 00 00	11 km
Trenton, ON	47 07 00	77 31 45	11 km

vii. Protection of CDMA Base Stations Using GPS for Synchronization

The impact of ATC operations on GPS has been extensively studied. The GMPCS limits are applicable to both base stations and mobile terminals of ATC systems in all bands. The Department believes that compliance with these limits will also ensure the protection of the GPS-based Enhanced-911 service of mobile phones.

GPS is also used by CDMA-based cellular/PCS systems for timing and synchronization purposes. The Department has requested studies from the cellular/PCS CDMA operators. One study showed no impact on CDMA operations even at close range. Another study showed no impact beyond 11 metres. The Department will require that the ATC operator coordinate its base stations when within 11 metres of a CDMA station. The Department notes that a policy for tower sharing is under development; ATC operators should have the same access to towers as cellular/PCS operators.

viii. Other Requirements

Based on the findings of the various cases studied to date, the Department is of the view that the potential of interference to other MSS systems and to other services operating in adjacent bands can be reduced to acceptable minimal levels with appropriate ATC network design, as per these technical and operational constraints. The licensees will have to comply with any new licence condition(s) the Department considers relevant so as not to constrain or interfere with the primary services.

These findings are based on the use of the Global System for Mobile Communications (GSM) technology for the ATC system. Should other technologies be used or should new scenarios be identified, the Department will assess under what technical and operational measures the MSS ATC mobile system can be permitted to operate so as not to cause harmful interference to other systems.

Part C

Technical and Operational Measures Applicable to MSS ATC Operations in the 1.6/2.4 GHz Big LEO MSS Bands

The Department concludes that it is in the public interest to provide these MSS systems with the same competitive framework as for other MSS systems. This flexibility cannot be afforded, at this time, to systems which propose to operate ATC mobile systems in a mode other than the "forward-band mode" since this is likely to increase the potential of interference to primary services.

Many technical studies were provided as part of the FCC proceeding. The Department analyzed these studies, the FCC findings and the rules adopted in 47 CFR §25.254, and concluded that similar constraints are likely to apply in Canada, in particular:

1. Protection of radio astronomy sites
2. Application of Recommendation ITU-R M 1186[10]
3. Emission limits
4. Protection of ISM operations in adjacent bands
5. Protection of terrestrial services in the 2500–2690 MHz band.

Detailed technical and operational measures will be developed in a future RSS and a future SRSP taking into consideration the proposed technology and architecture of the MSS ATC system.

[10] Recommendation ITU-R M.1186: Technical considerations for the coordination between mobile-satellite service (MSS) networks utilizing code division multiple access (CDMA) and other spread spectrum techniques in the 1-3 GHz band.