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Consultation on Spectrum Utilization Policies and Technical Requirements Related to Backhaul Spectrum in Various Bands, Including Bands Shared With Satellite, Mobile and Other Services

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1. Intent

Through this consultation paper, announced in *Canada Gazette* notice SMSE-018-12, Industry Canada is hereby initiating public discussion on backhaul spectrum, in light of the increasing requirements and demand for backhaul capacity. This broad consultation seeks comments on the possibility of making additional spectrum available for backhaul, as well as views on updating standards and policies, with a view to increasing flexibility, utilization and efficiency, taking into account technological advances.

2. Policy Objectives

The Minister of Industry, through the *Department of Industry Act*, the *Radiocommunication Act* and the *Radiocommunication Regulations*, with due regard to the objectives of the *Telecommunications Act*, is responsible for spectrum management in Canada. As such, the Minister is responsible for developing national policies for spectrum utilization and ensuring effective management of the radio frequency spectrum resource.

In developing policies and a technical framework to make additional spectrum available, Industry Canada takes into consideration the need to provide spectrum access for new services and technologies, including backhaul applications; the impact of such a framework on all stakeholders; and the *Spectrum Policy Framework for Canada* (SPFC). The policy objective of the SPFC is to maximize the economic and social benefits that Canadians derive from the use of the radio frequency spectrum resource.

3. Background

Spectrum is a finite resource and its management is contingent on effective policies and efficient practices to optimize its utilization and facilitate equitable sharing among users.

There is a growing shift towards wireless broadband services. With global mobile traffic expected to increase significantly over the next five years, mobile data traffic will overtake mobile voice. Wireless carriers, which rely on the use of fixed systems to backhaul their telecommunications traffic, are anticipating significant growth in their service offerings due to new broadband mobile data applications, the continued deployment of third and fourth generation wireless mobile systems, as well as increased usage of multimedia and high bandwidth applications. As a result of the Advanced Wireless Services (AWS) auction in 2008, many new wireless carriers have entered the Canadian marketplace, further pressuring existing backhaul spectrum resources. With the provision of these high-capacity (HC) applications to subscribers, carriers may need to increase their backhaul capacity to accommodate this traffic.

In addition to the traffic associated with mobile broadband, Internet service providers (ISPs) are also faced with increasing subscriber capacity and traffic requirements. Although ISPs use various solutions to connect their customers to their network, they are increasingly relying on wireless solutions, with some gradually identifying and employing licensed backhaul spectrum to meet their traffic needs.

Over the past few years, spectrum that was once designated for microwave backhaul use has been reallocated for other services. Most recently, the Department redesignated a portion of the 15 GHz band¹ (14.66-14.82 GHz and 15.135-15.295 GHz) for government-exclusive aeronautical mobile applications in the mobile service, and introduced a one-time transitional solution whereby the bands 11.075-11.2 GHz and 11.575-11.7 GHz² were reallocated to provide direct-to-home (DTH) services in Canada.

3.1 International Backhaul Strategies and Initiatives

Many administrations are either in the process of, or have completed, an assessment of spectrum utilization as part of their spectrum management planning. Given the significant increase in demand by various services, including backhaul, Industry Canada completed a spectrum inventory³ of the 52 MHz to 38 GHz frequency range, in which the Department examined the current Canadian spectrum environment. This study focussed on the allocations and assignments of 12 services and applications, including fixed backhaul. This data provided the Department with the necessary information to further its technical and strategic planning functions. The fixed service (FS) (point-to-point and point-to-multipoint) is allocated almost 24 GHz of spectrum within the 52 MHz to 95 GHz frequency range.

In addition to the spectrum inventory, the Department commissioned a study to evaluate the future demand of radio spectrum in Canada, which was recently released.⁴ As part of the study of the many services and applications in the 52 MHz to 38 GHz range, detailed assessments were conducted on the following five services: cellular, broadcasting (radio and television), fixed wireless access, backhaul and satellite communication services. The findings indicated that due to several factors, including the offloading of traffic, the migration from microwave to fibre for high-capacity links and general improvement in spectral efficiencies, there is enough backhaul spectrum overall to meet the demand and growth in traffic over the next three to five years.⁵ However, the report also noted that, given the high growth of assignments in frequency bands within the 11 to 23 GHz range and with the growth in cellular traffic, these bands will experience an increase in the demand over the next few years.

¹ SP 14.5 GHz: *Spectrum Utilization Policy, Technical and Licensing Decisions on a Portion of the Band 14.5-15.35 GHz for Tactical Common Data Link (TCDL) Systems* ([http://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/sp-ps-145ghz-e.pdf/\\$file/sp-ps-145ghz-e.pdf](http://www.ic.gc.ca/eic/site/smt-gst.nsf/vwapj/sp-ps-145ghz-e.pdf/$file/sp-ps-145ghz-e.pdf))

² *Canada Gazette* notice DGTP-013-09, *Decision Regarding Spectrum Utilization Policy for the 11 GHz Band* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09685.html>)

³ *Radio Spectrum Inventory: A 2010 Snapshot – Canada*. This study provides a snapshot of the frequencies assigned in Canada as of August 2010 (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10023.html>).

⁴ Red Mobile Consulting, *Study of Future Demand for Radio Spectrum in Canada 2011-2015* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10253.html>)

⁵ The study spanned a five-year period, starting in 2011.

3.1.1 United States

The U.S. Federal Communications Commission's (FCC) National Broadband Plan (NBP)⁶ included discussions and recommendations on increasing the flexibility, capacity and cost-effectiveness of spectrum for wireless backhaul services.

Given that many wireless providers increasingly rely on microwave for backhaul, especially in rural areas, the NBP recommended that the FCC take steps to ensure that sufficient microwave spectrum is available to meet current and future demand for wireless backhaul. The FCC has targeted the bands below 13 GHz for backhaul given their propagation characteristics. In addition, it recommended that the FCC revise Parts 74, 78 and 101 of its rules to allow for increased spectrum sharing among compatible point-to-point microwave services.

The NBP noted that the following bands below 12 GHz, currently available for point-to-point microwave backhaul, either on a primary basis or secondary to other uses in the band, are preferred for long-haul heavy route backhaul due to the rain fading effects at higher frequencies:

- 3700-4200 MHz (shared with fixed-satellite space-to-Earth on a primary basis);
- 5925-6425 MHz (shared with fixed-satellite Earth-to-space on a primary basis);
- 6525-6700 MHz (shared with fixed-satellite Earth-to-space on a primary basis);
- 6700-6875 MHz (shared with fixed-satellite Earth-to-space and space-to-Earth on a primary basis);
- 10550-10600 MHz (no other services sharing the band);
- 10600-10680 MHz (shared with Earth exploration-satellite passive, space research passive on a primary basis); and
- 10700-11700 MHz (shared with fixed-satellite space-to-Earth on a primary basis).

In August 2010, the FCC released a Notice of Proposed Rulemaking and Notice of Inquiry (FCC 10-146),⁷ in which it sought comments on ways to facilitate the use of microwave for wireless backhaul and other uses, and on ways to provide additional flexibility to broadcast auxiliary service and operational fixed microwave licensees. Specifically, the FCC sought comments on its proposed rulemakings that will permit greater sharing between FS operators in the bands 6875-7125 MHz and 12.7-13.2 GHz; the elimination of the "final link rule," which prohibits broadcasters from using certain spectrum for their final link of program material delivery to broadcast stations; the use of adaptive modulation; and permit auxiliary fixed stations. The FCC 10-146 notice of inquiry sought comments and views on: relaxing the efficiency standards (capacity requirements) in rural areas; reviewing Part 101 antenna standards to make use of smaller antennas; weighing the impact on the radio environment; and in general, on increasing the flexibility of the rules and procedures as a means of reducing backhaul costs and promoting the growth of broadband.

⁶ National Broadband Plan (<http://www.broadband.gov/plan/>)

⁷ *Notice of Proposed Rulemaking and Notice of Inquiry*, FCC 10-146 (http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-10-146A1.pdf)

The FCC published its Report and Order, Further Notice of Proposed Rulemaking, and Memorandum Opinion and Order (FCC 11-120)⁸ in August 2011, announcing its decisions regarding FCC 10-146. Part 101 of the Rules was amended to provide an additional 650 MHz of FS allocations in the 7 GHz (6875-6975 MHz and 7025-7125 MHz) and 13 GHz (12700-13150 MHz) bands in areas where TV pickup stations are not licensed, to eliminate the final link rule and to permit the use of adaptive modulation. Although a petition for reconsideration⁹ was filed in November 2011 regarding WT Docket No. 10-153¹⁰ of the above rulemaking proceeding, the FCC declined to modify the *Report and Order*.

To provide additional flexibility for wireless backhaul, the FCC, through FCC 12-87,¹¹ has liberalized its rules to allow for smaller antennas in the 6 GHz (5925-6875 MHz), 18 GHz (17700-18820 MHz and 18920-19700 MHz) and 23 GHz (21200-23600 MHz) bands, relaxed efficiency standards in rural areas, increased channel bandwidths in the Lower 6 GHz (5925-6425 MHz) and 11 GHz (10700-11700 MHz) bands to 60 MHz and 80 MHz respectively, revised the criteria for waivers when antennas are pointed towards geostationary satellites to better align with international regulations, and updated efficiency standards.

3.1.2 United Kingdom

In January 2007, the Office of Communications (Ofcom) for the United Kingdom (U.K.) released the results of a study it commissioned into future options for efficient backhaul.¹² Through industry stakeholder input on technology evolution, future backhaul requirements, and an examination of international trends and deployments, the impact of backhaul on the development of future U.K. networks' ability to carry mixed traffic, high-capacity applications, and high data rate service was investigated.

The study revealed that increases in data volumes, data rates of new services and capacities, coupled with new devices and technologies, will drive backhaul needs. As population densities grow, there is a movement towards smaller cells (macro/micro/pico base station) resulting in the need for additional links spaced closer together. The study also indicated that each backhaul solution has its own merits for different types of deployment in rural, suburban and urban areas along with its own set of obstacles,

⁸ *Report and Order, Further Notice of Proposed Rulemaking, and Memorandum Opinion and Order*, FCC 11-120 (http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-11-120A1.pdf)

⁹ *Petitions for Reconsideration of Action in Rulemaking Proceeding*, Report No. 2937 (http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-310986A1.doc)

¹⁰ *Amendment of Part 101 of the Commission's Rules to Facilitate the Use of Microwave for Wireless Backhaul and Other Uses and to Provide Additional Flexibility to Broadcast Auxiliary Service and Operational Fixed Microwave Licensees*, WT Docket No. 10-153 (http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-11-120A1.pdf).

¹¹ *Second Report and Order, Second Further Notice of Proposed Rulemaking, Second Notice of Inquiry, Order on Reconsideration, and Memorandum Opinion and Order*, FCC 12-87 (http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0822/FCC-12-87A1.pdf)

¹² PA Consulting Group (for Ofcom), *Future Options for Efficient Backhaul* (23 January 2007) (<http://stakeholders.ofcom.org.uk/binaries/research/technology-research/backhaul1.pdf>)

whether it is public opposition to additional towers and antennas, lengthier rollout times, or range limitations.

Of the multiple backhaul technologies currently available, point-to-point microwave, fibre and DSL were anticipated to dominate future backhaul networks within the United Kingdom. Due to their overall variety of strengths in technical performance (range, capacity and reliability), cost and speed to deployment, some solutions are more suitable in certain areas than others. Ofcom anticipates that in the coming years, with the advancement of technology, increased traffic volumes and deployments in the rural, suburban and urban markets, there is enough spectrum (30 GHz available for point-to-point FS with the release of 10 GHz above 70 GHz), to meet the United Kingdom's backhaul demands.

In March 2011, the United Kingdom's Department for Culture, Media and Sports (DCMS), in conjunction with other major departments of state, released a report entitled *Enabling UK growth – Releasing public spectrum: Making 500 MHz of spectrum available by 2020*,¹³ in which it set out how it plans to release at least 500 MHz of public sector spectrum below 5 GHz by 2020. Although demand seems to be the highest for mobile services, various market demand studies and discussions with the industry were conducted to gauge demand for a wide range of possible applications. The market studies revealed that more than 100 MHz of additional backhaul spectrum was desired to support fixed and mobile broadband within the 3.5 GHz frequency range in rural areas, and within the 10 GHz frequency range in urban areas. In an effort to improve spectrum efficiencies, public spectrum holdings are being reviewed and additional spectrum may be released. DCMS plans to coordinate its spectrum release plans with Ofcom, where appropriate.

In 2011, Aegis Systems Ltd. provided Ofcom with its commissioned report on the underlying drivers of demand by various industry sectors (e.g. utility and public). Its analysis indicated that the dominant driver for this demand was backhaul, in particular for public mobile networks. Even though demand for fixed links in the United Kingdom has generally been stable over the past couple of years, there are some areas that are experiencing congestion. The study indicated that although there will be sufficient spectrum to meet all anticipated future needs for fixed links in the bands above 20 GHz, there may not be sufficient spectrum between 3 GHz and 20 GHz to meet the demand given the future deployment of broadband networks. Coinciding with the release of this study, on January 31, 2012, Ofcom initiated a consultation on spectrum management policy measures to facilitate more efficient usage of the fixed link bands between 1.4 GHz and 86 GHz. This multi-phase consultation focuses on the spectrum demand in the next five to 10 years and the underlying factors influencing change. Future consultations will examine possible changes to the management of these bands (e.g. new licensing mechanisms and new models of band management).

3.1.3 Australia

In April 2008, the Australian Communications and Media Authority (ACMA) released its spectrum demand analysis and five-year work plans entitled *Five-year Spectrum Outlook 2009-2014*.¹⁴ The

¹³ Department for Culture, Media and Sport's report entitled *Enabling UK growth – Releasing public spectrum: Making 500 MHz of spectrum available by 2020* (http://www.culture.gov.uk/images/publications/Spectrum_Release.pdf)

¹⁴ Australian Communications and Media Authority's consultation entitled *Five-year Spectrum Outlook 2009-2014: Consultation on ACMA's draft spectrum demand analysis and indicative work programs for the next five years* (http://www.acma.gov.au/webwr/assets/main/lib310645/five-year_spectrum_outlook_2009-2014.pdf)

consultation examined the ACMA's spectrum management program, drivers of spectrum demand, various work projects, including a review of government licences, as well as current and future spectrum requirements of nine radiocommunication services.

The analysis of microwave fixed services focused on long-haul, medium-haul, backhaul and urban networks. Spectrum demand in Australia is expected to be driven by a variety of factors, including international trends, increased capacity requirements to support broadband services, high-capacity applications and the increased use of non-radio alternatives.

Currently in Australia, the majority of bands are lightly to moderately utilized; however, the limited spectrum below 3 GHz has resulted in a shift to further use spectrum within the 6 to 8 GHz range. It is anticipated that all of the bands above 7 GHz will experience a growth in demand, in particular within the bands 50 GHz, 58 GHz, 71-76 GHz and 81-86 GHz. Although it is thought that there is sufficient spectrum to meet increased backhaul requirements, the ACMA anticipates that in highly dense areas, demand may exceed supply in 10 years within certain frequency bands (i.e. 7.5 GHz, 13 GHz, 15 GHz and 22 GHz). As such, the ACMA routinely conducts licensing studies and seeks input from stakeholders to gauge potential areas where congestion may be a concern. As a means of resolving demand issues, the ACMA investigates methods and technologies to increase spectrum efficiencies and will look to possibly releasing additional spectrum, exploring unpaired spectrum, and promoting non-radio alternatives.

4. Backhaul in Canada

Worldwide, regulators are dealing with increasing demands for access to radio spectrum. With advances in technology and the rapidly increasing demand for broadband mobile services, spectrum usage audits and forecasting are valuable tools in determining future spectrum demand. Through international benchmarking, it is becoming apparent that the demand for additional backhaul capacity is global, and not specific to Canada.

The international and regional nature of spectrum usage and harmonization provides regulators with opportunities to identify global trends and build on technological and spectrum management advances. While forecasting backhaul demand provides insight into future requirements, it is also important to understand how the spectrum is utilized and in what capacity. These spectrum studies and analyses provide regulators with valuable information, and are also beneficial to stakeholders in their design and planning for new wireless technology and services.

4.1 Overview of the Canadian Backhaul Market

There are multiple backhaul solutions, including fibre optics, leased lines, microwave radio and satellites. Generally, a combination of backhaul solutions is employed in Canada, with service providers tending to favour a mix of fibre and wireless microwave. Backhaul communication is defined as the "transport of aggregate communication signals from base stations to the core network."¹⁵ For the

¹⁵ Definition from various sources: ITU-R *Radio Regulations*; ITU-R Recommendations; *Canadian Table of Frequency Allocations*; and Industry Canada's Standard Radio System Plans.

purposes of this consultation paper, backhaul is considered as any form of transport of aggregated traffic regardless of the source and destination.

Historically, microwave radio in the FS has been the largest user of spectrum above 1 GHz. Spectrum policies have provided for suitable spectrum for a variety of fixed system applications, such as: long-haul, heavy route microwave systems; light-to-medium route microwave systems; as well as systems supporting broadcast undertakings, including studio transmitter links (STL), highly portable news gathering units, inter-studio video transmission, and a variety of point-to-point and multipoint systems for cable television operations.

Backhaul networks are designed to employ a diverse range of frequency bands depending on specific technical requirements, design characteristics and operational practicalities. Although there are many frequency bands available for backhaul, the following are the most frequently assigned¹⁶ in Canada:

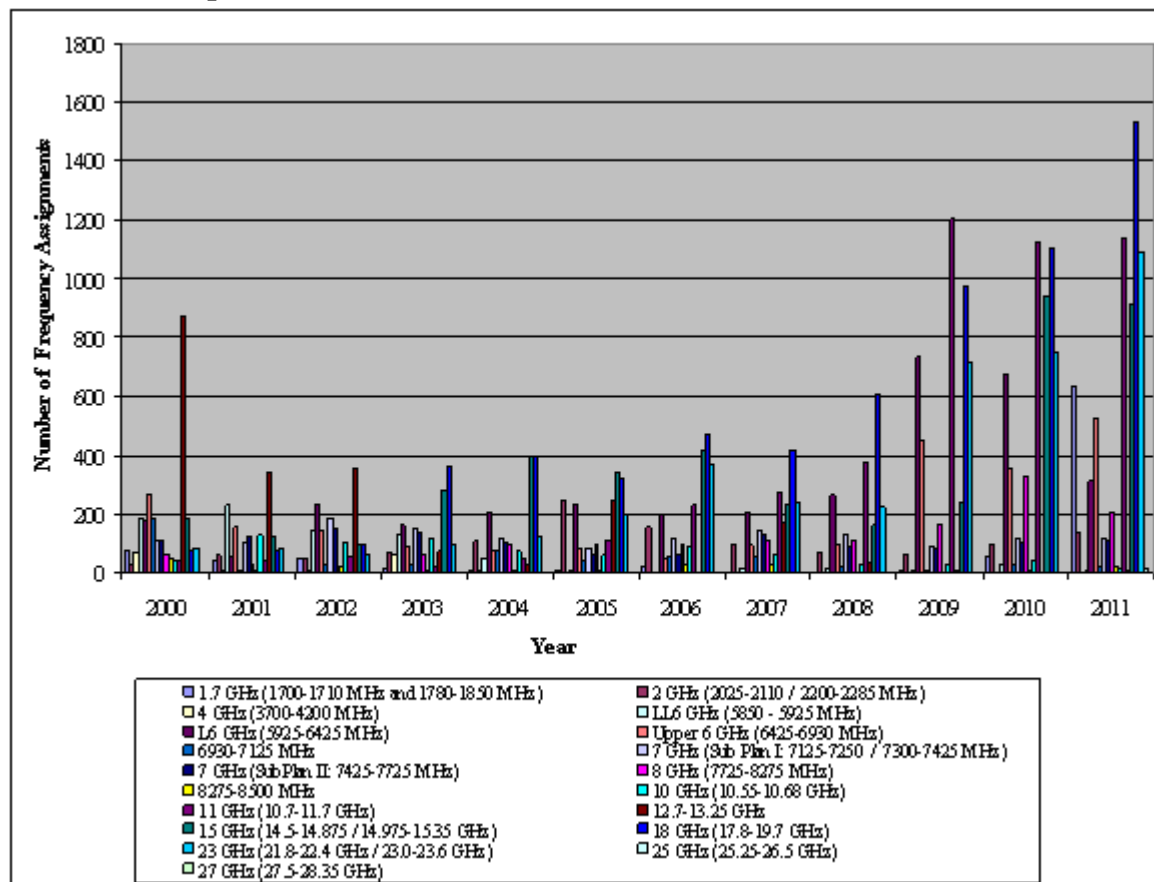
- Lower 6 GHz: 5925-6425 MHz (shared with fixed-satellite Earth-to-space on a primary basis);
- Upper 6 GHz: 6425-6930 MHz (shared with fixed-satellite Earth-to-space and/or space-to-Earth on a primary basis);
- 11 GHz: 10.7-11.7 GHz (shared with fixed-satellite space-to-Earth on a primary basis);
- 15 GHz: 14.5-15.35 GHz (shared with mobile, which is a primary/secondary service);
- 18 GHz: 17.8-18.3 / 19.3-19.7 GHz (shared with fixed-satellite space-to-Earth and/or Earth-to-space and/or meteorological-satellite service space-to-Earth on a primary basis);
- 23 GHz: 21.8-22.4 / 23.0-23.6 GHz (shared with fixed-satellite space-to-Earth on a primary basis); and
- 38 GHz: 38.4-40.0 GHz (shared with fixed-satellite space-to-Earth, mobile and/or mobile-satellite space-to-Earth on a primary basis and/or Earth exploration-satellite space-to-Earth on a secondary basis).

Traditionally, bands shared on a co-primary basis between the FS and the fixed satellite service (FSS) could accommodate fixed microwave systems, due to the relatively limited number of stations in both services. As the number of FS and FSS deployments continues to increase, sharing and deployment issues may develop. For instance, in the 11 GHz band, which is shared on a primary basis between the FS and the FSS, there was tremendous growth in the total number of FS frequency assignments; a 600% increase from 1998 to 2010. This increase may be a result of requirements for higher capacity short-haul links to support the cellular systems. Concurrently, there is demand for the FSS to deploy very small aperture terminals (VSATs), and even direct-to-home television services. Increased deployments by both the FS and FSS may affect sharing, potential growth and expansion of these services in the future.

Since the issuance of AWS and other licences for mobile spectrum in the 2 GHz range in late 2008 and early 2009, there has been a dramatic increase in licence requests for microwave backhaul as new entrants have begun building their own networks, and as incumbents overlay and upgrade their networks for long-term evolution/high-speed packet access (LTE/HSPA+ technologies). This increase, especially in the higher frequency bands, is shown in Figure 1 below.

¹⁶ Refer to Annex A — Distribution of fixed point-to-point microwave systems in backhaul bands across Canada. These maps depict site-specific microwave licensed stations in bands with more than 2,500 point-to-point frequency assignments (record identifiers).

Figure 1: Applications submitted for new fixed point-to-point assignments¹⁷ within microwave site-specific licensed¹⁸ bands above 1 GHz

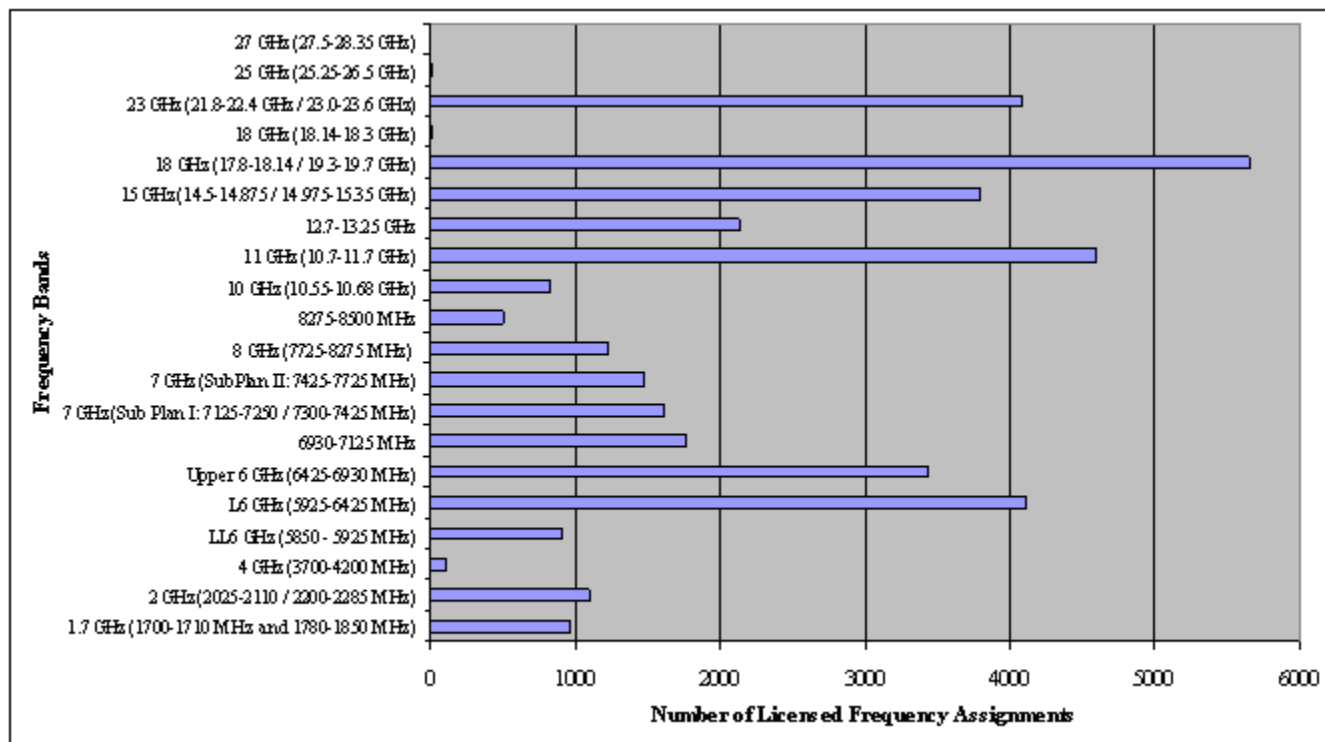


With the Department’s announcement to make spectrum available within the 700 MHz band for commercial mobile systems and the transition to Broadband Radio Service (BRS) in the band 2500-2690 MHz, as well as the further deployment of AWS, the continued evolution of cellular and Personal Communications Services (PCS) systems, and deployments of Fixed Wireless Access (FWA) and Broadband Wireless Access (BWA), greater capacity demands are being placed on telecommunication providers’ backhaul networks. This, in conjunction with the transition and potential displacement of fixed systems from portions of the 2 GHz, 5.9 GHz, 11 GHz and 15 GHz bands, has resulted in congestion in some backhaul bands.

¹⁷ Point-to-point microwave data based on application date of submission. Various moratoriums and realignments have resulted in shifts in the popularity of frequency bands.

¹⁸ Site-specific radio licences are issued for a specified frequency, location and technical operating parameters.

Figure 2: Total number of fixed service point-to-point microwave frequency assignments¹⁹



Fixed broadband and mobile broadband (i.e. 1.5 Mbps) are available to 98% of households in Canada.²⁰ Given the increased usage of new mobile broadband applications (e.g. high definition video on demand, mobile television and smart phones), telecommunication providers may require additional FS backhaul spectrum to build, expand and upgrade their networks to meet new traffic demands.

To address the service providers' current and foreseen traffic growth, manufacturers are focusing on, and taking advantage of, advances in technology to deliver radios capable of meeting some of their customers' growing needs. Canadian providers are currently deploying radios with features such as co-channel dual polarization (CCDP) with cross-polarization interference cancellation (XPIC), and adaptive modulation to effectively optimize the capacity and throughput delivered.

The following sections of this consultation list and describe in detail the frequency bands currently being used for backhaul, as well as the potential opportunities to introduce additional backhaul services in specific frequency bands already allocated to the FS. This consultation also addresses specific under-utilized frequency bands, or portions thereof, and how they may be leveraged to meet growing demands for capacity.

¹⁹ The number of assignments (record identifiers) was extracted from Industry Canada's database in June 2012.

²⁰ Canadian Radio-television and Telecommunications Commission's *Broadband Report: November 2011* (<http://crtc.gc.ca/eng/publications/reports/broadband/bbreport1111.htm>)

4.2 Backhaul Spectrum in Support of Fixed and Mobile Broadband

Spectrum is typically allocated to services whose specific needs are best tailored to the use of that particular frequency band. Based on the *Canadian Table of Frequency Allocations* (CTFA)²¹ and spectrum utilization policies which define the use or application of services, several bands may be used in support of fixed and mobile broadband. However, the growth and increased usage of fixed and mobile broadband have resulted in requests for additional backhaul spectrum to support these services and applications.

Due to a variety of technical and operational characteristics, including propagation and capacity, short-, medium-, and long-haul systems use different backhaul spectrum bands. The Department encourages the use of higher frequency bands for short hops and the preservation of lower frequency bands for longer hops, ensuring that the unique characteristics of the bands meet the technical requirements of the system. Unlike other countries, Canada does not have defined minimum path length or limits; rather, it addresses the link requirements from technical and operational perspectives.

The following subsections identify the frequency bands available for backhaul in Canada.

4.2.1 Frequency Bands for Short-haul Systems

For the purposes of this consultation, short-haul systems are defined as being one to 10 hops, and often considered to be localized or intra-regional systems. The frequency bands in Table 1 are therefore considered relevant for short-haul systems.

Table 1: Frequency bands for short-haul systems

Frequency Bands	Available Spectrum (MHz)
23 GHz (21.8-22.4 GHz / 23.0-23.6 GHz)	1200
24 GHz (24.25-24.45 GHz / 25.05-25.25 GHz)	400 ^a
25 GHz (25.25-26.5 GHz)	1250
27 GHz (27.5-28.35 GHz)	850
38 GHz (38.6-40 GHz)	1400 ^b
70, 80 and 90 GHz (71-76, 81-86, 92-95 GHz)	12900

a. Broadband Wireless Access: Auction of the 24 GHz Frequency Band, October to November 1999, (http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/h_sf01797.html). The Department has implemented a first-come, first-served process for any unassigned and/or returned 24 GHz spectrum through *Canada Gazette* notice DGRB-004-09, *Decision on the Renewal of 24 and 38 GHz Spectrum Licences and Consultation on Spectrum Licence Fees for 24, 28 and 38 GHz Bands* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09302.html>).

b. Broadband Wireless Access: Auction of the 38 GHz Frequency Band (38.7-39.1/39.4-39.8 GHz) (http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/h_sf01797.html). The Department has implemented a first-come, first-served process for any unassigned and/or returned 38 GHz spectrum through *Canada Gazette* notice DGRB-004-09,

²¹ *Canadian Table of Frequency Allocations 9 kHz to 275 GHz (2009 Edition)*, available at (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09686.html>)

Decision on the Renewal of 24 and 38 GHz Spectrum Licences and Consultation on Spectrum Licence Fees for 24, 28 and 38 GHz Bands (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09302.html>). For one-way point-to-multipoint and one-way and two-way point-to-point systems in 38 GHz first-come, first-served spectrum, see CPC-2-1-17, *Licensing Process and Application Procedure for Non-auctioned Spectrum Licences in the 38 GHz band* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01386.html>).

In recognition of the growing demand for short-range backhaul facilities and broadband network infrastructure, the Department continues to advance its efforts to make spectrum available for use.

In May 2010, Industry Canada released DGTP-002-10, *Consultation on the Use of the Band 25.25-28.35 GHz*, for point-to-point and multipoint fixed systems.²² The consultation presented band plan options, taking into account harmonization with other countries and sharing conditions with other radiocommunication services. Decisions on the band plan and licensing principles were established in June 2011 with the publication of SP 25.25 GHz, *Spectrum Utilization Policy, Decisions on the Band 25.25-28.35 GHz*.²³ In particular, fixed radio systems may be deployed in the bands 25.25-26.5 GHz and 27.5-28.35 GHz. The specific channelling plans and technical details will be soon developed through the revision or replacement of Standard Radio System Plan SRSP-325.35, *Technical Requirements for Local Multipoint Communication Systems (LMCS) Operating in the Band 25.35-28.35 GHz*.

Furthermore, the Department recently concluded a public consultation²⁴ on making available the bands 71-76 GHz (5000 MHz), 81-86 GHz (5000 MHz), and 92-94/94.1-95 GHz (2900 MHz) for FS in support of the deployment of broadband applications. Seven interested parties submitted comments²⁵ on the proposed use of the bands, policy, technical specifications and licensing frameworks. In June 2012, the Department released SP 70 GHz, *Decisions on the Frequency Bands 71-76 GHz, 81-86 GHz and 92-95 GHz*, in which it announced its decisions, designating the bands 71-76 GHz, 81-86 GHz and 92-95 GHz for use by the FS.

4.2.2 Frequency Bands for Medium-haul Systems

For the purposes of this consultation, medium-haul systems are defined as having up to 20 hops and covering distances of up to 1000 km, and are often considered to be intra-provincial systems. The frequency bands in Table 2 are therefore considered relevant for medium-haul systems.

²² Canada Gazette notice DGTP-002-10, *Consultation on the Use of the Band 25.25-28.35 GHz* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09869.html>)

²³ SP 25.25 GHz: *Spectrum Utilization Policy, Decisions on the Band 25.25-28.35 GHz* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10028.html>)

²⁴ Canada Gazette notice SMSE-010-11, *Consultation on Spectrum Utilization of Frequency Bands 71-76 GHz, 81-86 GHz and 92-95 GHz by the Fixed Service* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10046.html>)

²⁵ Comments received on Canada Gazette notice SMSE-010-11 (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10080.html>)

Table 2: Frequency bands for medium-haul systems

Frequency Bands	Available Spectrum (MHz)
10 GHz (10.55-10.68 GHz)	130 ^a
11 GHz (10.7-11.2 / 11.2-11.7 GHz)	750 ^b
13 GHz (12.7-13.25 GHz)	550 ^c
15 GHz (14.5-14.875 / 14.975-15.35 GHz)	430 ^d
18 GHz (17.8-18.3 / 19.3-19.7 GHz)	900

- a. The band 10.60-10.68 GHz is shared with the Earth exploration-satellite (passive), radio astronomy and space research (passive) services on a co-primary basis. See SRSP-310.5: *Technical Requirements for Fixed Line-of-Sight Radio Systems Operating in the Band 10.55-10.68 GHz* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf00041.html>).
- b. Following the Department's decision to designate portions of the 11 GHz band (11.075-11.2 GHz and 11.575-11.7 GHz) for DTH services in Canada, 250 MHz is not available for more backhaul licences until 2028. See SRSP-310.7: *Technical Requirements for Fixed Line-of-Sight Radio Systems Operating in the Band 10.7-11.7 GHz* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10414.html>).
- c. This band is shared with the FSS (Earth-to-space) on a co-primary basis. Within the FS, the band is used by Very High-Capacity Microwave (VHCM) point-to-multipoint systems, TV STLs and TV pickups. See SRSP-312.7: *Technical Requirements for Radio Systems Operating in the Fixed Service, in the Band 12.7-13.25 GHz* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf00043.html>).
- d. Following the Department's decision to allocate certain portions of the 15 GHz band (14.66-14.82 GHz and 15.135-15.295 GHz) for exclusive use by the Government of Canada for the aeronautical mobile service, 320 MHz is no longer available for backhaul. See SRSP-314.5: *Technical Requirements for Fixed Line-of-Sight Radio Systems Operating in the Band 14.5 - 15.35 GHz* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf00044.html>).

Industry Canada periodically reallocates spectrum, as necessary, to support the implementation of new services or to comply with changes to international frequency allocations. Consequently, some of the resulting policy changes have limited the available spectrum traditionally used in the deployment of medium-haul systems.

In 2004, through *Revisions to Spectrum Utilization Policies in the 3-30 GHz Frequency Range and Further Consultation* (DGTP-008-04), the Department designated FS priority over FSS (space-to-Earth) within the bands 17.8-18.3 GHz and 19.3-19.7 GHz, and imposed a moratorium on licensing new FS systems in the bands 17.7-17.8 GHz and 18.3-19.3 GHz. In 2014, incumbent FS systems within the band 18.58-19.3 GHz may continue to operate, but on a non-interference basis with respect to FSS, and will be subject to displacement as required.

In December 2008, Industry Canada carried out a public consultation on the 11 GHz (10.7-11.7 GHz) band, with the release of *Consultation Paper on the Possible Use of the Extended-Ku Spectrum Bands for Direct-to-Home (DTH) Satellite Broadcasting Services* (DGTP-003-08), whereby comments were sought on the use of portions of the band to provide DTH satellite broadcasting services. Weighing the spectrum needs of the terrestrial and satellite services, in late 2009, the Department announced a transitional solution whereby DTH services would be permitted within the bands 11.075-11.2 GHz and 11.575-11.7 GHz until January 2028, after which time they would be migrated from the band.

Industry Canada also issued a public consultation document regarding accommodation of the Department of National Defence's (DND) requirements for tactical common data link (TCDL) systems in a portion of the 15 GHz band. The consultation was entitled DGTP-004-08, *Consultation Paper on Using a Portion of the Band 14.5-15.35 GHz for Tactical Common Data Link (TCDL) Systems*. In December 2009, the Department announced that a total of 320 MHz of spectrum (14.66-14.82 GHz and 15.135-15.295 GHz) would be reallocated for the exclusive use by the Government of Canada.

As a result of the already moderate to heavy usage within this mid-range spectrum, coupled with the recent loss of the above-noted spectrum and potential displacements, various geographical areas may become highly congested, requiring the use of more directional antennas, higher spectral efficiencies and other enhanced technical standards.

4.2.3 Frequency Bands for Long-haul Systems

For the purposes of this consultation, long-haul systems may be comprised of hundreds of hops covering distances of up to 5,000 km, and are considered national or interprovincial systems. The following frequency bands are therefore considered relevant for long-haul systems.

Table 3: Frequency bands for long-haul systems

Frequency Bands	Available Spectrum (MHz)
1.8 GHz (1700-1710 and 1780-1850 MHz)	80 ^a
Upper 2 GHz (2025-2110 / 2200-2285 MHz)	170 ^b
4 GHz (3700-4200 MHz)	500 ^c
Lower 6 GHz (5925-6425 MHz)	500 ^d
Upper 6 GHz (6425-6930 MHz)	505 ^e
7 GHz (7125-7250 MHz and 7300-7725 MHz)	550 ^f
8 GHz (7725-8275 MHz)	550 ^g

- a. The band 1800-1830 MHz (30 MHz) is identified for fixed radio systems used for the management of the electricity supply. See SRSP-301.7: *Technical Requirements for Fixed Radio Systems Operating in the Bands 1700-1710 MHz and 1780-1850 MHz* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01268.html>).
- b. TV pickup operations share the band 2025-2110 MHz with point-to-point systems on an urban/rural basis. See SRSP-302.0: *Technical Requirements for Fixed Line-of-Sight Radio Systems Operating in the Bands 2025-2110 MHz and 2200-2285 MHz* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf02145.html>).
- c. The FS shares this band equally, on a primary basis, with the FSS (space-to-Earth). See SRSP-303.7: *Technical Requirements for Fixed Line-of-Sight Radio Systems Operating in the Band 3700-4200 MHz* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01604.html>).
- d. The FS shares this band equally, on a primary basis, with the FSS (Earth-to-space) service. See SRSP-305.9: *Technical Requirements for Fixed Line-of-Sight Radio Systems Operating in the Band 5925-6425 MHz* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01177.html>).
- e. The FS shares this band with other services, including the radio astronomy service, which operates in the band 6650-6675.2 MHz. See SRSP-306.4: *Technical Requirements for Fixed Line-of-Sight Radio Systems Operating in the Band 6425-6930 MHz* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01183.html>).

- f. Assignments will be made primarily, but not exclusively to, systems serving the telemetry, control and protection of electric power grids. See SP 7125-7725 MHz, *Policy for the Fixed Service in the Band 7125-7725 MHz* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf08370.html>).
- g. The FS shares this band with other services and is required to coordinate with satellite systems. See SRSP-307.7: *Technical Requirements for Fixed Line-of-Sight Radio Systems Operating in the Band 7725-8275 MHz* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01186.html>).

These lower frequency bands were traditionally used in the design and rollout of national networks. Although most Canada-wide networks are currently in place, or are being decommissioned in favour of fibre, long-haul microwave systems are still being employed along certain corridors and to reach areas where other backhaul options may be cost prohibitive or not accessible.

As part of Industry Canada's mandate to effectively manage spectrum in Canada, and in an effort to respond to new demands regarding radio spectrum, the Department, through this consultation, is seeking input from the industry regarding the operation of its networks, as well as its current and future requirements and deployment plans. Given that spectrum use evolves with changing technology and service requirements, the responses will assist Industry Canada in spectrum planning, with a view to increasing the utilization and efficiency of the spectrum.

The Department is seeking comments on specific requirements for wireless backhaul spectrum with respect to microwave short-, medium- and long-haul systems.

- 4-1 Please provide current and forecasted usage information and deployment plans for short-, medium- and long-haul wireless backhaul systems within your network.**
- 4-2 Describe your current needs and technical requirements (e.g. capacity, data rates) for backhaul systems.**
 - a. Is there an immediate need for additional spectrum for network expansion or system upgrades? If so, how much spectrum is required and in which frequency range?**
- 4-3 Describe your forecasted needs and technical requirements in the medium to long term (three to five years). Provide specifics regarding capacity, frequency (short-, medium- and long-haul) and other related aspects that may affect network design and operation.**
 - a. Is there a requirement for additional spectrum? If so, how much spectrum is required? In what frequency range? What are the related time frames?**
- 4-4 Is there a continuing need for bands below 3.7 GHz for long-haul systems or could this need be met in bands at 3.7 GHz and above?**

Responses should address short-, medium-, and long-haul systems individually. If any replies are considered proprietary, they must be submitted separately and clearly marked as "Confidential."

4.2.4 Congestion

Because of propagation characteristics and population centres, deployments are not distributed uniformly across the country or within the frequency bands (see Figure 2 and Annex A). As indicated in

Industry Canada's *Radio Spectrum Inventory*,²⁶ although on average approximately 65% of all backhaul links in Canada are located outside of metropolitan areas,²⁷ the number of assignments in these urban areas tends to be greater in bands above 15 GHz. Generally, short-, medium-, and long-haul systems are best suited for specific niches and geographic areas. For instance, short-haul systems may be localized in urban centres, linking cell sites to fibre, whereas long- and medium-haul systems may route this traffic from one urban centre to another.

Congestion in bands is caused by a variety of factors, including deployment intensity within a geographical area and technical characteristics of systems (e.g. antenna, power). As part of the spectrum planning process and to accommodate new demands, certain frequency bands may be reallocated or repurposed for use by other services. Depending on the sharing and transition details, it may be necessary for some incumbent systems to be displaced to other bands, increasing the deployment intensity within these bands.

Congestion may also be the result of using older, less spectrally efficient equipment. In some bands, radio systems have been in operation for decades. If radio systems based on old, inefficient technologies are not removed or upgraded, new opportunities for the most effective use of the radio spectrum may be hindered. In specific situations, the Department may be required to alleviate frequency congestion in a frequency band or range of bands in a given geographical area, and may require the upgrade or removal of a system in the area that does not conform to current standards.

4-5 Given current and anticipated deployments, identify specific frequency bands and corresponding geographical areas in which you are experiencing or expect congestion. Please provide your deployment plans for these areas and proposals to mitigate congestion.

Responses should specifically address short-, medium-, and long- haul systems individually. If any replies are considered proprietary, they must be submitted separately and clearly marked as "Confidential."

4.2.4.1 Geographical Differences Policy Guideline (GDP guideline)

Recognizing the need for flexibility in spectrum utilization policies and technical standards, Industry Canada has introduced the Geographical Differences Policy guideline (GDP guideline),²⁸ which permits specification of enhanced provisions in congested areas and some relaxation of policy and/or technical requirements in uncongested areas. The following are definitions of FS frequency congestion areas, as per SP 1-20 GHz, *Revisions to Microwave Spectrum Utilization Policies in the Range of 1-20 GHz*:

²⁶ *Radio Spectrum Inventory: A 2010 Snapshot – Canada* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10023.html>)

²⁷ Statistics Canada Census 2006 definition of metropolitan area

²⁸ SP 1-20 GHz, *Revisions to Microwave Spectrum Utilization Policies in the Range of 1-20 GHz* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01055.html>)

Uncongested Area

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

Normal Congestion Area

An area where the population of systems does not preclude the introduction of a significant number of new systems. An indicator may be where 50% to 90% of the channels are available in 90% or more of the possible directions.

Moderately Congested Area

An area in which the band is well used as intended, and there is adequate spectrum for future growth. A suitable indicator may be where 10% to 50% or fewer of the channels are available in 90% or more of the possible directions.

Highly Congested Area

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

The application of the GDP guideline²⁹ allows service providers to economically redeploy older equipment in more remote areas, whereas in moderately and highly congested areas, enhanced criteria such as improved antenna off-axis discrimination performance, as per the associated Standard Radio System Plan (SRSP), must be met to ensure that the maximum number of systems can be accommodated. The congestion level³⁰ is an important parameter in the planning and design stages of a system, as it will affect the type of equipment and antenna that can be deployed in the area.

²⁹ GDP guideline definitions and text from SP 1-20 GHz, *Revisions to Microwave Spectrum Utilization Policies in the Range of 1-20 GHz* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01055.html>)

³⁰ Areas of congestion are linked to technical parameters, but not related to fees.

These congestion area definitions are based on percentages of channels available in 90% or more of the possible directions. The Department is seeking comments on the following:

- 4-6 Are the above definitions still practical in determining what areas are congested (i.e. when technical requirements should be relaxed or tightened)? If not, please explain and provide proposals on alternative definitions and/or measures.**
- 4-7 Although a relaxation of antenna pattern is most commonly requested through the application of the GDP guideline, other policy and technical requirements may also be eased. Should the Department specify technical requirements and policies to be relaxed when the GDP guideline is applied in uncongested areas? Please explain and provide proposals on the specific minimum technical requirements that should be relaxed.**
- 4-8 Currently, the GDP guideline is applied to specific frequency bands. Are there other bands that would benefit from the application of the guideline? Please provide proposals.**

Interested parties are invited to provide any other comments that may be relevant to congestion levels.

5. Consideration of Specific Frequency Bands

As part of Industry Canada's commitment to ensuring the orderly development and efficient operation of radiocommunications in Canada, and to assist it in assessing both traditional and potential new backhaul bands, the Department is seeking comments on several specific frequency bands, each with its own unique characteristics. The following sections identify potential bands for backhaul, as well as frequency bands that although already identified for backhaul, are currently underutilized for backhaul purposes.

5.1 4 GHz Band (3700-4200 MHz)

The 4 GHz band is available for licensing by high-capacity, point-to-point radio systems in the FS, shared equally on a primary basis with the FSS (space-to-Earth), known as the conventional C-band. At present, there is limited FS use of this band, with fewer than 60 links Canada-wide, as heavy route microwave systems were gradually replaced through the 1990s by national fibre systems. However, with the recent introduction of regional, provincial and national new entrants into the telecommunications market, there may be a renewed interest in heavy route, long-haul microwave systems as they look to build out their networks.

The Department is seeking comments regarding deployments within the 4 GHz band, including the following:

- 5-1 Is there any interest in the deployment of new heavy route backhaul systems or the expansion/growth of existing systems within the band? What is the anticipated time frame?**
- 5-2 Are there technical characteristics or regulatory provisions limiting deployment within the band (e.g. capacity designation)?**
- 5-3 Provide proposals on specific revisions to policy and/or technical standards to improve usage of the band.**

Interested parties are invited to provide any other comments that may be relevant to the use of this spectrum.

Internationally, there has been interest in making the band 3400-3800 MHz available for a range of mobile applications. Europe in particular is interested in the band for mobile/fixed communications networks, including International Mobile Telecommunications (IMT). Given this wide-reaching interest, the band 3400-3800 MHz may be subject to a future policy review to determine if the band is required for other uses, taking into account other services such as the FSS in bands above 3.7 GHz.

5.2 6930-7125 MHz

The band 6930-7125 MHz is used for one-way television auxiliary services, including TV pickup for the transmission of television programs to a television broadcast studio or to a cable television head-end (generally from mobile studio to main studio), and for temporary TV links. When covering breaking news events, fast deployment is often required for TV pickup and temporary TV operations. In an attempt to facilitate this fast deployment, broadcasters are licensed for multiple frequencies within a given area. However, they are usually only authorized to use a single frequency at a time within their licensed area. Although primarily located in the metropolitan areas, these systems may also be deployed in other areas. As such, inter-user domestic coordination mechanisms have been established to ensure interference-free operation when broadcasters cover events in the same geographical area.

FS use in the adjacent band 6425-6930 MHz includes low-, medium- and high-capacity systems using digital modulation, radio systems using analog modulation and television STLs. The FS and FSS (Earth-to-space) share the band 6425-7075 MHz on a primary basis and the radio astronomy service also operates in the band 6650-6675.2 MHz. Low-, medium-, and high-capacity digital point-to-point radio systems in the FS also operate in the 7125-7725 MHz band. As the band 6930-7125 MHz and both adjacent bands are used by the FS, the band 6930-7125 MHz may be appropriate for backhaul applications; however, the introduction of fixed two-way services may affect the flexibility of broadcasters in covering news events given the unpredictable nature of these activities and existing deployments in the band.

In the United States, this particular frequency range is used by similar services, namely the TV Broadcast Auxiliary Service (BAS), which transmits program material from the site of a local news story to the studio, and the Cable TV Relay Service (CARS), which distributes programming to microwave centres. As part of the United States' effort to ensure sufficient spectrum for wireless

backhaul through the release of FCC 11-120,³¹ the FCC will update Part 101 of the Rules to permit FS operators to share the bands 6875-6975 MHz and 7025-7125 MHz with fixed and mobile BAS and CARS operators in areas where TV pickup operations are not licensed. Two 25 MHz channels (6975-7025 MHz) will be reserved for TV pickup operations outside of their local BAS and CARS areas of operation.

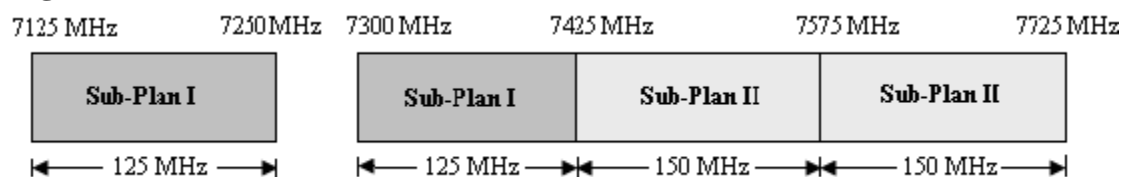
5-4 The Department is seeking comments on deploying fixed two-way backhaul systems within the band 6930-7125 MHz. Please specifically address any technical issues, the feasibility of sharing, as well as any coordination considerations with the FSS and transportable TV pickup operations.

Interested parties are invited to provide any other comments that may be relevant to the use of this spectrum.

5.3 7 GHz Band (7125-7725 MHz)

The 7 GHz band is allocated on a primary basis to the FS. Portions of this band are also allocated on a primary basis to the FSS (space-to-Earth), space research (Earth-to-space) and meteorological-satellite (space-to-Earth) services. The use of the FSS allocation within the band 7250-7750 MHz is limited to the Government of Canada. The fixed portion is designated for high-, medium- and low-capacity systems through two sub-plans with a transmit/receive separation of 175 MHz and 150 MHz respectively (see Figure 3).

Figure 3: Current 7 GHz Band Plan (SRSP-307.1, Issue 5)



FS assignments in this band may accommodate point-to-point fixed systems, including essential circuits that support the operation of power generating plants and high voltage transmission lines. Although the defined radio frequency channel arrangements provide for six RF channel bandwidths (30 MHz, 20 MHz, 10 MHz, 7.5 MHz, 5 MHz and 2.5 MHz), only the electric power utilities have been granted preferred, but not exclusive, access to the 30 MHz bandwidth channels for the carriage of critical telemetry, control and protection circuits. However, in areas of congestion, these channels may be assigned to other users.

5-5 Given the demand for additional spectrum, the Department is seeking comments on providing other users with access to all channels, including 30 MHz bandwidth channels within the band.

³¹ Report and Order, Further Notice of Proposed Rulemaking, and Memorandum Opinion and Order, FCC 11-120 (http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-11-120A1.pdf)

Traditionally, power utilities have employed various diversity techniques to meet their stringent reliability requirements, including route, space and frequency diversity. Frequency diversity refers to the simultaneous transmission of the same traffic over multiple RF frequency channels. Given that frequency diversity is not as spectrally efficient as other diversity techniques (e.g. space diversity), the Department does not normally encourage its use. However, within the 7 GHz band, the use of frequency diversity is explicitly addressed and allowed on a case-by-case basis by systems “serving telemetry, control and protection purposes” provided that economic or technical justification is presented.

5-6 As the Department continues to encourage other diversity techniques that are more spectrally efficient, comments are being sought on the continued use of frequency diversity by utilities in this band.

5.4 8275-8500 MHz

This band is allocated to the FS, with portions shared on a primary basis with Earth exploration-satellite service (space-to-Earth), Space Research (space-to-Earth), and the FSS limited to the Government of Canada. It is used by the FS primarily for one-way video distribution in support of cable television undertakings, as well as to provide video program feeds to broadcast stations. It may also be used on a case-by-case basis for wideband radar.

FS use in the adjacent 7725-8275 MHz band is available for point-to-point low-, medium- and high-capacity systems. As such, this band may be appropriate for backhaul applications; however, the introduction of fixed two-way services may impact the flexibility of broadcasters and DND’s ability to quickly deploy FSS terminals on short notice.

5-7 The Department is seeking comments on deploying fixed two-way backhaul systems within the band 8275-8500 MHz. Please address any technical issues, the feasibility of sharing and any coordination considerations with the incumbent services, including Earth exploration-satellite service (space-to-Earth), space research service (space-to-Earth) FSS (Earth-to-space), and one-way fixed services.

Interested parties are invited to provide any other comments that may be relevant to the use of this spectrum.

5.5 13 GHz Band (12.7-13.25 GHz)

The 13 GHz band is shared on a co-primary basis between the FS and the FSS (Earth-to-space). The use of the FSS is in accordance with the International Telecommunication Union’s (ITU) *Appendix 30B — Provisions and associated plan for the fixed-satellite service in the frequency bands 4500-4800 MHz, 6725-7025 MHz, 10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz*, with Canada currently having access to four geostationary orbital positions using the band 12.75-13.25 GHz. Three orbit positions are assigned for feeder links and telemetry, tracking and telecommand (TT&C), in support of Canadian mobile satellites. Such feeder link and TT&C operations usually involve gateway earth stations. There are only a few such gateway earth stations located in Canada and this number is not expected to increase significantly. The remaining orbital position is available for assignment to Canadian satellite operators.

The 12.7-13.2 GHz portion is utilized by a variety of FS system applications, including Very High Capacity Microwave (VHCM)³² point-to-multipoint, TV STLs, with TV pickup also sharing a portion of the band (13.15-13.25 GHz) on a case-by-case basis in certain geographic areas (see Figure 4). The majority of these fixed microwave systems carry several analog television signals on consecutive radio channels spaced 6 MHz apart. VHCM systems also provide cable TV feeds to distribution points within large cable television systems. Typically, VHCM systems use the entire band to deliver a cable program package from a main cable head-end to cable distribution points in adjacent towns and communities. These systems are authorized on a site-by-site and frequency-by-frequency basis, and while deployments may be considered as high-density (more than 2,000 frequency assignments), they are generally localized in specific geographical areas (approximately 60 sites). However, with the wide deployment of fibre and coaxial cable television networks in recent years, several links in many VHCM systems have been decommissioned.

TV pickup operations, including Electronic News Gathering (ENG), are generally licensed on a geographical basis over a defined area, within the 13.20-13.25 GHz portion of the band. In addition, they may be licensed on a case-by-case basis in certain geographical areas within the 13.15-13.20 GHz portion provided that such use does not cause harmful interference to VHCM systems or claim protection from interference from VHCM. For the purposes of news and special event coverage, these systems traditionally require fast deployment and their use is generally coordinated on a domestic inter-user, event basis. These links are usually deployed in metropolitan areas; however, they may also be located in other areas.

Figure 4: Current 13 GHz Band Plan

12.7 GHz	13.15 GHz	13.2 GHz	13.25 GHz
VHCM, TV STL		VHCM, TV - STL, TV-Pickup*	TV Pickup
Fixed-Satellite (Earth-to-space)			

* TV Pickup use on a case-by-case basis in certain geographic areas

To address microwave spectrum availability for wireless backhaul, countries are exploring opportunities whereby spectrum can be shared between applications. In the United States, the 12.7-13.2 GHz frequency range was identified for additional backhaul spectrum. Similar to the band 6875-7125 MHz, the 13 GHz band is currently used by both the TV BAS and the CARS in that country. The FCC 11-120 Report and Order announced that FS operators would be permitted to share the 12.7-13.15 GHz band with fixed and mobile BAS and CARS in areas where TV pickup operations are not licensed, and that the upper 50 MHz (13.15-13.2 GHz) portion would be reserved for TV pickup operations.

Industry Canada recognizes that the use of microwave radio facilities for the carriage of broadcasting programming signals to cable system head-ends and to other broadcasting distribution undertakings has changed with alternate delivery methods (satellite, fibre optic systems and coaxial cable television

³² VHCM is an FS used primarily for the delivery of microwave broadcast programming signals to broadcast receiving undertakings. See SP-Gen, *General Information Related to Spectrum Utilization and Radio Systems Policies* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01049.html>).

networks). Currently, there are roughly 70 licences comprising more than 2,000 licensed frequency assignments held by approximately 25 licensed users. The Department also appreciates the integral part that VHCM still plays within some cable distribution networks.

Given the interest and spectrum demand to deploy medium-haul systems, as well as the limited requests for additional VHCM systems, the Department proposes to introduce fixed two-way low-, medium- and high-capacity (LC, MC and HC) point-to-point backhaul services in the band 12.7-13.2 GHz on a coordinated basis with the FSS and the FS (point-to-multipoint VHCM and TV pickup). For details, see Figure 5.

Figure 5: Proposal for 13 GHz Band

12.7 GHz	13.15 GHz	13.2 GHz	13.25 GHz
VHCM, TV STL, two-way fixed service	VHCM, TV-STL, two-way Fixed,* TV-Pickup**	TV Pickup	
Fixed-Satellite (Earth-to-space)			

* Shared on an urban/rural basis
 ** TV Pickup use on a case-by-case basis in certain geographic areas

In particular, the Department proposes that two-way fixed point-to-point systems would share the 13.15-13.2 GHz portion of the band with VHCM, TV-STL, and TV pickup operations on an urban/rural basis. In major metropolitan areas of greater Toronto, Montréal and Vancouver, preference would be given to the existing VHCM, TV-STL and TV pickup systems. Elsewhere, the level of priority access given would be at the discretion of Industry Canada’s regional offices.

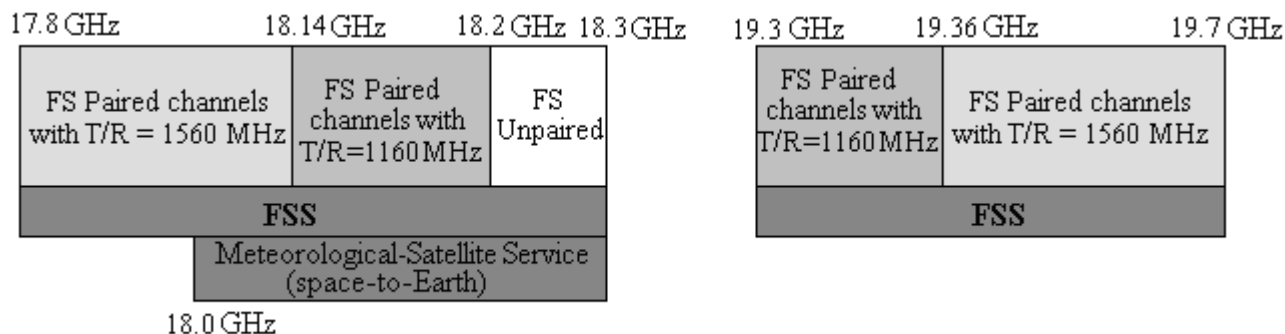
- 5-8 The Department is seeking comments on its proposal to introduce fixed two-way backhaul services within the 12.7-13.2 GHz range, including any technical issues (e.g. preferred channel plan, bandwidths and capacity requirements), sharing and coordination considerations, as well as any other relevant factors regarding the use of this band.**
- 5-9 Given the limited requests for VHCM systems, the Department is seeking comments on the introduction of a moratorium on future licensing of new VHCM systems in the band.**

5.6 17.8-18.3 GHz and 19.3-19.7 GHz

These bands are allocated on a co-primary basis for both the FS and the FSS (space-to-Earth) (Earth-to-space); however, the use of the spectrum by the FSS is limited to applications that pose minimal constraints on deployment of the FS, with the FS having priority over FSS (space-to-Earth).³³ In addition, the band 18.0-18.3 GHz in Region 2 is allocated to the meteorological-satellite service (space-to-Earth) on a primary basis. For details of the band, see Figure 6.

³³ Canadian Table of Frequency Allocations 9 kHz to 275 GHz (2009 Edition) (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09686.html>)

Figure 6: 17.8-18.3 GHz and 19.3-19.7 GHz Band Plan



Currently, there are 5,600 FS licensed frequency assignments³⁴ for low-, medium- and high-capacity fixed links licensed in the paired bands 17.8-18.14 GHz and 19.36-19.7 GHz; very few licensed frequencies (10 assignments) in the paired bands 18.14-18.2 GHz and 19.3-19.36 GHz, and the unpaired band 18.2-18.3 GHz.

United States

As part of the United States’ ongoing backhaul reform, the FCC reviewed its antenna standards in the 18 GHz band (17.7-18.82 GHz and 18.92-19.7 GHz), and is now permitting the use of smaller antennas, per FCC 12-87.³⁵ Although smaller antennas may be deployed, their performance must be upgraded should they cause interference or prevent the entry of new systems.

5-10 The Department is seeking comments regarding the low usage of the 18.14-18.3 GHz and 19.3-19.36 GHz portions of the band. Please address any technical characteristics or regulatory provisions limiting deployment, and provide proposals on specific policy or allocation revisions to improve usage within the band.

5.7 31.8-33.4 GHz

This frequency range has primary allocations for fixed and radionavigation services. Specific portions are also allocated to space research (space-to-Earth, deep space) and inter-satellite services. As a result of decisions adopted by the ITU at the World Radiocommunication Conference 2000, the CTFA was updated to include high-density fixed service (HDFS) applications with specific footnotes regarding interaction with the other services.³⁶ In *Revisions to Spectrum Utilization Policies in the 3-30 GHz Frequency Range and Further Consultation* (DGTP-008-04), it was noted that the band 31.8-33.4 GHz

³⁴ Assignment and Licensing System (ALS), June 2012.

³⁵ *Second Report and Order, Second Further Notice of Proposed Rulemaking, Second Notice of Inquiry, Order of Reconsideration, and Memorandum Opinion and Order*, FCC 12-87 (http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0822/FCC-12-87A1.doc)

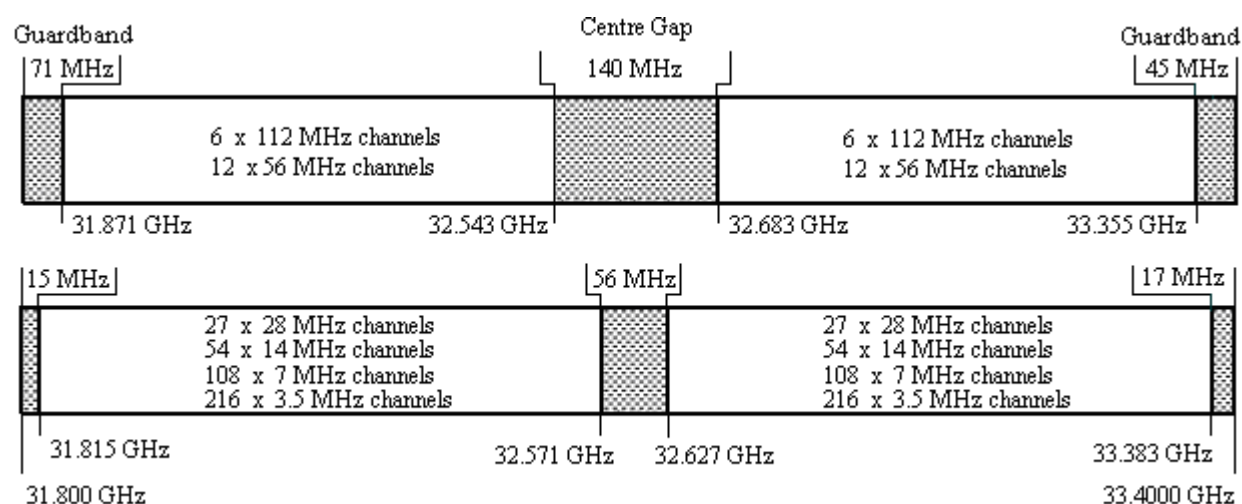
³⁶ *Canadian Table of Frequency Allocations 9 kHz to 275 GHz (2009 Edition)*. Footnotes 5.547, 5.547A, 5.548 (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09686.html>)

is well suited for HDFS applications (point-to-point and point-to-multipoint configurations), as it is allocated internationally and in all three ITU Regions (apart from the United States) for the FS without an allocation to the FSS. In the DGTP-008-04 consultation paper, the Department indicated that it would make the band 31.8-33.4 GHz available for HDFS by way of future consultation.

Europe

The European common allocation³⁷ of this band is for fixed and radionavigation services shared with space research (space-to-Earth, deep space) in 31.8-32.3 GHz and with inter-satellite in 32.3-33.4 GHz. It is used for HDFS applications in either the point-to-point or point-to-multipoint configurations. Frequency assignments for fixed systems use various channel bandwidths of 3.5 MHz, 7 MHz, 14 MHz, 28 MHz, 56 MHz and 112 MHz.

Figure 7: European Radiocommunication Committee Recommendation ERC(01)02, Preferred Channel Arrangement for FS Systems Operating in the Frequency Band 31.8-33.4 GHz



In the United Kingdom, Ofcom initially opened a portion of the band for point-to-point applications in 2003. However, with very little interest expressed and no active assignments, Ofcom decided to auction the entire band. All six national block licences were awarded in 2008.³⁸

United States

In the United States, the band 31.8-33.4 GHz is not allocated for FS use. The band 31.8-32 GHz is allocated to the radionavigation and space research (space-to-Earth, deep space) services; and the band 32-32.3 GHz is allocated to the radionavigation and space research (space-to-Earth, deep space) services, all on a primary basis. The band 32.3-33 GHz is allocated to the inter-satellite and

³⁷ ERO European Common Allocation Database (<http://www.cept.org/>)

³⁸ Summary of the 2008 auction results (<http://stakeholders.ofcom.org.uk/binaries/spectrum/spectrum-awards/completed-awards/results.pdf>)

radionavigation services; and the band 33-33.4 GHz is allocated to the radionavigation service, all on a primary basis.

- 5-11 The Department is seeking comments on making the band 31.8-33.4 GHz available for backhaul and is seeking views on equipment availability, considering that the band is not allocated for FS in United States.**
- 5-12 In addition to backhaul, comments are being sought on other potential FS applications.**
- 5-13 The Department is seeking comments on channelling plans, policy implications, sharing measures and coordination considerations or constraints, architecture (point-to-point, point-to-multipoint or a combination thereof) and anticipated time frames in which this spectrum would be required.**

5.8 38 GHz Band (38.4-40.0 GHz)

The 38 GHz band is allocated on a primary basis to multiple services, including the FS, the FSS (space-to-Earth), mobile, and mobile-satellite (space-to-Earth), as well as to the Earth exploration-satellite service (space-to-Earth) on a secondary basis. The mobile-satellite allocation, which is limited to the use by the Government of Canada, is only within the 39.5-40 GHz portion.

Furthermore, in Canada, the band 38.4-40 GHz is licensed for HDFS applications operating on an area basis.³⁹ The band is divided into 14 paired frequency blocks and four unpaired frequency blocks, each with a bandwidth of 50 MHz, as per Table 4 below. In 1999, Industry Canada auctioned eight frequency pairs (800 MHz) in 38.7-39.1 GHz and 39.4-39.8 GHz for fixed point-to-point and point-to-multipoint systems. The remaining frequency blocks are authorized on a shared basis within a given geographical area, for the operation of one-way point-to-multipoint and one-way and two-way point-to-point systems.

Table 4: 38 GHz Fixed Band Plan and Associated Usage

Paired Blocks: Two-way

Block	Lower Frequency Block (GHz)	Upper Frequency Block (GHz)	Usage
A / A'	38.60-38.65	39.30-39.35	point-to-point
B / B'	38.65-38.70	39.35-39.40	point-to-point
C / C'	38.70-38.75	39.40-39.45	point-to-point and point-to-multipoint ^a
D / D'	38.75-38.80	39.45-39.50	point-to-point and point-to-multipoint ^a
E / E'	38.80-38.85	39.50-39.55	point-to-point and point-to-multipoint ^a
F / F'	38.85-38.90	39.55-39.60	point-to-point and point-to-multipoint ^a
G / G'	38.90-38.95	39.60-39.65	point-to-point and point-to-multipoint ^a
H / H'	38.95-39.00	39.65-39.70	point-to-point and point-to-multipoint ^a
I / I'	39.00-39.05	39.70-39.75	point-to-point and point-to-multipoint ^a

³⁹ Canadian Table of Frequency Allocations 9 kHz to 275 GHz (2009 Edition), Footnote C51 (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09686.html>)

Block	Lower Frequency Block (GHz)	Upper Frequency Block (GHz)	Usage
J / J'	39.05-39.10	39.75-39.80	point-to-point and point-to-multipoint ^a
K / K'	39.10-39.15	39.80-39.85	point-to-point
L / L'	39.15-39.20	39.85-39.90	point-to-point
M / M'	39.20-39.25	39.90-39.95	point-to-point
N / N'	39.25-39.30	39.95-40.00	point-to-point

^a Auctioned spectrum. In 2009, the Department granted a five-year extension to the licence term for the auctioned 24 GHz and 38 GHz spectrum. (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09302.html>). Licence renewals will be subject to a future consultation.

Unpaired Blocks: One-way only

Block	Frequency Block (GHz)	Usage
A	38.40-38.45	point-to-point and point-to-multipoint
B	38.45-38.50	point-to-point and point-to-multipoint
C	38.50-38.55	point-to-point and point-to-multipoint
D	38.55-38.60	point-to-point and point-to-multipoint

The 38 GHz band is popular with service providers in urban core areas, as spectrum blocks are available on a self-managed basis, permitting rapid deployment of multiple links. However, the Department notes that there has been very little usage by FS systems within the 38.4-38.6 GHz portion. This could be attributed to the current designation of this portion of the band as one-way only. As such, Industry Canada proposes to make these 200 MHz available for both one-way and two-way point-to-point and point-to-multipoint systems, noting that all deployments must adhere to co-primary sharing rules.

5-14	The Department is seeking comments on the lack of usage to date within the 38.4-38.6 GHz portion of the band. Are there technical characteristics or regulatory provisions limiting deployment within this portion of the band?
5-15	The Department is also seeking comments on its proposal to allow fixed two-way systems within the 38.4-38.6 GHz range. Please include any technical issues, sharing and coordination considerations with other services, preference regarding duplexing methods, and other relevant factors.
5-16	Comments are being sought as well on alternate uses of this portion of the band. Please include any technical issues, sharing and coordination considerations with any other services, and other relevant factors.
Interested parties are invited to provide any other comments that may be relevant to the use of this spectrum.	

5.9 40.5-43.5 GHz

In Canada, the band 40.5-42.5 GHz is currently allocated to broadcasting, broadcasting-satellite, the FS and the FSS on a primary basis and to mobile and mobile-satellite on a secondary basis, whereas the

42.5-43.5 GHz range is allocated to the FS, the FSS (Earth-to-space), mobile (except aeronautical mobile) and radio astronomy on a primary basis. In particular, the entire 40.5-43.5 GHz range is available for HDFSS applications (Resolution 75, WRC-2000), whereas the 40.5-42 GHz segment is also identified for HDFSS applications (space-to-Earth), but this does not preclude other services that are allocated on a co-primary basis within the band.

Generally speaking, in Europe, the 40.5-43.5 GHz portion of the band is allocated for HDFSS, with priority over uncoordinated FSS terminals within 40.5-42.5 GHz. In the United Kingdom, however, Ofcom has assigned by auction six blocks⁴⁰ (250 + 250 MHz) of nationwide spectrum in the 40.5-43.5 GHz band.

In the United States, the FS and the FSS are co-primary within the entire 37.5-42.5 GHz band, yet through a soft segmentation approach in the band, power flux density (PFD) limits encourage the use of 37.5-40.0 GHz and 42.0-42.5 GHz by the FS and 40.0-42.0 GHz by the FSS. In November 2010, the United States released a proposal to increase sharing between terrestrial and satellite services in the band 37.5-42.5 GHz (FCC 10-186). Specifically, the FCC proposed to delete the Broadcasting-Satellite Service (BSS) allocation from 42.0-42.5 GHz and add a primary allocation for FSS (space-to-Earth).⁴¹ Industry Canada is exploring whether there is interest in FS deployments within the band 40.5-43.5 GHz, noting that all deployments must adhere to co-primary sharing rules.

5-17 The Department is seeking comments on whether deploying fixed systems in the band 40.5-43.5 GHz should be permitted. Factors such as potential applications, anticipated time frames, sharing constraints, mitigation measures and/or coordination considerations with other services, including radio astronomy and future HDFSS applications, are of particular interest. As well, comments are being sought on whether this band should be made available for point-to-point, point-to-multipoint systems or a combination thereof.

Interested parties are invited to provide any other comments that may be relevant to the use of this spectrum.

5.10 Additional Backhaul Spectrum

As part of Industry Canada's mandate to effectively manage spectrum, the Department has recently made available several frequency bands, previously designated for use by the FS (e.g. 25 GHz, 27 GHz, 70 GHz and 80 GHz), for fixed systems in support of fixed and mobile broadband access. However, backhaul capacity requirements continue to increase as networks experience a growing demand for high bandwidth applications, stemming from the use of mobile devices carrying video and Internet traffic, the current and future rollout of HSPA and LTE.

⁴⁰ 10 GHz, 28 GHz, 32 GHz and 40 GHz Award: Summary of auction results (<http://stakeholders.ofcom.org.uk/binaries/spectrum/spectrum-awards/completed-awards/results.pdf>)

⁴¹ *Third Notice of Proposed Rulemaking*, FCC 10-186, IB Docket No. 97-95 (http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-10-186A1.pdf)

As detailed in Red Mobile's spectrum demand study,⁴² although licensees are offloading traffic to fibre systems, the volume of traffic carried over microwave backhaul continues to increase. The study indicated that spectrum demand was "expected to grow from approximately 900 MHz in 2010 to between 2600 and 3400 MHz" by 2015. Although the FS has more than 13 GHz of primary allocated spectrum, certain frequency bands (i.e. 11, 15, 18 and 23 GHz) in urban centres may already be experiencing some congestion and may see greater growth and demand than other bands over the 2011-2015 study period.

In the context of the above-mentioned study and given the spectrum recently made available for additional backhaul purposes, the Department is interested in determining if, apart from those frequency bands already being explored within this consultation, there is a need to further examine additional opportunities in other frequency bands to accommodate backhaul systems. This information will be useful in further forecasting requirements regarding demand for spectrum within short-, medium-, and long-haul frequency bands.

5-18 The Department is seeking comments on whether additional spectrum is needed for backhaul purposes. Proposals should identify the particular frequency band(s) and address technical requirements, policy and licensing implications, as well as sharing and coordination considerations. Proposals should also state whether equipment is currently available and provide as much information as possible on the use of such spectrum in other countries.

The comments received may be used in the development of a separate consultation on specific frequency bands, as appropriate.

6. Promoting Efficient Frequency Use

Demand for capacity has increased and radiocommunication service providers are seeking to deploy wireless systems that can accommodate their expanding networks and increased traffic. As a result of the limited supply of spectrum and increasing congestion in certain frequency bands and geographical areas, there is an increasing need for efficient spectrum usage.

The following sections examine opportunities to promote spectrum efficiency across all fixed backhaul frequency bands.

6.1 Considerations

6.1.1 Spectral Efficiency

For the majority of microwave backhaul bands, the Department requires that applicants cooperate and coordinate with other licence holders to permit the reasonable and orderly sharing of spectrum. To ensure the efficient use of spectrum and maximize carriage capacity, spectrum policies and associated SRSPs specify minimum spectral efficiencies and permissible system capacities. The transmission

⁴² Red Mobile Consulting's *Study of Future Demand for Radio Spectrum in Canada 2011-2015* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10253.html>)

capacity of fixed spectrum is determined by, among other factors, the efficiency of use of the spectrum, measured in bits/second/hertz (b/s/Hz). Although the capacity of a system may be dictated by these technical requirements, other mechanisms can be used to influence efficiency. One such mechanism is to charge licence fees for spectrum that corresponds to spectrum consumption and is reflective of market value; providing economic incentives to achieve efficiencies.

6-1 The Department is seeking comments and proposals on mechanisms to encourage greater spectral efficiencies. Recommendations pertaining to a specific frequency band should identify the band and the proposed minimum spectral efficiency. Recommendations should also address any technical issues or implications and the treatment of existing deployments.

SRSPs specify the capacity of systems that can be deployed in a given frequency band. The definitions of system capacities continue to evolve to reflect changes in transmission technology and microwave system requirements. Table 5 (below) provides the current definitions of system capacities as defined in SP 1-20 GHz.

Table 5: Definitions of System Capacities

RF Channel Capacity ^{a,b}	Traffic Load (Mbit/s) ^c	
Low-capacity (LC)	≥ 1.544	≤ 24.704
Medium-capacity (MC)	> 24.704	≤ 51.840
High-capacity (HC)	> 51.840	

- a. Smaller system capacities are also permitted in LC bands on a case-by-case basis.
- b. Capacities of less than 1.544 Mbit/s are not permitted in channels identified for MC or HC unless specifically identified in the spectrum policy for the band.
- c. System capacities do not include radio system overhead bits.

Through advances in RF equipment, systems are now generally able to achieve higher capacities within narrower channel bandwidths. This directly results in more efficient use of the radio spectrum. Although the use of high-capacity (HC) systems seems to be a natural evolution of demand, low- (LC) and medium- (MC) capacity point-to-point systems have played an important role in the early stages of network development and in extending deployment of into rural areas. Traditionally, LC and MC systems have been used in the lower frequency spectrum range, where good propagation conditions allow for reliable links over longer distances. In order to balance spectrum use, limits are currently placed on available channel bandwidths and capacities in particular bands to ensure an overall ability to accommodate all types of systems (LC, MC and HC). This fosters the entry of new LC and MC systems with dedicated spectrum where higher capacity systems (generally larger bandwidths) might otherwise limit their deployment and prevent potential network expansion into rural or remote areas that might not initially require high traffic capacity.

The Department is seeking comments regarding the current capacity definitions (see Table 5) and restrictions on system traffic loads:

- 6-2 Do the current capacity definitions accurately reflect today's requirements?**
- 6-3 Is there still a specific requirement for LC- and/or MC-only bands, or should the current restrictions on the use of higher capacity systems in such bands be reconsidered? Please address specific bands, implications on usage and deployment.**

Interested parties are invited to provide any other comments that may be relevant to capacity.

Independently of the above general review, the Department has been petitioned by the Radio Advisory Board of Canada (RABC) to relax the capacity restrictions for the 10 GHz band (10.55-10.68 GHz). This band is currently only available for LC point-to-point radio systems with channel bandwidths of 1.25 MHz, 2.5 MHz and 5 MHz, as well as for multipoint communications systems (MCS).⁴³ Equipment is currently available to accommodate MC systems within the specified bandwidths.

6-4 Assuming that capacity restrictions are retained, the Department is seeking comments on the RABC's request to allow MC systems specifically within the 10 GHz band, including any implications that this may have on future usage and deployment.

6.1.2 Antenna Standards

Point-to-point microwave systems use highly directional antennas. System designers focus on antenna qualities such as gain, half-power beam width, front-to-back ratio, off-axis discrimination and size when planning their networks. The Department defines antenna characteristics, rather than specifying the size of an antenna, as a means of ensuring that radio systems are designed so that they do not cause harmful interference to existing licensed systems. These characteristics include radiation pattern envelopes (e.g. possible enhanced technical standards for moderately and highly congested areas) and minimum front-to-back ratios.

Smaller antennas are usually preferred by licensees because of cost, ease of installation, minimum impact of wind and tower loading and the ability to gain access to existing infrastructure (e.g. rooftops and water towers). However, smaller antennas can result in greater off-axis emissions that create an increase in the potential for interference, thereby preventing entry of new systems into the area and increasing congestion.

To reduce backhaul costs and promote the growth of broadband, the United States, through FCC 10-146, has solicited comments on its antenna standards, specifically on the use of smaller antennas, with a goal of increasing deployment without amplifying the interference environment. Through the Second Report and Order Notice FCC 12-87,⁴⁴ the FCC is now allowing the use of smaller antennas in the following

⁴³ SRSP-310.5, *Technical Requirements for Fixed Line-of-Sight Radio Systems Operating in the Band 10.55-10.68 GHz* (<http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf00041.html>)

⁴⁴ *Second Report and Order, Second Further Notice of Proposed Rulemaking, Second Notice of Inquiry, Order on Reconsideration, and Memorandum Opinion and Order*, FCC 12-87 (http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0822/FCC-12-87A1.pdf)

bands: 6 GHz (5925-6875 MHz), 18 GHz (17700-18820 MHz and 18920-19700 MHz) and 23 GHz (21200-23600 MHz). The FCC noted that operators would still be required to upgrade to antennas with reduced off-axis emissions should interference issues arise that could have been resolved with a larger antenna.

The Department is seeking comments on defining minimum antenna characteristics:

- 6-5 Please provide proposals on specific frequency bands for which the Department may wish to review the minimum antenna characteristics. The proposals must include specifics for new standards, including maximum beam width, minimum gain and maximum off-axis emissions or radiation pattern envelope. Address any implications to existing licensees and the radio environment, future deployments, spectrum sharing and congestion.**
- 6-6 Are there specific technical considerations or requirements that the Department should consider in order to mitigate any potential of increased interference or congestion if minimum antenna characteristics are relaxed or conversely, implications should these characteristics be made stricter?**

Interested parties are invited to provide any other comments that may be relevant to antenna characteristics and standards.

6.1.3 Equipment

Another aspect is the flexibility of current microwave radio equipment to provide scalable transmission capacities. It has become increasingly easy through software upgrades to expand a system's capacity as the network grows, upgrading from LC to MC to HC traffic in an orderly progression. In terms of the reuse of existing infrastructure, there are obvious advantages to being able to grow within the same spectrum range. However, with the continual growth in traffic demands, the pressure on microwave backhaul will continue to increase.

Manufacturers have introduced a variety of technologies and mechanisms in an effort to cope with growing capacities as microwave backhaul traffic requirements continue to rise. In certain areas, demands are approaching or exceeding 1 Gbps. Currently available equipment addresses some of these needs through adaptive modulation, which adapts to conditions on the radio link; co-channel dual polarization (CCDP), which essentially doubles the capacity of wireless systems over the same channel; and channel bonding, which increases bandwidth capabilities through the aggregation of channels, allowing for greater capacities.

6-7 The Department is seeking general information on new equipment advances or technologies that can ease the growing capacity issues on backhaul systems.

Should any of your comments be considered proprietary, they must be submitted separately and clearly marked as "Confidential."

Industry Canada classifies radio systems as “standard” if they conform to the most recent issue of the Spectrum Utilization Policy (SP) or Radio Systems Policy (RP), whichever is applicable, and to the corresponding SRSP. A radio system is classified as “non-standard” if it does not conform to the current SP/RP or the SRSP for the frequency band in question, or if it is authorized while an SRSP is under preparation.

Non-standard systems may continue to operate uninterrupted as long as they do not block the entry of a standard system. However, non-standard radio systems are subject to modification or replacement if their non-standard aspects prevent the establishment of a new system or the expansion of an existing system that is standard. In areas of high spectrum demand, the necessity for the modification, replacement or removal of “non-standard” systems will be greater than in areas of low demand (e.g. some remote areas).

- 6-8 The Department is seeking comments on whether the use of the following techniques should be considered as standard. Please address any resulting technical, policy or spectrum management issues, any sharing or coordination considerations, as well as any implications on congestion, frequency reuse or the radio environment as a whole.**
- a. Radio systems that employ adaptive modulation, noting that during adverse propagation conditions, the systems’ spectral efficiencies may fall below the specified minimums.**
 - b. Radio links that use CCDP to effectively increase the capacity over the same channel.**
 - c. Systems that make use of channel bonding to effectively increase the available bandwidth.**
 - d. Other planned or available types of radio equipment technology to ease capacity issues.**
- 6-9 Is there a need for additional flexibility or modernization of policies and/or standards to allow for evolution and advances in equipment? Please provide specific proposals addressing any technical implications, sharing and coordination considerations, as well as any impact on the interference environment and congestion levels.**

Should any of your comments be considered proprietary, they must be submitted separately and clearly marked as “Confidential.”

Over the past several years, as equipment and radio systems evolved towards digital, licensees have been converting their analog systems to digital. The Department has encouraged this transition as it is more spectrally efficient; however, some policies and SRSPs still make reference to analog systems and analog modulation.

- 6-10 The Department is seeking comments on the level of use of analog systems, including the number of operational systems, age of equipment, life expectancy, specific frequency band and geographical area.**
- 6-11 To reflect current deployment trends, the Department is seeking comments on whether to remove specific references to analog systems or retain them to address specific requirements. Please address potential technical or policy implications and submit any suggested amendments.**

6.2 Departmental Publications

Radio system plans and policies are often required in order for Industry Canada to ensure the orderly development of radiocommunication services and to foster the effective implementation of existing and emerging technologies and services.

6-12 The Department is seeking comments on the need for additional flexibility or other updates to policies and/or standards to promote flexible and efficient use of wireless backhaul services. Please provide specific situations and criteria under which greater flexibility of spectrum use may be afforded, addressing any technical implications, sharing and coordination considerations, as well as any impact on the interference environment and congestion levels.

SRSPs define the technical requirements for radio systems operating in frequency bands, as well as their channelling plans. Channelling plans ensure the orderly and efficient implementation of these radio systems. Depending on the nature of the service and applications, specific SRSPs may use a two-frequency channelling plan or a single frequency plan. Traditional microwave point-to-point backhaul systems, apart from those transporting broadcast programming, use full duplex frequency division duplex (FDD) links that use separate frequencies for their go and return paths. Backhaul networks and routes should be planned and designed so that a single frequency pair can be reused. This makes efficient reuse of the spectrum. However, depending on the path length, a variety of frequency bands may be required across a large network. For certain applications and links, such as STLs, a single frequency is used, as communications are in a single direction only. Given that some of the frequency bands being considered for possible two-way backhaul usage are currently designated for one-way transmissions, the reverse may also be desirable.

6-13 The Department is seeking general comments on the need to introduce one-way transmissions in certain bands where the use of a two-frequency plan is currently a regulatory obligation. Please specify the frequency band and address any technical, sharing and coordination issues.

7. Non-Radio Alternatives

There are multiple technical solutions to address the need for backhaul, and usually a combination of solutions is employed throughout a network. In Canada, service providers generally deploy a mix of fibre and wireless microwave, depending on the service area. As a principle, the Department encourages applicants for radio systems to pursue, to the extent possible, the use of non-radio alternatives, such as fibre and cable, where these can be economically and realistically employed from a technological point of view.

As backhaul traffic requirements continue to increase, they begin to challenge the current limitations of traditional microwave technology and potentially the available spectrum. With studies indicating that network data traffic is expected to continue to grow, the Department is seeking comments on the use of

non-radio alternatives, especially in spectrum congested urban areas, where system path lengths are relatively short and these alternatives can be employed.

The Department is seeking comments on the role of spectrum alternatives in managing capacity.

7-1 Provide general information on your use of non-radio alternatives to resolve backhaul challenges. What is the combination (and percentage of wireless and other backhaul solutions) used within your network? Has this ratio changed within the last few years, and do you expect it to change within the next three to five years?

Interested parties are invited to provide other comments relevant to non-radio alternatives. Should any of your comments be considered proprietary, they must be submitted separately and clearly marked as “Confidential.”

8. Conclusion and Next Steps

The results of this consultation will provide Industry Canada with valuable information concerning the backhaul market in general, as well as specific details on existing and forecasted backhaul deployments and requirements, including likely developments over the next several years, congestion and technological advances, which will affect capacity. This information will allow the Department to revisit its policies and technical rules, with a view to accommodating these needs through the possible provisioning of additional backhaul spectrum or amendments to departmental publications. Decisions and supplementary consultations may be initiated on specific methods that the Department intends to explore further.

Marc Dupuis
Director General
Engineering, Planning and Standards Branch

Annex A: Distribution of Fixed Point-to-Point Microwave Systems in Backhaul Bands Across Canada⁴⁵

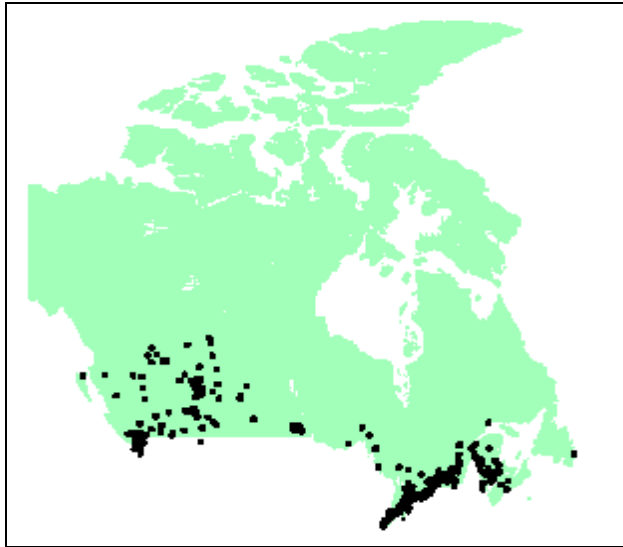


Figure A1: 23 GHz Systems

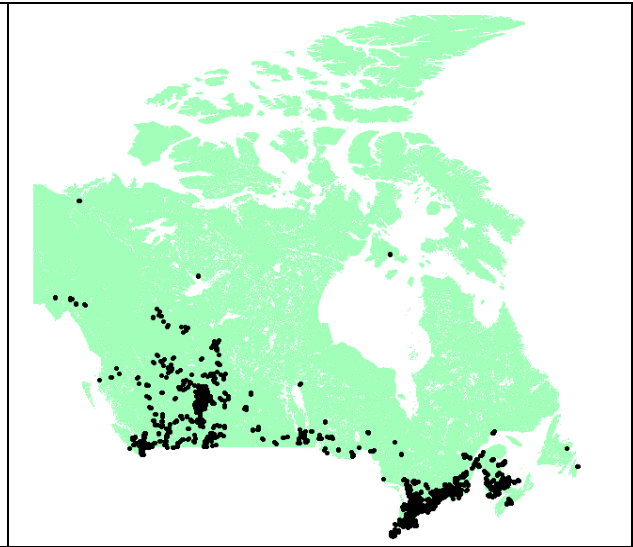


Figure A2: 18 GHz Systems

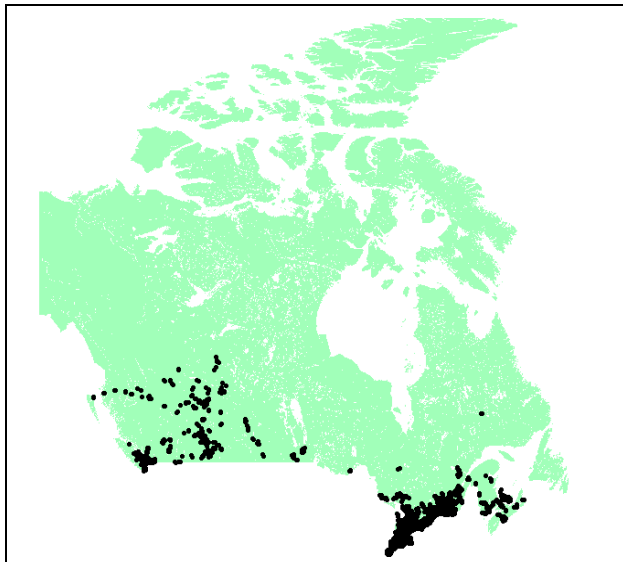


Figure A3: 15 GHz Systems

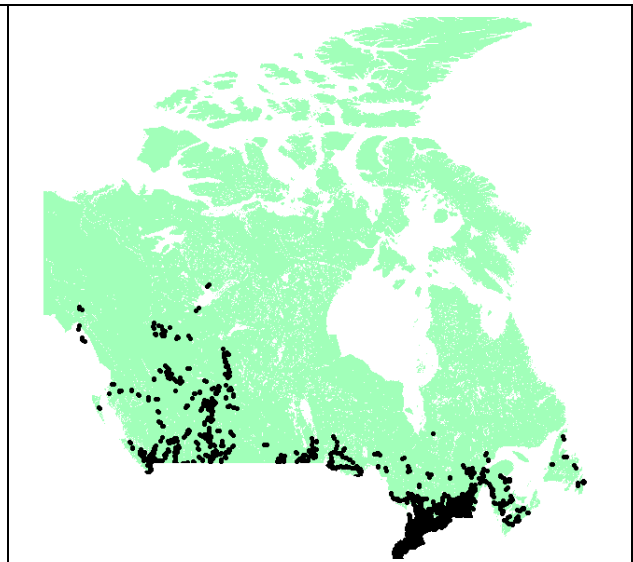


Figure A4: 11 GHz Systems

⁴⁵ Frequency bands with more than 2,500 frequency assignments (record identifiers)

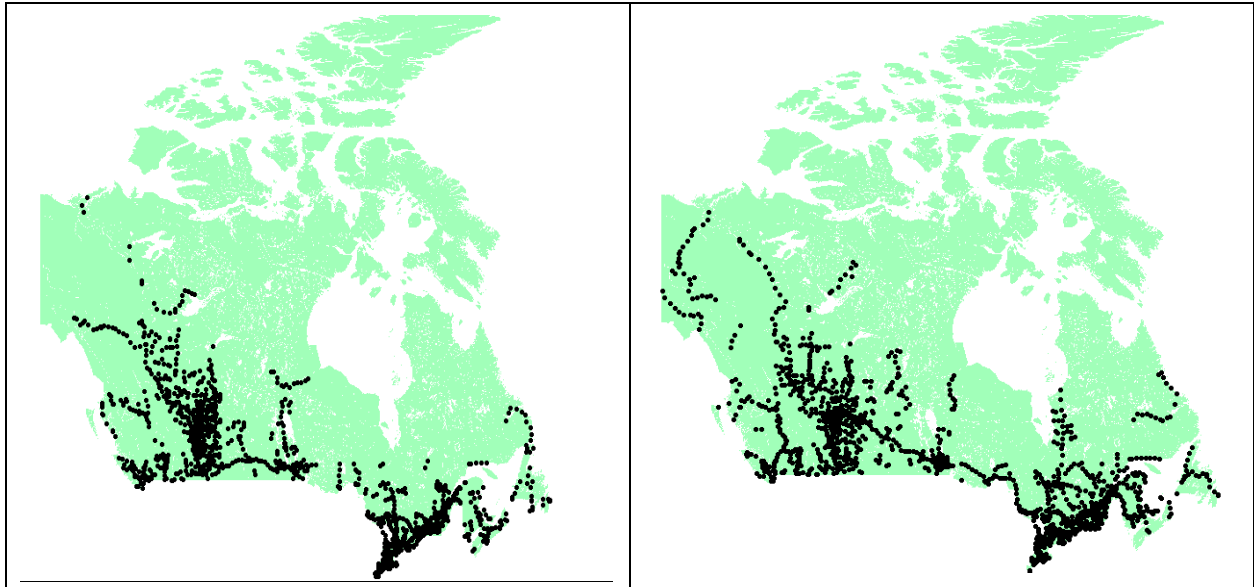


Figure A5: Upper 6 GHz Systems

Figure A6: Lower 6 GHz Systems