CONSULTATION ON RADIO LICENCE FEES - PHASE 1
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Summary</td>
<td>i</td>
</tr>
<tr>
<td>Background</td>
<td>i</td>
</tr>
<tr>
<td>A New Model for Radio Licence Fees</td>
<td>i</td>
</tr>
<tr>
<td>The Consultation Process</td>
<td>ii</td>
</tr>
<tr>
<td>Background</td>
<td>1</td>
</tr>
<tr>
<td>The Current Situation</td>
<td>2</td>
</tr>
<tr>
<td>Guiding Principles</td>
<td>3</td>
</tr>
<tr>
<td>Description of the model</td>
<td>3</td>
</tr>
<tr>
<td>Applying a new model for radio licence fees</td>
<td>5</td>
</tr>
<tr>
<td>Step 1 - Measure the amount of spectrum consumed by each licensee</td>
<td>5</td>
</tr>
<tr>
<td>Step 2 - Measure spectrum saturation</td>
<td>8</td>
</tr>
<tr>
<td>Step 3 - Assign rates to grid cells</td>
<td>11</td>
</tr>
<tr>
<td>Step 4 - Calculate the licence fees for a radio system</td>
<td>12</td>
</tr>
<tr>
<td>Advantages of the Model</td>
<td>15</td>
</tr>
<tr>
<td>Results Expected</td>
<td>16</td>
</tr>
<tr>
<td>Issues Still to be Addressed</td>
<td>16</td>
</tr>
<tr>
<td>Public Comment</td>
<td>17</td>
</tr>
<tr>
<td>Instructions for filing your comments</td>
<td>21</td>
</tr>
<tr>
<td>Public access</td>
<td>21</td>
</tr>
<tr>
<td>Appendix A - Measuring the Volume of Spectrum Consumed</td>
<td>22</td>
</tr>
</tbody>
</table>
### List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>Example of graphical representation of coverage</td>
<td>7</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Dimensions of spectrum consumption</td>
<td>8</td>
</tr>
<tr>
<td>Figure 3</td>
<td>Illustration of saturation</td>
<td>10</td>
</tr>
<tr>
<td>Figure 4</td>
<td>Example of intensity of spectrum use leading to saturation</td>
<td>11</td>
</tr>
<tr>
<td>Figure 5</td>
<td>Example of licence fees rate grid</td>
<td>13</td>
</tr>
<tr>
<td>Figure 6</td>
<td>Example of fee calculations for a radio system</td>
<td>14</td>
</tr>
</tbody>
</table>
Consultation on Radio Licence Fees - Phase 1

Executive Summary

Background

Under the authority of the Minister of Industry, Industry Canada is responsible for radio licensing and spectrum management. These activities are carried out through the Spectrum Information Technologies and Telecommunications Sector and by Industry Canada's regional and district offices.

In the past few years, the radiocommunications field has been growing rapidly, and a wide range of innovations has been introduced. Industry Canada recognized that the current radio licence fee system, which is based strictly on radio apparatus, does not have the flexibility to deal quickly and easily with a number of these innovations. As a result, Industry Canada decided to undertake a thorough review of its licence fee structure. A multi-disciplinary team of experts from the field of Spectrum Management was asked to develop a proposal for a new fee structure that would be simple, flexible and fair for all applicants.

A New Model for Radio Licence Fees

The Development Team took a wide variety of factors into account, and considered a number of options before developing the model outlined in this discussion paper. This new model suggests that radio license fees should be calculated based on the amount of spectrum used and the relative scarcity of spectrum in an area. A geographically based spectrum grid is being proposed to provide a consistent way of measuring coverage areas across the country. This grid will allow the fees for each radio system to be determined according to the system's spectrum consumption and to the scarcity of the spectrum in that location. The Department proposes to use the gross licence revenue at the time the model is implemented to set the initial cell rate. That amount will be redistributed among all licensees based on calculations of their consumption and the relative scarcity of spectrum, as proposed in the model.

The model has not yet been developed in detail (for example, no schedule of fees has been created). At this stage of the consultation, the Department is asking for comments on the concepts presented. Feedback from the public and the radiocommunications industry will guide further development of the model.

It should be noted that the model proposed here is limited to non-broadcast spectrum. While broadcasting undertakings consume radio frequency spectrum, they are licensed under the Broadcasting Act and not the Radiocommunication Act. As a result, they do not pay radio licence fees.
The Consultation Process

Industry Canada wants to ensure that anyone who is interested in radio licensing and fees will have an opportunity to make comments on the model proposed in this discussion paper. The Department will then develop a more detailed proposal that will reflect the results of this phase of the consultation process.

A second consultation will be carried out on specific issues such as the implementation process and time frame, application to individual cases, adjustments and transition measures. When the framework has been completely developed, the Radiocommunication Regulations will be amended to implement the new licence fee structure. An approximate time frame for the consultation process is outlined below.

Phase 1

February 1996  -  Notice of the licence fee structure review is posted in the Canada Gazette and the discussion paper is available to the public.

90 days  -  Time allowed for comments in writing or in electronic format to be received by Industry Canada.

(Submissions received will be available for public viewing for one year following the closing date for submissions.)

Phase 2

November 1996  -  Detailed proposal, including fee schedule and implementation process, will be available for discussion.

90 days  -  Time allowed for comments in writing or in electronic format to be received by Industry Canada.

April 1997  -  The framework for the new licence fee structure will be complete. Amendment of the Regulations will follow.
Consultation on Radio Licence Fees - Phase 1

Background

Under the Radiocommunication Act, the Minister of Industry is responsible for the establishment and development of radiocommunication in Canada according to the policy objectives set out in the Telecommunications Act. The Minister of Industry authorizes Industry Canada to carry out this responsibility.

In 1992, the Department of Communications defined the core objectives of a Spectrum Policy Framework for Canada, including:

- To plan and manage the utilization of the spectrum resource in accordance with legislative and public policy objectives through continuing review and improvement of the spectrum management process.

- To further improve efficient and optimum use of the spectrum resource through adoption of advanced spectrum allocation and management techniques based on operational requirements and technical and economic viability.

- To ensure flexibility and adaptability and ease of access to the spectrum resource in response to technological advances, economic, social and market factors.

The radio licensing process is one of several features of the integrated spectrum management system, established under the authority of the Minister, to accomplish these objectives. Radio licensing ensures that radio systems operate according to government policies and technical requirements. Licensing also helps to prevent interference between stations.

Under the Radiocommunication Act, the Governor in Council may prescribe fees for radio authorizations (licences) and for services provided by Industry Canada relating to spectrum management.

Radio licence fees are user fees governed by the Treasury Board policy, "External User Charges for Goods, Services, Property, Rights and Privileges". Under this policy, radio licence fees are considered to be "charges for limited rights or privileges, including access to and the use of publicly-controlled natural resources". Although the charges may be greater than the full cost of making the resource available, these fees are not considered to be a tax. A higher cost is justified by the fact that the value to the user is more than the full cost of making the radio frequency spectrum resource available. Radio licence fees should reflect the economic value of the spectrum resource being consumed. Fees should be designed to "promote the effective use, or prevent the overuse" of this natural public resource.
Radio licence fees are set out in the General Radio Regulations, Part I. The fee is currently determined by the type of station licensed and the type of radio system used. In certain cases, the equipment installed, the number of equivalent telephone channels required or frequencies assigned, and the location of operation are also taken into account.

**The Current Situation**

Issuing radio licences and setting licence fees based on the radio apparatus used has led to a number of difficulties. Industry Canada is seeking to correct these difficulties and improve the system by:

- ensuring that licensing decisions for all radio system technologies and architectures are based on technical and operational factors, rather than licence costs;

- ensuring that radio licence fees encourage conservation of the limited spectrum resource and reward spectral efficiency;

- ensuring that radio licence fees do not inadvertently or inappropriately distort user choice between alternatives (such as different service providers, building or buying services, spectrum and non-spectrum-based services);

- providing a fair, equitable and more transparent basis for determining licence fees; and,

- reducing the administrative burden for licensees and departmental staff.

As the radiocommunication sector has grown and introduced greater innovation, traditional licensing procedures and fees have not been flexible enough to respond adequately. The equity of the system, its administrative efficiency, and the size of fees have not always been acceptable. In recent years, Industry Canada has introduced numerous innovations, such as "band", "system", "fleet" and "multi-station" licensing, which recognize new ways of doing business in the sector. However, the Department continues to receive applications to establish new types of radiocommunication systems that were never anticipated by the existing fee schedule. Establishing fees for these systems under the current system is difficult and often inappropriate. In some cases, the fees may even be prohibitive.

Because radio licence fees are set by government regulations, they cannot be easily or quickly changed to respond to the unique characteristics of new and innovative radio systems. In developing a new model for radio licence fees, the Department has emphasized the need for flexibility. The proposed model can accommodate both high-level licensing approaches and new developments in technology, service and architecture.
Guiding Principles

Senior managers in the Spectrum Management Program set the following basic principles to guide the review and restructuring of the license fee system.

- The fee structure should be as simple and as equitable as possible.
- The more of the spectrum resource used, the higher the licence fee should be.
- Where the spectrum resource is relatively scarce, the licence fee should be higher.
- The fee structure should be flexible and independent of the licensing process. This separation would enable licensing decisions to be based on technical and operational factors alone rather than being influenced by fee considerations.
- Any significant change to the fees paid by a specific user or groups of users should be announced as soon as it is determined and should be implemented over a reasonable period of time.

Description of the Model

Overview of the model

The Development Team proposes a model in which licence fees will be based on the spectrum used by each licensee and the relative scarcity of spectrum in a specific geographic area. The model includes methods to standardize the measure of individual and total spectrum consumption as well as spectrum scarcity. Making these measures consistent for all users and all geographic areas will ensure that licence fee rates are easier to calculate and fair for all users.

The Development Team also proposes a graphic presentation of licence rate information that will be easy for applicants to use. A computer program will be developed that will display the relevant information for any given band or geographic area on a map. Once the rates have been set, an applicant will be able to see exactly what the costs will be to establish a proposed radio system in a specific location. The computer will use the applicant's own system information to demonstrate the area that will be covered by the station and the costs involved.

This "hands-on" approach will ensure that applicants can get the information they need to make decisions about their system quickly, and in a format that is easy to understand.
Applying the model

The proposed model for radio licence fees includes four steps:

**Step 1** - Measure the amount of spectrum consumed by each licensee.

**Step 2** - Measure the amount of spectrum that is being used by all users in a band and geographic area, and the amount available for allocation. This gives a measure of spectrum saturation.

**Step 3** - Based on spectrum saturation, assign a value in $/kHz to each cell in a geographic spectrum grid for each band.

**Step 4** - Calculate the licence fees for a radio system.

For each of the four steps, this discussion paper provides the following information:

- definitions of relevant terms
- proposed calculation methods
- how the model will be applied for the majority of users

Appendices A and B provide detailed technical information and discuss options that are being considered for specific situations or users.

Appendix C outlines issues related to fee concessions for specific types of users.
Applying a new model for radio licence fees

**Step 1 - Measure the amount of spectrum consumed by each licensee.**

In the proposed model, the radio licence fee will depend on the quantity of the radio frequency spectrum that is used (spectrum consumption). The more a user uses, the more that consumer will pay. This approach will help to promote greater equity between users.

*How will spectrum consumption be measured?*

Academics, engineers and policy analysts have been trying to develop an effective way of measuring spectrum consumption for nearly two decades. Two things are now generally agreed: (a) that both transmitters and receivers can consume spectrum; and (b) that three dimensions must be considered in measuring spectrum consumption: bandwidth, coverage area, and exclusivity required by the system. These three dimensions are outlined below.

- **Bandwidth measured in Hertz**

  Individual radio systems generally use only a relatively narrow slice of the vast range of radio frequencies. However, when the total consumption of all the systems in one band is considered, they may entirely consume the spectrum available in that band. It is important to be able to measure the consumption of each individual system in order to calculate overall consumption.

  → *The new model proposes to use a radio system's authorized bandwidth, expressed in kilohertz, to calculate its spectrum consumption.*

- **Coverage - the area over which spectrum is reduced or denied to other users by a consumer’s authorized usage**

  Because every radio system consumes spectrum in a geographic area when it operates, the amount of spectrum available to other users within that area is reduced. However, outside of the area, the same frequency range may be entirely available to other users.

  A system's coverage area depends on the propagation characteristics of the band and system characteristics such as antenna height and power. Two systems operating in the same geographic area may have quite different coverage areas.
The new model proposes to define a radio system's coverage area as the geographic area over which spectrum is reduced or denied to other users by the system's authorized usage.

A geographic grid has been developed to standardize the units of measurement for a system's coverage area. To develop the grid, the map of Canada was divided into hexagonal cells with an area of 25 square kilometers. The size of the cell is less than the propagation distance of most authorized stations, and it is small enough to avoid significant quantification errors. Because the entire country is included, the grid avoids the problems experienced with "zones" defined around metropolitan areas. (For example, intensity of spectrum use within the zones was inconsistent, and the borders of the zone did not correspond well to some stations' actual coverage areas.)

The model proposes to measure a radio system's coverage area by plotting its coverage contour on a spectrum grid that has cells of uniform size and fixed geographic location.
A radio system may coexist with other radio systems using the same frequency bandwidth or one that partially overlaps, or it may require exclusive use of the bandwidth. The technological design, traffic load and nature of operation will determine the amount of exclusivity each system needs.

→ The new model proposes to define the exclusivity required on a scale ranging from very little exclusivity (values approaching zero) to full exclusivity (value of one).

When the three factors outlined above are considered together, they provide the dimensions to measure spectrum consumption. The amount of spectrum consumed can be measured as the volume of a cube whose three sides are:
- Height - the authorized bandwidth;
- Length - the coverage or geographic area over which the spectrum has been reduced;
- Width - the degree of exclusivity required by or dedicated to an authorized user.

Figure 2 - Dimensions of spectrum consumption

→ Spectrum consumption for an individual radio system will be calculated for each of the spectrum grid cells included in the station's coverage area by multiplying the bandwidth occupied by the system times the exclusivity required.

Appendix A provides more detailed information on how the volume of spectrum consumed by each station will be determined.

Step 2 - Measure Spectrum saturation: Measure the amount of spectrum that is being used by all users in a band or geographic area, and determine the amount available for allocation. This gives a measure of spectrum saturation.
In the proposed model, the amount of the radio licence fee will depend on how much of the spectrum resource is already consumed and what the total demand is. Where spectrum is relatively scarce, the fee will be higher. This approach will provide an inducement to conserve spectrum where it is least available.

*How will spectrum saturation be measured?*

Although the spectrum is always there as a resource, it may be more or less available for use depending on prevailing frequency allocations or the presence of other users. When the number of users in a band or geographic area increases, the amount of spectrum remaining available for use is reduced. Spectrum is then described as "scarce" reflecting a high degree of usage in that band or geographic area.

A number of factors may increase the intensity of spectrum use in some bands: for example, the equipment available, the propagation characteristics of the band, and historical usage patterns. Geographic or demographic characteristics of an area, and the use of communications "corridors" also tend to group radio systems close together. In bands and locations that are used particularly intensively, the amount of spectrum available is extremely limited; the resource may be close to being completely used up.

The intensity of spectrum use can be described as the degree of "spectrum saturation" in a band or location. **Spectrum saturation is defined as the ratio of spectrum consumed to spectrum available in that geographic area.** (Spectrum available is usually the whole band.)

For each cell on the spectrum grid, the following calculations will be carried out for every band:

- the total spectrum consumed will be calculated by adding the spectrum used by both transmitters and receivers for all the stations whose coverage includes that cell.

- the saturation level will be calculated by dividing the total consumption by all stations by the total spectrum that is available in that band.

A Spectrum Saturation Index will indicate the extent to which the available spectrum has been consumed for a given band and geographical area.

The Table below demonstrates one way of presenting this index:
The example in Figure 4 illustrates that spectrum consumption in Band A is much more intense in the cells closest to the metropolitan area. When usage by all stations is considered, the band may be approaching full saturation.
Appendix B provides more detailed information on how the Spectrum Saturation Index will be calculated.

**Step 3 - Assign rates to grid cells:** Based on spectrum saturation, assign a rate in $/kHz to each cell in the spectrum grid for each band.

The model proposes to calculate a rate for each cell in the spectrum grid for every band. Because the cells of the spectrum grid are uniform in size, and the rate will be based on spectrum scarcity, the basis for setting licence fees will be more consistent and equitable for all bands and geographic areas in Canada.

*How will the rate for a spectrum grid cell be calculated?*

For every band, the Spectrum Saturation Index will be used to set the rate for each of the cells in the spectrum grid. Saturation will be measured on a scale from zero to one with approximately
five steps in between. Each step on the saturation scale will be assigned a value. The greater the saturation level of a cell, the higher the rate will be.

The saturation index and the rate for each cell in every band, will be reassessed each year to take into account new stations or new spectrum uses.

*Setting the initial cell rate*

The Department proposes to use the gross licence revenue at the time the model is implemented to set the initial cell rate. That amount (currently $133.5M) will be redistributed among all licensees based on calculations of their consumption weighted by the spectrum saturation in that geographic area, as proposed in the model.

**Step 4 - Calculate the licence fees for a radio system**

The Department intends to present the spectrum grid and rate information in an easy to understand graphic format. A computer program will be developed which shows all the spectrum grid cells in a geographic area. By selecting the area where the station will operate and its proposed band, a licence applicant will be able to see a "map" of the different cell rates for that band and that area.

*Example of a spectrum rate grid map*

The example below illustrates a spectrum grid rate map for a given band in the Montreal area where the cell rates have been calculated according to the saturation levels. Note that the actual rates have not yet been determined. The amounts shown are only an example.
Calculating the price for a specific radio system

The licence fees for a specific radio system will be calculated by adding the individual prices of all grid cells covered by that system's coverage. If applicants do not require full exclusivity, they will be entitled to a discount.

Using the Department's computer program, a licence applicant will be able to get an estimate of the licence fees for a proposed station by entering information about the required bandwidth and exclusivity, and the technical parameters for the station. The computer will calculate the system's coverage and overlay it on the spectrum rate grid. It will then calculate the cost of a licence to set up the system. Applicants will be able to quickly compare how different options for their station (such as choosing a different band or a higher performance system) would affect their licence fees.
The example below shows how one station's licence fees would be calculated using the spectrum rate grid.

Figure 6 - Example of fee calculations for a radio system
Advantages of the Model

The extremely diverse nature of the radio station population poses many challenges to developing a common basis for determining fees. Considerable effort will be required to fully develop and apply the model described here. Industry Canada looks forward to comments and guidance from all interested parties.

Some advantages of the proposed model are already apparent, even at this stage of development.

- There would be greater equity in licence fees because the criteria used to determine the fees would be common for all licensees.

- Users in remote and under-served areas of Canada, where spectrum scarcity is not a problem, would benefit from lower fees. Lower rates would facilitate the development of radio telecommunications services to these areas.

- In areas where spectrum is scarce, users would have an incentive to use the resource more efficiently in order to reduce their costs. They might reduce their spectrum use to their actual requirements, implement more spectrally efficient techniques, or pioneer in new bands that are not as intensely used.

- Applicants would be able to see and calculate immediately the costs for their proposed system by using the spectrum fee grid. The Department could make a computer program available to its regular clients to enable them to consider their options early in the planning stage.

- Users could take a greater role in deciding how to be more efficient in their use of the spectrum. If applicants and licensees want to minimize their radio licence fees, they could adopt any form of spectrum conservation. Lower bandwidth and lesser used bands would carry lower prices than highly used bands. Lower power levels and antennas that contain the emitted energy only to the area where it is essential would be rewarded by lower fees. Sharing spectrum to reduce exclusivity would also be rewarded by lower fees.

Industry Canada believes that a new and more rational approach to setting radio licence fees is required. By presenting a proposed model for discussion at this stage, the Department can benefit from users' advice and guidance as it defines the parameters, tools and applications.
Results Expected

Industry Canada believes that a new radio licence fee structure based on this proposed model will:

- establish common measures for fees that promote greater equity between diverse users and uses;
- redistribute fees among licensees based on clear and rational criteria;
- be able to respond fairly to new technologies and system architectures;
- allow applicants a greater degree of flexibility to adopt efficient approaches that serve their clients well;
- encourage spectrum conservation and the adoption of new spectrally efficient technologies where spectrum is scarce;
- encourage users to accept the need to reallocate spectrum to bands that are almost fully consumed; and,
- provide a means of expressing the economic value of the radio frequency spectrum resource.

Issues Still to be Addressed

- Application of the model to high frequency (HF), satellite, point-to-point, and repeater operations.
- Circumstances where certain frequency bands include multiple allocations and certain services embrace multiple and disparate bands.
- Non-discretionary services such as the Amateur Radio Service or Maritime Mobile Service where the band is fixed by Industry Canada. These services do not have any choice about where in the spectrum they will operate. In addition, although the amount of spectrum available to licensees using the service is relatively large, it is rare that any one station uses the entire spectrum. In these cases the model may be applied at the service level, to establish an aggregate fee which could be shared equally by all users in the service.
Fee concessions for government departments, public bodies and voluntary organizations. Appendix C presents some preliminary points for discussion on this issue.

Many similar types of questions are anticipated, for which imaginative and innovative approaches will be required. Application to specific circumstances will be addressed in Phase 2 of the consultation process.

**Public Comment**

The Department recognizes that some interested parties may want to know how the proposed model would affect their fees before they offer detailed comments on the proposal. However, it is not possible to provide such detailed information at this time.

Consultation at this stage is designed to gather comments on the concepts proposed, so that the model can be developed further. If there is general approval of the model, the Department will develop the various tools required to implement a new fee structure, and will propose a schedule of fees in Phase 2 of the consultation.

The Department invites comments from interested parties on any aspect of its considerations. In particular, comments are requested on the issues noted below where further definition and development are required.

**The Current Situation**

- Have the issues associated with the current radio licence fee system been adequately identified? Are there other important aspects that require attention?

**Guiding Principles**

- Are the guiding principles appropriate? Are there other important considerations?

**Spectrum Consumption**

Spectrum consumption would be one factor used to establish licence fees. In order to do so, a method must be developed to measure spectrum consumption. It is proposed that spectrum consumption be considered conceptually as a volume described by the three dimensions of coverage, exclusivity and bandwidth.
• Is it acceptable to measure spectrum consumption based on coverage, exclusivity and bandwidth?

• Is it appropriate to use the authorized spectrum (rather than the spectrum actually used) to determine radio licence fees?

Determining the volume of spectrum consumed

Bandwidth

The model proposes a linear scale where a given amount of bandwidth would cost the same fee regardless of where in the spectrum that bandwidth is located.

• Is a linear scale acceptable? If not, how should bandwidth be scaled?

Exclusivity

We are suggesting that a licensee’s need for exclusivity in the use of the spectrum depends on factors such as operational requirements, traffic requirements, performance objectives and the technology employed (See Appendix A). The allocation or assignment status associated with the licensee's emission and admission rights also affect exclusivity.

• Are these factors appropriate for all types of radio systems? Should any other factors be considered in determining exclusivity?

• How should the exclusivity of users having secondary allocation status compare with that of users having primary allocation status?

Coverage

We are proposing to measure a radio system’s coverage area by plotting its coverage contour on a spectrum grid that has cells of uniform size and fixed geographic location.

• For land mobile and other point-to-area type systems generally operating below 1 GHz, we propose the simplifying assumption that the area over which the associated receivers have admission rights is the same as the area over which the associated transmitters have emission rights. Is this an acceptable simplification?
Spectrum Saturation

The model proposes to include spectrum saturation as a determinant of fees. A spectrum saturation index will be developed to identify the ratio of total spectrum consumed to total spectrum available for every cell of a grid covering the geography of Canada, and for every frequency band. Frequency bands will require definition.

- Is it acceptable to identify spectrum saturation as a major fee determinant?
- How should the Department approach the grouping of frequencies/ frequency bands to determine spectrum scarcity? By service? By similar propagation characteristics? By current intensity of use?

The Spectrum Grid

- Does a cellular grid structure having hexagonal cells of 25 square kilometres have sufficient resolution or granularity to adequately capture zones of intensive spectrum use and the coverage of the various radio systems (including point-to-point systems)?
- Does the spectrum fee grid adequately show the implications of establishing a radio system in a given area? Does the grid seem easy to use and understand?
- Would a computer program that automatically calculated the fees for a real or proposed radio system be an effective tool to help users?

Setting the initial cell rate

- The Department proposes to use the gross fee revenue at the time of implementation to set the initial cell rate (see Appendix B). The total amount will be redistributed among all licensees based on calculations of their consumption and on spectrum scarcity, as proposed in the model. Is there a better approach?

Adjustments to cell rates

- Government policy for user fees and the stated position of the Department is that radio licence fees should reflect the economic value of the spectrum. How should the Department determine the appropriate value of the spectrum?

Fees as a spectrum management tool
• Do users agree that radio licence fees that reflect the value of spectrum should play a role in spectrum management, by:
  - signalling the need for reallocation of spectrum to bands that are intensely used;
  - steering spectrum to areas where it is particularly scarce and to uses that generate maximum social benefit;
  - encouraging spectrum conservation, efficient technologies and the use of technical substitutes where possible.

Applicability

• Are there situations where it would be inappropriate, prohibitively difficult or impossible to apply the proposed model? If so, what adjustments are required or what alternatives are there?

Fee concessions (See Appendix C)

• Should the Department offer fee concessions to certain uses or users? If so, why? What eligibility criteria should apply?
Instructions for filing your comments

Comments may be submitted in writing and/or in electronic format. Address your submission to:

Licence fee structure review  
Spectrum Management Operations  
Radiocommunications & Broadcasting Regulations Branch  
Industry Canada  
300 Slater Street  
15th Floor  
Ottawa (Ontario)  
K1A 0C8  

Attention: DOSP-A

We can also receive comments electronically via the Internet at:  
Fees@ic.gc.ca

To ensure your comments are considered, your submission must be received at the above address within 90 days after the publication of the notice in the Canada Gazette.

Public access

Submissions received in response to this review will be made available for public viewing for a period of one year following the closing date for filing submissions. These submissions may be seen in the libraries of the Department at 365 Laurier Street, 2nd Floor, Ottawa, or the Department's spectrum management offices in Moncton, Montréal, Toronto, Winnipeg and Vancouver.
Appendix A - Measuring the Volume of Spectrum Consumed

Key points:

- The proposed model will use Bandwidth, Exclusivity, and Coverage to determine the volume of spectrum consumed by a radio system. These dimensions are defined below.

- The model has simplified some assumptions in order to make the calculations of spectrum consumption realistic, practical and relevant. It is important to note that the calculation of spectrum consumption will not correspond exactly with measurements used for licensing or to determine electromagnetic compatibility.

- The calculations derived using the proposed model will be used only to determine radio licence fees, not for any other purpose.

Bandwidth

Bandwidth is characterized by the following needs:

- **high dynamic range** (e.g. from a few kilohertz for typical voice dispatch systems to over 100 megahertz for satellite feeder links)

- **high resolution** so that opportunities for reducing the bandwidth by amounts as small as a few kilohertz may be recognized and encouraged. (e.g. initiatives in the crowded VHF and UHF land mobile bands).

The Development Team considered a number of options to measure bandwidth, including setting an average value based on the carrier or centre frequency of the emission. However, the Team concluded that the most efficient approach was to use a linear scale to measure bandwidth. That means that no matter where in the spectrum the given amount of bandwidth is located, it would be considered to have the same dollar value ("a hertz is a hertz").

**Bandwidth is defined as the authorized bandwidth for a given radio system expressed in kilohertz.**
**Exclusivity**

Exclusivity is defined as the extent to which an authorized system excludes, denies or diminishes access by other potential systems to the same spectrum. Examples include: (1) a specific system's emissions may have sufficient energy to affect coincident frequencies or other systems within the same geographic area; (2) a system's receivers may be susceptible to the emissions of other systems.

Exclusivity is a function of several factors including:

<table>
<thead>
<tr>
<th>Operational Requirements:</th>
<th>The nature of the business conducted may demand fully exclusive use. As an example, a safety service may not have continuous high traffic volumes but would require full exclusivity to guarantee that it would have full access to its authorized spectrum in an emergency.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Requirements:</td>
<td>A user's traffic may be so heavy that it would be impractical to share spectrum with any other potential user (e.g. the &quot;fully loaded channel&quot;).</td>
</tr>
<tr>
<td>Allocation or Assignment Status:</td>
<td>Stations that have secondary allocation status are required to not prevent usage for the service that has primary allocation status. These stations generally do not deny usage to other primary users, but are more likely to find themselves denied usage. Similarly, assignments made on a “no protection, no interference” basis have very limited exclusivity.</td>
</tr>
<tr>
<td>Performance Objectives:</td>
<td>The technology employed may determine the degree of exclusivity required by the licensee. High reliability and/or high throughput systems may require high protection and, therefore, high exclusivity such that an absolute minimum of energy is present from other systems. Low performance and/or low throughput systems, on the other hand, may require relatively little protection. For example, the carrier sense dynamic frequency assignment scheme used by one LEO (Low Earth Orbiting satellite) proponent, requires virtually no exclusivity because it is based on having a non-intrusive yielding-to-incumbent-users technology. Similarly, the technical characteristics of spread-spectrum systems may be configured to transmit at a low throughput relative to bandwidth. This set-up makes them very tolerant to</td>
</tr>
</tbody>
</table>

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Consultation on Radio Licence Fees

Appendix A - 23
interference and also reduces their potential to interfere with other users.

Spread spectrum technology provides a particular challenge to the proposed concept, as it is possible to have a system with considerable bandwidth but whose spectrum consumption, and exclusivity needs, are relatively low because the throughput is low. This implies that exclusivity must be measured over a dynamic range similar to that of bandwidth so that one is able to offset the other in such situations.

Since exclusivity is a function of the factors mentioned above, the model proposes to measure a radio system's exclusivity on a scale ranging from very little exclusivity (values approaching zero) to full exclusivity (value of one).

**Coverage**

In its traditional sense "coverage" refers to the area or space over which a radio system provides communications to some specified level of reliability and quality (the performance objective). As it is used in defining spectrum consumption however, coverage refers to the area or space over which access to the spectrum is denied or diminished to other users.

It is now generally agreed that both transmitters and receivers consume spectrum. Transmitters consume spectrum by virtue of the energy they radiate on a specified bandwidth, at a specified time, within a specified area and at some power level. Receivers consume spectrum by excluding other transmitters from radiating energy greater than some predetermined level within a specified bandwidth, at a specified time and in a specified area. A radio licence, therefore, defines both emission rights (for transmitters) and admission rights (for receivers) for each licensee.

The following paragraphs describe the approach which the proposed model will take to define the coverage of a radio system based on the technical characteristics of its transmitter(s) and receiver(s). The Development Team considered a number of methods to determine coverage before deciding to adopt this rather detailed method. A number of assumptions have been made to simplify the process; the Department believes that these assumptions are acceptable for the specific purpose of calculating fees, although they may not apply in other situations.

It is anticipated that licensees who operate extensive and particularly wide coverage systems may be allowed to simply indicate the area over which they wish to establish emission and admission rights for their systems rather than applying for each individual station or radio apparatus.

**For land mobile and other point-to-area type systems operating below 1 GHz**

To simplify the calculations, it will be assumed that, for any radiocommunications system, the area over which its receiver has admission rights and the area over which its transmitter has
emission rights will be the same area. Therefore, only transmitter emission rights will be measured. While this assumption is not entirely accurate, it is generally true. The additional effort required to measure the two areas separately would not change the fee calculations in any significant way.

For receive only systems, the receiver's susceptibility coverage will be measured.

Point-to-point systems and space systems generally operating above 1 GHz

Because of the highly directive nature of these systems and the importance of characteristics such as angular separation, both the transmitter and the receiver's coverage will be measured.

*How will coverage be calculated?*

For transmitting stations, coverage will be calculated using the *coverage contour*. The limits of the coverage contour are determined by path loss calculations from the source to the points at which the transmitted energy falls below a specific level and is no longer considered significant.

For receive-only systems and for the receive side of point-to-point systems, a "susceptibility" contour will be described in similar terms. However, since a receiver's susceptibility contour depends entirely on the nature of a potentially interfering emitter, it is anticipated that the model will identify a standard emitter for use in the calculations.

The model proposes to measure the size of the area defined by the calculated contour through standardized grid cells of uniform size and fixed geographical location. The same grid will also be used to measure spectrum saturation.
Appendix B - Measuring Spectrum Saturation

Key Points:

- The proposed model will measure the relative intensity of spectrum usage in every band.
- The model includes a spectrum grid which breaks the map of Canada up into uniformly sized hexagonal cells (25 square kilometres). Spectrum saturation will be calculated for each cell in each band.
- A Spectrum Saturation Index will indicate the degree to which the spectrum is consumed in each cell for each band.
- Spectrum saturation (and fees) will be reviewed annually.

Definitions

Spectrum scarcity is defined as the degree of difficulty that exists in a defined geographic area in obtaining access to different frequency bands because of the intensity of their use.

A number of factors contribute to spectrum scarcity. For example, the equipment available, the propagation characteristics of the band, and historical usage patterns all combine to make spectrum usage particularly intense in some bands. In addition, geographic or demographic characteristics of an area, and the use of communications "corridors" tend to group radio systems close together. Both lead to spectrum scarcity. In bands and locations that are used particularly intensively, the amount of spectrum available is extremely limited; the resource may be close to being completely used up.

The intensity of use can be described as the degree of "spectrum saturation" in a band or location. Spectrum saturation is defined as the ratio of spectrum consumed to spectrum available. (Spectrum available is usually the whole band.)

Unit of measurement

The Development Team examined a number of alternative measures for spectrum saturation including: adding all the assigned bandwidths in a band; expressing the number of frequency assignments in a band as a geographical density (i.e. assignments/sq.km.) These methods were rejected in favour of a unit that would complement the three-dimensional concept of spectrum volume.
The unit of measurement for spectrum saturation must be consistent and complementary to the
notion of "coverage" included in the calculation of spectrum consumed. To achieve this
consistency, the Development Team adopted a grid of hexagonal cells, each with an area of 25
Km$^2$ as the unit within which spectrum saturation will be measured. This area is smaller than a
station's propagation area. The unit is also small enough that conditions in any given band will
be essentially the same throughout the area. A station's coverage will also be defined with
reference to these spectrum grid cells.

**Measurement formula**

The saturation of a cell in a given band (e.g. band A) will be calculated as follows:

$$\text{Saturation}_{\text{cell,A}} = \frac{\text{Total spectrum consumed}_{\text{cell,A}}}{\text{Total spectrum available}_{\text{cell,A}}}$$

The total spectrum consumed will be calculated by adding the spectrum used by all transmitters
and receivers whose coverage includes that cell.

The total spectrum available in the cell would be the bandwidth of the band in question, as
exclusivity would assume its maximum value of 1.

The range of saturation will be between 0 (no presence of a radio system) and 1 (all spectrum
in the band entirely consumed). This range will be quantified into a scale with approximately 5
steps, where each step corresponds to a value on a Spectrum Saturation Index.

**Changes in saturation level**

Each newly authorized radio system will change the saturation level to some extent by increasing
the spectrum consumed in all the cells included in the system's coverage area. However, it will
not be necessary to recalculate the saturation index after each new licence is granted. Two factors
make this unnecessary. First, the small number of steps used to quantify saturation will allow
adequate space for marginal changes before crossing into an adjacent step. Second, the
Department's experience indicates that, barring some extraordinary event such as band clearing
or the opening of a new service, the radio station population in a given area does not generally
change so rapidly that there is any significant short term change in the degree of saturation.

Saturation levels will likely be reviewed annually. Changes in saturation level (and fees) will only
occur when there has truly been a significant change in band conditions.
Appendix C - Fee Concessions

Under the current regulations, radio licence fees are set for classes of radio stations independent from the nature of the licensees. Thus, all users, regardless of their line of business or the nature of the service they provide, are charged the same fee. On various occasions, the Department has been asked to consider reducing fees for government departments and agencies, public institutions and volunteer organizations, because these groups provide emergency services or other public services, or because their volunteer funding base is limited.

Priority Support Areas

The Department's Spectrum Policy Framework includes the following guideline for "Priority Support Areas".

Radiocommunication systems vital to sovereignty and national security, national defence, public security, safety and emergency will be granted high priority and support in the access and use of the radio spectrum. Also, essential government operations, and other agencies providing critical services to the general public, will have high priority in use of the spectrum.

The Department's support does not, however, presently extend to fee concessions for the bodies providing priority services. The Department is seeking comments on the issue of fee concessions in this phase of the consultation. The principle concerns are outlined below.

Arguments for fee concessions

The organizations that have asked for reduced radio licence fees have done so on one or more of the following bases:

- the service provided is an essential public service and should not be subject to the fees that apply to commercial systems;
- the fees impose an additional cost on the delivery of essential services which is ultimately borne by the public; and,
- the fees are a serious burden for volunteer organizations that provide essential services because their sources of revenue are limited.

Issues related to government services

Because all levels of government are facing difficult fiscal situations, they are reviewing the nature and level of services they provide. They are often faced with difficult choices in order to
reduce their costs. When government provides any service, economic resources are consumed (labour, energy, papercclips, fire hoses, property etc) and these resources are not available for alternative uses in the economy. When the cost of services is clearly visible, taxpayers, whose tax dollars support these services, have the information they need to decide what, and what level of, services they want and are prepared to pay for. Community members can indicate their priorities by using the services or not, and by ultimately electing government members who will represent their views.

To a very large extent, and with rare exception, all resources consumed in the provision of public services are acquired at "market rates". What would be the possible effects of reducing radio licence fee to below market rates by granting fee concessions? The provision of radio frequency spectrum, a resource increasingly recognized for its strategic economic value, at less than "market rates" raises several potential issues.

- Fee concessions could be a form of hidden subsidy that conceals the true cost of the radio dependent services. Concessions might have the potential to distort decision-making about whether or not to provide these services, especially in relation to other services that also provide social benefit, but cost the market rate.

- Fee concessions could distort government decision-making about whether to undertake their own systems (by building, owning and operating their own infrastructure) or to purchase services from other providers. Such a decision should ordinarily be based on best value for the money, considering the government's perhaps unique operational requirements. However, if lower spectrum costs are available to government, this decision may be distorted towards building their own systems rather than buying services, and away from that decision that would otherwise generate the maximum net social benefit by avoiding the costs of redundant infrastructure.

**Issues related to volunteer organizations providing essential safety services**

For many volunteer organizations, their ability to provide essential safety services may depend on reducing administrative costs to the absolute minimum. In situations where the service operates only because volunteers provide their time and resources, providing fee concessions may be warranted.

Fee concessions would presumably only be required where the otherwise applicable fee posed a burden. The Department's experience suggests that the instances where essential safety services are provided by volunteer organizations is most frequently encountered in sparsely populated rural and remote areas that in turn do not usually experience spectrum congestion. Under the new model for licence fees these areas will be at the very bottom of the saturation scale where fees will be the least. Using the new model to calculate fees may reduce the fees significantly
compared to the level under the old licence fee system, making additional concessions unnecessary.