

# **Comment on: Consultation on Policy and Technical Framework for the 700MHz Band and Aspects Related to Commercial Mobile Spectrum\***

**Re: *Canada Gazette*, Part 1, December 4, 2010, Notice No. SMSE-018-10**

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**Executive Summary** – This comment examines the band plan options presented in the *Consultation on a Policy and Technical Framework for the 700 MHz Band and Aspects Related to Commercial Mobile Spectrum*. The issue of harmonizing with the United States in the 700 MHz band does not necessarily need to result in the ineffective use of the radio spectrum, if policy is created accordingly. Wireless devices such as cognitive radio may access spectrum dynamically resulting in higher spectrum utilization. However, before devices that employ dynamic spectrum access are able to make use of the inefficiencies in the radio spectrum, clear policy is needed that promotes their use. This comment recommends that policy be created that supports the use of dynamic spectrum access in the 700 MHz band.

**This comment addresses the following question:**

**5-1. Which of the four band plan options should be adopted in Canada? Why is this option preferred over the other options? Also comment on any related aspects not addressed or other possible options.**

## **1. Introduction**

The 700 MHz band presents Industry Canada with a great opportunity, an opportunity to create policy and a technical framework that will promote high spectrum efficiency and Canada's Digital Agenda. However, Canada is also faced with a dilemma as to whether it should

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adopt a framework similar to the United States (U.S.) or develop its own framework uniquely different from the U.S. framework. If Canada chooses to harmonize with the U.S. 700 MHz band plan, which is based on channel bandwidth spacings that are larger than the commercially available equipment, this will result in several spectrum holes and up to 12 MHz of unused spectrum.<sup>1</sup> While most see this channel bandwidth spacing issue as a significant problem, in fact, this channel bandwidth spacing issue actually creates a great opportunity for Canada to develop policy that supports the development of future technologies.

Dynamic spectrum access is a technique used by wireless communication devices to opportunistically find unused spectrum (spectrum holes) and transmits and/or receives over these spectrum holes, resulting in higher spectrum utilization. Due to the fact that Canada's band plan for the 700 MHz band will most likely mirror that of the U.S. and will have several spectrum holes, Industry Canada should develop policy and a technical framework that supports the use of dynamic spectrum access in the 700 MHz band.

This comment is organized as follows: Section 2 discusses the current problems with the management of wireless spectrum, in general and in the 700 MHz band; the issue of whether Canada should harmonize with the U.S. band plan is briefly addressed in Section 3; Section 4 explains what dynamic spectrum access is and the need for policy in this area; this comment is concluded in Section 5.

## **2. The Problem with the Wireless Spectrum**

The traditional means of spectrum access in Canada is not necessarily the most effective way of managing and utilizing spectrum. In general, spectrum access in Canada is based on

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<sup>1</sup> Industry Canada, *Consultation on a Policy and Technical Framework for the 700 MHz Band and Aspects Related to Commercial Mobile Spectrum*, SMSE-018-10 (December 2010) [*Consultation on a Policy and Technical Framework for the 700 MHz Band and Aspects Related to Commercial Mobile Spectrum*] at 16.

dividing the radio spectrum into bands and licensing each band for a specific time period for a specific geographical location to a single licensee. The licensee, in general, then has the exclusive rights<sup>2</sup> to access a specific band of frequencies free of interference from others. One draw back to this traditional way of licensing is that the licensee may not necessarily be using the entire band of assigned spectrum at all times, resulting in ineffective allocation and utilization of spectrum.

The problem of not using the entire band of assigned spectrum is imminent in the 700 MHz band if 6 MHz and 11 MHz channel bandwidth spacings are used, while standard radio equipment in this band is based on 5 MHz and 10 MHz channel bandwidth spacings. In the U.S. the 700 MHz band plan consists of several 6 MHz channel bands that are either paired (for transmission and reception) or unpaired, a single paired 11 MHz channel band, two paired 1 MHz channel bands (based on harmonic guard bands), and public safety channel bands. However, manufactures of standard radio equipment for the 700 MHz band have designed equipment based on 5 MHz and 10 MHz channel bandwidth spacings.<sup>3</sup> If Canada is to adopt a similar frequency band plan as the U.S., the differences in the channel bandwidth spacing and equipment bandwidth spacing will results in several spectrum holes and up to 12 MHz of unused spectrum.<sup>4</sup> The issues regarding the U.S. decision to licence the spectrum in 6 MHz channel bandwidth spacings are problematic for Canada, as Canada needs to decide if it should adopt the U.S. 700 MHz band plan or develop its own.

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<sup>2</sup> However these rights are not absolute rights as the licensee has limited rights regarding transferability, division, and leasing.

<sup>3</sup> *Consultation on a Policy and Technical Framework for the 700 MHz Band and Aspects Related to Commercial Mobile Spectrum supra* note 1 at 14.

<sup>4</sup> See *Consultation on a Policy and Technical Framework for the 700 MHz Band and Aspects Related to Commercial Mobile Spectrum supra* note 1 at 16 for a more thorough discussion on this issue.

### **3. Should Canada Harmonize with the U.S. Band Plan?**

Frequency coordination along the Canada-U.S. border and cross-border roaming between Canada and the U.S. should be paramount in developing the policy and technical framework for the 700MHz band. As spectrum has no strict borders, it is important that Canadian spectrum is coordinated with the U.S. due to the large geographical border that is shared between the two countries. To have seamless integration of wireless services along either side of the U.S.-Canada border, it is crucial that the frequency band plans of the two countries are similar. It is also critical that citizens of both countries are able to use their wireless devices in either country (i.e., cross-border roaming) without any technical difficulties. Conforming strictly to the U.S. band plan ensures the greatest reliability in cross-border coordination and cross-border roaming, with the tradeoff of ineffectively using spectrum. On the other hand, options 2a or 2b proposed in the *Consultation on a Policy and Technical Framework for the 700 MHz Band and Aspects Related to Commercial Mobile Spectrum*<sup>5</sup> are viable options to the U.S. model at a cost of potential cross-border coordination issue but with a benefit of a reduction in the number of spectrum holes, resulting in only about 2 MHz of unused spectrum. However, harmonizing with the U.S. does not need to result in an ineffective use of spectrum if policy instead promotes dynamic spectrum access in the 700 MHz band.

### **4. Dynamic Spectrum Access: Opportunistically Accessing the Radio Spectrum**

Dynamic spectrum access is a suitable solution for higher spectrum utilization and a viable option for making use of spectrum holes in the 700 MHz band. For instance, cognitive

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<sup>5</sup> *Consultation on a Policy and Technical Framework for the 700 MHz Band and Aspects Related to Commercial Mobile Spectrum supra* note 1 at 13.

radio<sup>6</sup> and software-defined radio<sup>7</sup> can make use of dynamic spectrum access to opportunistically find spectrum holes and transmits and/or receives over these spectrum holes. Where a spectrum hole can be defined as: “a band of frequencies assigned to a primary user, but, at a particular time and specific geographic location the band is not being utilized by that user”.<sup>8</sup> In essence, a secondary wireless device that employs dynamic spectrum access techniques will find these spectrum holes using spectrum-sensing techniques<sup>9</sup> or some coordination technique with the primary licensee. Then the secondary device will communicate over this spectrum hole, at a specific time and geographical location. The secondary device would potentially pay some form of licensing fees to the primary licensee or be granted access on a licence-exempt basis. When the primary licensee wants their spectrum back the secondary device moves to a new spectrum hole and continues communicating.

Before devices that employ dynamic spectrum access are able to make use of the inefficiencies in the wireless spectrum clear policy is needed that promotes their use. The 700 MHz band channel spacing issue provides Canadian spectrum policy makers with an ample opportunity to harmonize with the U.S. without having to worry about underutilization of the wireless spectrum if they deploy policy on dynamic spectrum access. The most recent revision to

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<sup>6</sup> Cognitive radio is defined in, Simon Haykin, “Cognitive Radio: Brain-Empowered Wireless Communications” (2005) IEEE Journal on Selected Areas in Communications, Vol. 23, No. 2, [Haykin] at 201-202 as “[c]ognitive radio is an intelligent wireless communication system that is aware of its surrounding environment (i.e., outside world) and uses the methodology of understanding-by-building to learn from the environment and adapt its internal states to statistical variations in the incoming RF stimuli by making corresponding changes in certain operating parameters (e.g., transmit-power, carrier-frequency, and modulation strategy) in real-time, with two primary objectives in mind: highly reliable communications whenever and wherever needed; efficient utilization of radio spectrum.”

<sup>7</sup> Software-defined radio, has limited capabilities compared to cognitive radio and as such in general can be described a communication device which is able to adapt to different radio services over a range of frequencies in software instead of being restricted by hardware.

<sup>8</sup> P. Kolodzy *et al.*, “Next Generation Communications: Kickoff meeting” (Oct. 17, 2001) Proc. DARPA, cited in Haykin *supra* note 6 at 201.

<sup>9</sup> See: I. Budiarto, *et al.*, “Cognitive Radio Dynamic Access Techniques” (2008) Wireless Pers. Commun. Vol. 45 at 293-324, for how some dynamic spectrum access techniques can be physically implemented.

the *Spectrum Policy Framework for Canada*<sup>10</sup> was clearly drafted with the conception of creating policy that supports dynamic spectrum access as the enabling guideline, to the single policy objective states: “licensing methods, should minimize administrative burden and be responsive to changing technology”, “permitting the flexible use of spectrum”, “facilitating secondary markets for spectrum authorizations”.<sup>11</sup> These aforementioned guidelines seem to strongly support the implementation of policy that would support dynamic spectrum access although no such policies currently exist. Furthermore, the *Spectrum Policy Framework for Canada*, Section 3 Context for Spectrum Policy Framework, briefly notes the use of advances in technologies such as cognitive radio and software-defined radio along with dynamic spectrum management.<sup>12</sup> Moreover, in the *Consultation on a Renewed Spectrum Policy Framework for Canada and Continued Advancements in Spectrum Management*, Industry Canada noted “[o]ppportunistic and dynamic use of existing bands by licence-exempt devices might be achieved through cognitive radio techniques”<sup>13</sup> and “licence-exempt devices using cognitive, SDR [(software-defined radio)] or UWB [(ultra wide band)]<sup>14</sup> techniques could be permitted to operate in licensed spectrum provided that they adapt their operations to ensure that the mandated interference limit is not exceeded.”<sup>15</sup> Although Industry Canada has created policy

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<sup>10</sup> Industry Canada, *Spectrum Policy Framework for Canada*, DGTP-001-07 (June 2007) [*Spectrum Policy Framework for Canada*].

<sup>11</sup> *Spectrum Policy Framework for Canada* *supra* note 10 at 8-9.

<sup>12</sup> *Spectrum Policy Framework for Canada* *supra* note 10 at 5-6.

<sup>13</sup> Industry Canada, *Consultation on a Renewed Spectrum Policy Framework for Canada and Continued Advancements in Spectrum Management* (May 2005) [*Consultation on a Renewed Spectrum Policy Framework for Canada and Continued Advancements in Spectrum Management*], at 24.

<sup>14</sup> UWB is a form communication which spectral characteristics occupy 500 MHz or more of spectrum. As UWB communications uses such a large band, the power at a specific frequency is negligible, and a UWB device should not interfere with primary devices communicating in the same frequency band.

<sup>15</sup> *Consultation on a Renewed Spectrum Policy Framework for Canada and Continued Advancements in Spectrum Management* *supra* note 13 at 25.

regarding UWB<sup>16</sup> it is now time for Industry Canada to create policy regarding the use of cognitive radio and dynamic spectrum access.

## 5. Conclusion

Given the latest development in wireless technologies, there is no such thing as spectrum scarcity; there is only a lack of access to spectrum created by our current regulatory framework. Allowing dynamic spectrum access in select bands, and in particularly the 700 MHz band, is a step forward in reducing the lack of access to spectrum problem. Harmonizing with the U.S. in the 700 MHz band does not necessarily need to result in ineffective use of the radio spectrum, if policy is created accordingly. By allowing secondary user access to the spectrum holes in the 700 MHz band on a no-interference basis<sup>17</sup>, high spectrum utilization will be achieved without the problematic cross-border frequency coordination issues that will result if Canada does not harmonize with the U.S. 700 MHz band plan. The time has come for Industry Canada to develop policy on cognitive radio and dynamic spectrum access in order to achieve high spectrum efficiency and meet the needs of Canada's Digital Agenda to be a global leader, once again, in wireless communications.

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<sup>16</sup> Industry Canada, *Devices Using Ultra-Wideband (UWB) Technology*, RSS-220 (March 2009).

<sup>17</sup> A no-interference basis means that the secondary licensee does not interfere with the primary licence.