**IEEE P802.15**

**Wireless Personal Area Networks**

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| Re: | Discussion issues for consultation paper from Industry Canada |
| Abstract | [A consultation paper on a Policy and Technical Framework for the Use of Non-Broadcasting Applications in the Television Broadcasting Bands below 698 MHz is issued by Industry Canada. This document is prepared to provide a baseline material for discussion on this this paper.] |
| Purpose | [Working document for discussion on a consultation paper from Industry Canada.] |
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1. Introduction

A consultation paper was issued to get comments on a Policy and Technical Framework for the Use of Non-Broadcasting Applications in the Television Broadcasting Bands below 698 MHz by Industry Canada in August 2011.

This document summarizes technical framework from the document (the consultation paper) to provide key issues for further discussion to the TG4m group with a hope that some comments can be identified from this group.

1. Summary of the consultation paper from Industry Canada

Consultation on a Policy and Technical Framework for the Use of Non-Broadcasting Applications in the Television Broadcasting Bands Below 698 MHz, *Canada Gazette* notice SMSE-012-11,

Issued by Industry Canada in August 2011

**Intent**

Industry Canada is considering whether to introduce a new wireless telecommunications application into the television (TV) broadcasting bands using TV white spaces.

Comments are sought on all aspects of the policy and technical framework, including the:

1. possible introduction of licence-exempt TV band white space devices;
2. possible changes to the policy and regulatory framework for licensed remote rural broadband systems (RRBS); and
3. possible changes to the policy and regulatory framework for licensed low-power apparatus (LPA), such as wireless microphones.

**Policy Objectives**

The goal of the proposals presented in this document is to develop a policy and technical framework to make additional spectrum available for licence-exempt applications while taking into consideration the impact on existing users of the spectrum.

**Current Spectrum Use in TV Broadcasting Bands Below 698 MHz**



**Background: United States**

Television broadcasting bands in the United States have traditionally been shared with other radiocommunication applications, including wireless microphones, broadcast auxiliary services (BAS) and cable television distribution.

Portions of the frequency band 470-512 MHz are available for non-broadcasting applications, including one to three TV channels in 13 large U.S. cities for land mobile and public safety use.

In the United States, the transition to DTV was completed on June 12, 2009, at which time previously auctioned frequencies above 698 MHz became available for commercial and public safety mobile communications. In the spectrum below 698 MHz, wireless microphones, broadcast auxiliary services (BAS) and other services that have traditionally shared spectrum with TV will continue to operate. In addition, the U.S. Federal Communications Commission (FCC) has been very interested in the potential for opportunistic access by unlicensed devices, such as so-called “white space” devices.

In January 2011, the FCC designated nine companies that will be permitted to provide the database services required for use by white space devices and on July 29, 2011, conditionally designated a 10th company5 as a database administrator.

The FCC decision-making process related to white space devices is now complete, and it is anticipated that such products will first be available on the U.S. market in late 2011 or early 2012. The detailed U.S. rules for TV white space devices are contained in Part 15.701 of Title 47 of the U.S. *Code* *of Federal Regulations*.

Included in the FCC’s September 2010 decision were provisions to reserve two vacant TV channels across the United States, although not necessarily the same channels in each area, for the use of wireless microphones and other low-power auxiliary service devices.

In March 2010, the U.S. National Broadband Plan was published. The plan includes a goal to make 500 MHz of radio spectrum available for mobile broadband use in the frequency range from 225 MHz to 3.7 GHz within 10 years. Of this amount, 300 MHz is to be made available for mobile broadband use within five years. This would include up to 120 MHz of TV broadcast spectrum below 698 MHz. If this plan goes ahead, it will result in a reduction in spectrum available in the United States for white space applications in TV bands.

**Background: Canada**

The CRTC (Canadian Radio-television and Telecommunications Commission) has identified 11 regional markets where it will be mandatory for existing TV broadcasters to transition to DTV by August 31, 2011.

Using spectrum that has been made available due to the transition from analog to digital TV, radio spectrum above 698 MHz is now being made available for use by commercial entities and public safety agencies for mobile wireless telecommunications. TV broadcasting spectrum below 698 MHz is already shared with licensed LPA such as wireless microphones.

In addition, in June 2006, Industry Canada established rules for the use of licensed subscriber-based broadband Internet systems in remote rural areas on TV channels 21 to 51 (512-698 MHz) except channel 37. These systems, called RRBS, are unique to Canada and are established on a no-protection, no-interference basis with respect to all TV broadcast stations, including low-power and very low-power TV.

Although TV broadcasting bands are already shared with LPA and RRBS, many TV channels in many locations remain unassigned and unused by LPA, RRBS or broadcasting. The remainder of this paper considers how this unused spectrum could be put to use.

 **Introduction of TV White Space Devices in Canada**

White space devices are designed to operate using unassigned TV channels and without interfering with licensed broadcasters or other authorized wireless telecommunications licensees. These devices would be exempted from requiring a license and would operate on a no-protection, no-interference basis with respect to licensed radio systems. However, these devices would need to be certified under the applicable department’s technical standard.

The use of white space may facilitate the development of dynamic spectrum access techniques, which is a key component in making more spectrum available through improved spectrum sharing.

The introduction of new radio technologies in Canada requires that Industry Canada first develop appropriate technical standards and specify appropriate operating parameters to ensure that other users of the radio spectrum environment are adequately protected from potential radio interference.

One important innovation of white space devices is the use of registration databases, which allow for real time control of interference. Because much of the technical parameters that limit operation of white space devices reside in such databases, changes to technical and operating requirements can be made quite quickly, simply by modifying how the database functions.

**Use of Spectrum Sensing and Databases**

There are two general approaches that can be used by white space devices to provide interference protection for existing licensees in the TV bands: spectrum sensing and use of geographic TV band databases.

Spectrum sensing is defined as the capability of detecting and avoiding signals from TV broadcasting stations and LPA that exceed a certain threshold within defined receiver bandwidths. Monitoring would be required on an ongoing basis to determine if a TV broadcast, LPA or RRBS transmission begins. If such a signal is detected, the white space device would be required to cease transmission.

As an alternative to sensing, databases can be used to provide protection to other radio services. With this approach, a list of protected spectrum users is maintained in one or more central databases. Whitespace devices would automatically access these databases to determine what spectrum, if any, is available at its location. If spectrum is available, the devices would begin to operate in the channel specified by the database. White space devices would be required to periodically reconfirm what spectrum is available in case of changes or if the device has moved.

White space devices would register their intended areas of operation and obtain a list of frequencies available for use at those locations. Such registration would require that white space devices provide their geographic coordinates to one or more databases. Such databases could provide further intelligence by adapting the provided list of available frequencies to the technical parameters of a particular white space device.

Spectrum sensing is expected to continue to develop and would therefore be permitted once this technology has matured sufficiently. At that time, technical rules regarding spectrum sensing devices will be developed.

The performance requirements of white space devices as they pertain to spectrum would be dealt with through certification. This certification process would include the assessment of the system comprising the white space device and one or more databases rather than only the white space device on its own.

**Types of White Space Devices**

**Fixed white space device:** A white space device that transmits and/or receives radio communication signals at a specified fixed location.

**Mobile white space device:** A white space device that transmits and/or receives radio communication signals while in motion or at unspecified fixed points.

**Mode I mobile white space device:**

* + does not use an internal geo-location capability and does not directly access a TV band database.
	+ referred to as “slave” devices.
	+ obtain a list of available channels on which it may operate from either a fixed device or a Mode II mobile device.
	+ does not initiate a network of white space devices or provide a list of available radio frequency channels to another Mode I device.

**Mode II mobile white space device:**

* + uses an internal geo-location capability and access to a TV band database for a list of available radio frequency channels.
	+ referred to as “master” devices.
	+ Access to the database may be through a direct connection to the Internet or through an indirect connection via another fixed or Mode II white space device.
	+ may provide its list of available radio frequency channels to another mobile device for operation by that device.

**Protection of TV Broadcasting**

It will be essential to ensure the protection of all over-the-air TV broadcasting services, including full power, low-power and very low-power TV, as well as receive-only stations that make use of TV broadcast signals such as cable TV head-ends and low-power TV receive sites.

There will be continued analog TV broadcasting operations throughout the country. For this reason, protection criteria for both analog and digital TV broadcasting will be developed.

Separation distances would be defined with regard to the protected service contours of both analog and DTV broadcasting stations. Current TV protected contours are defined in Table 6.1.

**Table 6.1: Current TV Protected Contours**

**Note 1:** Protection would be extended to cable TV head-ends and low-power TV receive sites that may be located outside of the protected contour of the TV broadcasting station whose signal it receives.

**Note 2:** See BPR-10, *Application Procedures and Rules for Digital Television (DTV) Undertakings*, Appendix 6, <http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09574.html>. F(50,90) means the case exceeded at 50 percent of the potential receiver locations 90 percent of the time.

**Note 3:** See BPR-4, *Application Procedures and Rules for Television Broadcasting Undertakings*, Section C-1.1.17, http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf01154.html.

**Note 4:** See BPR-10, Section B-1.5.

**Note 5:** F is the centre frequency of the TV channel in megahertz.

**Note 6:** In the United States, a value of 41 dBμ is used instead of the equation 41-20log(615/F).

In keeping with Industry Canada’s proposal to broadly harmonize with the United States, the co-channel and adjacent-channel separation distances relative to the TV protected contours specified in Table 6.2 would form a starting point for discussion of interference protection criteria for TV receivers. In this scenario, there would be no restriction on the operation of white space devices on the second and further adjacent channels to a TV broadcasting station.

**Table 6.2: Potential Interference Protection Criteria for TV Receivers**



**Note 1:** Due to the low potential for interference, mobile white space devices with an e.i.r.p. of 16 dBm or less would be permitted to operate within or outside broadcast coverage areas with no minimum separation distance from the protected contour of a TV broadcast station when using the adjacent channel.

Ofcom has proposed that white space devices in the United Kingdom continuously adjust their transmitter power levels under database control to ensure that TV broadcast interference protection requirements are met. If the Department were to adopt a similar approach, it could provide additional flexibility and increase the amount of spectrum available to white space devices without any increased risk to TV broadcast reception.

**Remote Rural Broadband Systems (RRBS)**

RRBS are advanced communications systems that provide service in remote rural communities in Canada, using TV channels that are unalloted and unassigned. These systems are evaluated before receiving a license, to prevent interference to other spectrum users, in particular TV broadcasters. The RRBS are licensed on a no-protection, no-interference basis in relation to the broadcasting service, on condition that they not constrain the provision of existing or future broadcasting services.

RRBS incorporate base stations and fixed customer premises equipment (CPE). These base stations operate at up to 500 watts e.i.r.p. and are capable of providing service to a radius of 2 to 20 km, depending on the equipment used. System subscribers are not required to hold individual radio licenses provided that the RRBS service provider’s base stations are licensed.

Equipment that does not incorporate sensing or database systems to prevent interference to TV reception require, from the part of the licensee, technical sophistication and upfront efforts to prepare for deployment.

As an alternative to the status quo, Industry Canada is open to the consideration of a license-exempt regime for RRBS. In this case, RRBS would be phased out in favor of white space devices. In order to ensure that there is no loss of functionality or coverage compared to existing systems, the technical rules for white space devices would be relaxed (e.g. to allow for increased power), under database control, when they are operating in remote rural areas.

To the extent that licensing of RRBS is continued, these systems would be included in any TV band databases for Canada.

**Low-power Apparatus (LPA)**

For many years, Industry Canada has made parts of the FM and TV broadcast bands available for use by LPA. LPA operating in TV broadcasting bands includes devices such as wireless microphones, cue and control communications, and synchronization of video camera signals.

In January 2010, Industry Canada issued Spectrum Advisory Bulletin SAB-001-10, which restricted the licensing and certification of LPA in the band 698-806 MHz.

Industry Canada believes that it may be advantageous to identify specific frequency ranges for LPA use and to restrict the operation of licence-exempt LPA to these channels. Because this spectrum would not be shared with white space devices, it would ease sharing between broadcasting and LPA and would allow for rapid LPA deployment without the need to first register such devices.

Industry Canada is considering the following options for the authorization of LPA in Canada:

1. allow licence-exempt operation of LPA on a no-protection, no-interference basis, but with the option for users to apply for a licence in exchange for interference protection from white space devices;

2. move to a completely licence-exempt regime for LPA where users desiring protection from white space devices can voluntarily register details of their operation in a database, whereas other LPA would operate on a no-protection, no-interference basis;

3. move to a completely licence-exempt regime where all LPA will operate on a no-protection, no-interference basis;

4. phase out separate provisions for LPA and instead provide this functionality using specialized white space devices; and/or

5. continue to require a licence for the use of all LPA, with interference protection from white space devices provided to all licensees.

**Impact to Adjacent Bands**

Out-of-band emissions criteria would be established with respect to adjacent TV channels, as well as limits that would be applicable for emissions outside of the TV broadcasting bands.

The limits for emissions outside of the TV broadcasting bands would be based on the general field strength limits specified in Section 7.2.5 of Industry Canada’s document entitled RSS-Gen, *General* *Requirements and Information for the Certification of Radio Apparatus*

**Table 6.3: General Field Strength Limits for Transmitters at Frequencies above 30 MHz**



In the proposed U.K. rules, there are provisions for white space devices to operate with various out-of-band emission masks. The U.K. databases would provide white space devices with different lists of available frequencies and/or require those white space devices to operate at a reduced power level depending on their out-of-band performance. This is intended to ensure a constant level of interference protection for adjacent band systems.

**Areas which Industry Canada is seeking comments**

**6-1 Comments are sought on the benefits that could be expected from making white space available in Canada.**

**6-2 Comments are sought on the benefits of the above-mentioned innovation to manage interference.**

**6-3 Comments are sought on the above proposed approach of setting technical standards now with respect to database dependent systems, and developing standards with respect to spectrum sensing devices when that technology has matured.**

**6-4 Comments are sought on these proposed provisions related to database performance and operation. Would these provisions provide sufficient capability to respond to interference cases or other problems that might occur once the white space devices are in use? Are there any additional provisions that Industry Canada should adopt?**

**6-5 Comments are sought on the above device categories – fixed, Modes I and II of mobile.**

**6-6 Comments are sought on these proposals regarding operating channels below 698 MHz.**

**6-7 Comments are sought on the above proposal regarding technical parameters to be developed to broadly harmonize technical rules with those in the United States. Considering the potential benefits of such harmonization, are there areas where Canada should consider variations from the U.S. technical rules?**

**6-8 Comments are sought on the interference protection criteria for TV broadcasting operations. Are the provisions in Table 6.2 adequate to ensure the protection of over-the-air TV broadcasting services? Should provision be made for white space devices using power control to have additional flexibility in selecting frequencies, as has been proposed in the United Kingdom?**

**6-9 Comments are sought on the potential for improvements to the policy and technical framework for RRBS, including the possibility of moving to a license-exempt regime, leveraging white space technology.**

**6-10 Should Industry Canada identify specific spectrum for use by LPA? If so, how much should be identified and should the operation of license-exempt LPA be restricted to this spectrum?**

**6-11 Comments are sought on the options for the authorization of LPA in Canada. Provide justification for this choice of option.**

**6-12 If option 1, 2 or 5 is chosen, comments are sought on the proposal to collect “time and location of use” data based on voluntary registration and the proposal that eligibility to register for such protection be open to all users of LPA. Comments are also sought on the appropriate protection criteria to protect LPA from interference from white space devices.**

**6-13 Comments are sought on the above proposals. Should provisions for flexible out-of-band masks, similar to the U.K. rules, also be included? Is there a need for additional measures on adjacent channels to protect systems operating at the edge of the TV bands?**

**6-14 On balance, do the potential benefits of permitting license-exempt white space devices to operate in Canada outweigh their potential risks to other services?**

**7-1 Comments are sought on these proposed modifications to the *Canadian Table of Frequency Allocations*.**

**8-1 Comments are sought on whether the measures of the FCC to protect Canadian licensees are adequate and whether Industry Canada’s proposed measures are adequate to protect U.S. licensees, including TV broadcasters. Provide supporting arguments for your response.**