Open Spectrum and Community Wireless Networking in Canada: a Preliminary Review of the Policy and Regulatory Landscape

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Introduction

This paper provides a preliminary overview of the implications of national and international spectrum policy trends for the development of community wireless networking initiatives in Canada. As in the United States, the development and growth of community wireless initiatives in Canada hinges in part on spectrum policy that ensures access to plentiful, high quality, open (unlicensed or license-exempt) spectrum. Demand for spectrum has increased dramatically in recent years with the adoption of cell phones and widespread use of other wireless devices by consumers and businesses. Burgeoning spectrum use is leading to greater potential for as well as actual conflict and interference among users, particularly in the limited number of increasingly crowded unlicensed bands in which many community wireless systems operate (Lakshmipathy, 2006; Sandvig, 2005). Meanwhile, the future of prime spectrum real estate being vacated as a result of the transition from analog to digital TV, and that could be used for community wireless projects, remains uncertain (Lakshmipathy, 2006). While the digital television transition (DTV) and other technical developments (e.g. smart radios) are poised to make more spectrum available for unlicensed use, pressure on governments to auction off newly available spectrum in the form of commercial licenses to the highest bidder is almost irresistible (Snider, 2005). Recent administrative and regulatory shifts in both the U.S. and Canada favouring property rights in spectrum threaten to hinder the development of community wireless (Lakshmipathy, 2006; Meinrath, 2005). Communications policy research has a role to play in educating policymakers, practitioners and community members about the implications of various approaches to spectrum policy and management regimes for community-based initiatives in wireless networking.

The following paper begins with an overview of the state of community wireless networking in Canada, and a brief survey of an emerging academic literature devoted to it. Following this introduction, the paper provides an overview of a number of international trends in spectrum policy, particularly in the U.S., and their implications for the future development of community wireless networking. The U.S. situation is particularly salient for Canada, which tends to follow and conform to U.S. spectrum policy due to the size of the latter's market for wireless goods and services. The paper then goes on to provide an overview of current legislative and regulatory institutions and provisions governing radiocommunication and spectrum usage in Canada with an emphasis on licence-exempt equipment and use.

The research discussed herein is being undertaken by members of the Community Wireless Infrastructure Research Project (CWIRP), a collaborative research project exploring the status and benefits of community and municipal wireless networking in Canada (see Appendix A). CWIRP's spectrum policy research makes common cause with the work of Meinrath, who calls for "a major research initiative … to be conducted to support 'open' technological development, progressive policy reforms, and implementation of these new technologies." (Meinrath, 2005).

Background

Community Wireless Networking in Canada

Canada was an early pioneer in the development of community networks (Shade, 1999), and is a leader in the implementation of government policies and programs to promote connectivity nationwide. Nonetheless, like the United States, Canada has begun to fall behind other leading nations in the deployment of new technologies, including wireless broadband (Industry Canada, 2006b). Incumbent telecommunications firms that hold much of the spectrum that could be used to develop wireless broadband have been slow to deploy their networks and offer services. Having said that, community-

based groups, including emergent community wireless networks (CWNs) have begun to step in to fill the void and have, in some cases, pre-empted the deployment of commercial networks. While for a variety reasons Canada has not witnessed the same rapid deployment of and political controversy surrounding community and municipal wireless systems as the U.S. has, within the last couple of years CWNs in Canada have begun to establish themselves as leading innovators in the technical development and provision of wireless internet service.

The number of CWNs currently operating in Canada is difficult to estimate and no attempt has yet been made to enumerate them comprehensively. Research by Powell and Shade (2006) and Powell (2006) suggests that there are perhaps a dozen or so community-based and/or municipally-owned wireless networks currently operating in Canada. Among the reasons they suggest for the comparatively slow development of wireless networks in Canada relative to the U.S. and elsewhere is the country's relatively high rate of household broadband penetration via cable and DSL, particularly in urban areas. Having said that, the development of public wireless networks has begun to take off and many more communities are actively exploring the possibility of deploying wireless networks. A non-exhautive list of Canadian communities with either grassroots volunteer or municipally-run wireless networks currently would include: Calgary, Winnipeg, Toronto, Ottawa-Gatineau, Montreal, Quebec City, Laval, Hamilton. Not captured by this list are potentially hundreds of smaller scale community-based wireless projects in urban neighbourhoods and rural areas, as well as remote and/or aboriginal communities.

CWNs in Canada take different insitutional forms and have embraced a variety of organizational objectives and business models. Powell (2006) identifies and discusses four examples of CWNs in Canada. The aforementioned Île Sans Fil (ISF) focuses on free wireless internet access provision as well as location portal development and multimedia applications for its network of venue-sponsored WiFi hotspots in downtown Montreal. ISF is volunteer-run and subsists on a limited number of grants from arts funding agencies, individual donations, and membership fees paid by hotspot venue owners. The Vancouver-based British Columbia Wireless Networking Society (BCWNS) focuses on social networking and CWN training for community members, with an emphasis on maintaining a network of aid and expertise to support wireless networking initiatives and capacity building in rural, remote and aboriginal communities. Another urban CWN, *Wireless Toronto* (WT), maintains a network of WiFi hotspots deployed in public spaces (parks, public squares, etc.) in Toronto and develops content and multimedia projects to increase local community engagement (Cho, 2006). *Ottawa-Gatineau WiFi* (OG WiFi), one of Canada's newest CWNs, has projects attached to social agencies, housing coops, and shelters that serve low income residents, and is experimenting with using WiFi to build bridges between different linguistic and cultural communities in Canada's bilingual and multicultural national capital region.

In addition to community wireless organizations like ISF and WT, which deploy free WiFi hotspots in public places, a number of other models of community and public/municipal wireless initiatives have recently emerged in Canada. *Wireless Nomad* is a Toronto-based co-operative ISP established in 2005 to develop a community-based and cooperatively managed residential and commercial broadband network using WiFi "mesh" networking technology. The network is financed through fees paid by subscribers, who automatically become members of the WN co-operative, with full membership rights to participate in developing and managing the network. The *Lac Seul Wireless Network* in Northern Ontario uses community-owned wireless backhaul and WLAN technologies to provide band administrators, health and education facilities, and local residents with wireless broadband in the three northen Ontario Indian reserve communities of the Lac Seul First Nation (Middleton, Longford, Clement and Potter, 2006).

Two significant models of municipal WiFi have recently emerged in Canada as well, both of which are being watched closely by other municipalities. The City of Fredericton shares excess

bandwidth from its community-owned broadband fibre network by making it available to residents, businesses and visitors in the form of its free Fred e-Zone wireless internet service (Powell and Shade, 2006; Middleton *et al*, 2006)). Alternatively, Toronto's municipally-owned power utility, Toronto Hydro Telecom, has begun to deploy an ambitious city-wide wireless mesh network that will provide ubiquitous WiFi internet access on a subscription basis ($29/month), with profits to be returned to the city. The Toronto Hydro WiFi plan originated out of a provincially mandated "smart metering" program, which will require the installation of smart electricty meters in all city residences and wireless meter-reading devices on street light poles throughout the city by 2011 (Longford and Clement, 2006; Middleton *et al*, 2006). Other significant municipal wireless deployments in Canada incude Hamilton's *Fibrewired* smart-metering project, Calgary's *Wireless City* initiative (WiTec Alberta, 2006), and a recently completed WiFi mesh networking pilot in the northern Ontario town of Chapleau, conducted in partnership with Bell Canada and Nortel Networks (Township of Chapleau, 2006) . Smaller scale municipal WiFi pilots and deployments have taken place in Ottawa and elsewhere, with major cities like Vancouver and Edmonton seriously considering city-wide networks.

While most community and municipal wireless deployments have taken place in urban areas of Canada thus far, the potential application of CWN models to bring broadband connectivity to rural and remote communities is generating considerable interest as well. In its recently released final report, the federal Telecommunications Policy Review Panel recommended that the federal government reserve the necessary spectrum for such deployments and that it fund the extension of wireless broadband backhaul infrastructure to serve all rural and remote communities that remain without commercial broadband service (Industry Canada, 2006b).

Research on CWNs in Canada

Within the last two years, a number of researchers have begun to study various aspects of community wireless networking in Canada. Powell and Shade (2006) produced one of the first publications to provide a general survey of signficant community wireless initiatives in Canada. Powell, a Ph.D. candidate in Communication Studies at Concordia University, has spent much of the last two years conducting intensive participatory research with Ile Sans Fil. Her work has focused, among other things, on understanding the technical development processes at ISF (e.g. open source software development) as a form of civic and political engagement for its members (Powell, 2006). Cho's 2006 M.A. thesis offers a profile of Wireless Toronto and a detailed ethnography of its members, whom she characterizes, after Florida's "creative class," as part of the city's *"creative civic core"* (Cho, 2006). WT members tend to be young, male, educated, and technically skilled, and are involved in community wireless projects for a variety of reasons, including the desire to develop alternative models of internet access and to use WiFi technology to enrich and engage local communities. Cho argues that the efforts of CWN groups like WT increase what she calls "civic bandwidth". Wong has also recently completed a thesis that explores the feasibility of a neighbourhood wireless network in downtown Toronto (Wong, 2006).

The Community Wireless Infrastructure Research Project (CWIRP) was launched in 2006 in order to conduct the first comprehensive survey of public wireless networking initiatives, models and their impacts on communities in Canada. CWIRP brings together an interdisciplinary team of academic researchers and community and government partners to engage in in-depth case studies of public/community-based wireless initiatives in order to document and assess the various models, best practices and benefits of public wireless infrastructure provision in Canada (Middleton *et al*, 2006). CWIRP's case studies - K-Net (NW Ontario), Wireless Nomad (Toronto), Ile Sans Fil (Montreal) and Fred e-Zone (Fredericton) - represent leading and innovative examples of public/community-based wireless infrastructure deployment in remote and urban community settings in Canada. The CWIRP

project promises to deliver a series of studies that, in addition to enriching the academic research literature on CWNs, will help foster more informed discussion and debate within communities and policy making circles about the nature, benefits and challenges of community wireless infrastructure in Canada and elsewhere.

Open Spectrum, Public Policy, and the Future of Community Wireless Networking

The Case for Open Spectrum

Access to the electromagnetic or radio spectrum is an essential condition of wireless communication, be it via radio, television broadcasting or cellular telephony. This spectrum is the essential medium for all radiocommunication. The physical properties of different frequency bands of the spectrum (e.g. the ability of radio waves to travel long distances or pass through objects, or not) along with their interaction with changing social uses of radiocommunication, combine to make questions of allocating and granting access to the former a complex socio-technical and public policy challenge (Gow and Smith, 2006). As Meinrath and others have recently pointed out, the future development of community wireless networking depends in part on the increasing availability of plentiful, high quality unlicensed or open spectrum. With most CWN initiatives limited to using existing unlicensed spectrum in increasingly crowded, relatively high frequency bands in the 2.4 GHz and 5 GHz ranges, their ability to expand and develop new applications is hindered (Lakshmipathy, 2006; Meinrath, 2005). More worrisome are a number of international policy trends, including an increased emphasis on spectrum auctions and property rights in spectrum, that threaten to undermine efforts to improve access to the open spectrum on which community wireless networking initiatives depend. As Meinrath warns, "wireless technologies and the public airwaves that are this medium's lifeblood are rapidly being cordoned off, made proprietary, and licensed - a process being driven by a desire to maximize profit margins, not serve the public good" (Meinrath, 2005).

Increasing the availability of open spectrum for community wireless networking initiatives finds some basis in human rights and international law. Communication rights and freedom of speech advocates suggest that access to spectrum for the purpose of communicating through radio devices (including WLANs) is a fundamental human right, one that state spectrum licensing regimes are in potential violation of. Article 19, a free speech advocacy group, argues that:

> "freedom of expression is not limited to the right to express oneself; it also includes the right to *seek* and to *receive* information from others… the right to freedom of expression may be exercised *through any media*; it is not limited to traditional media such as newspapers or radio, but also covers any contemporary or future technology used for the exchange of ideas and information, including wireless communication devices." (Article 19, 2005)

While open spectrum advocates recognize some legitimate reasons for licensing requirements – e.g. public safety, national security – they reject licensing schemes as the default position for spectrum management by states. By effectively denying citizens ready access to radio spectrum for the purposes of communication, they argue, spectrum licensing regimes violate their fundamental communication rights.

In spite of the position taken by Article 19 and other open spectrum advocacy groups, the vast majority of states require the owners of radiocommunication systems to be licensed by state authorities. While during the early days of radio there were no such licensing requirements, today virtually every state

imposes some form of licensing requirement on the use of at least some portions of the radio spectrum within its borders. Historically, licensing requirements have been justified on the basis that spectrum was a scarce public resource that had to be carefully managed in order to ensure its efficient use, to minimize harmful interference between systems, and to avoid a tragedy of the "spectrum commons". On the basis of these and other arguments, the licensing of spectrum and radiocommunication systems became the default position of most if not all regulators worldwide.

The Limits of Current Unlicensed Spectrum Allocations

More recently, however, regulators in the U.S., U.K., Europe and Canada have experimented with designating and allocating small slices of the spectrum for "open," "unlicensed," or "license-exempt" use, as part of a broader trend toward the liberalization of spectrum policy and regulation. Beginning in the 1970s and 80s, for example, some regulators began to allow unlicensed operation of radio devices in the Instrument, Scientific, and Medical (ISM) band at 2.4 GHz to accommodate the proliferation of wireless consumer products such as cordless phones, garage door openers, baby monitors, and microwave ovens. More recently, in 2003 member states of the World Radiocommunication Conference (WRC) approved a new allocation of open spectrum in the 5-6 GHz range. Governments in the U.S., U.K. and Canada, among others, are on record as being committed to increasing the amount of open spectrum within their jurisdiction. Aside from the human rights case for open spectrum, arguments in favour of increasing license exemptions for spectrum use include: the greater technical sophistication of radios that operate with more flexibility and that enable frequency sharing, e.g. cognitive radios (Lehr, Merino, and Gillett, 2003); the relatively greater amount of technological innovation in the area of wireless devices using unlicensed spectrum (Snider, 2005); reduced operating costs, which can be passed onto consumers; and the growing use of open spectrum for various community media applications (Best, 2006; Powell, 2006; Snider, 2006a).

In spite of recent experiments with open spectrum, both domestically and internationally, the total spectrum allocated to unlicensed use remains miniscule relative to the amount of licensed, commercial or government/military spectrum allocations, while progress on opening up new frequency bands for unlicensed use has been slow. The International Telecommunications Union (ITU), for example, recently reported that only 55 countries globally had set aside spectrum for unlicensed use as of 2005 (ITU, 2005). Another survey of 75 countries found that just one third made provision for some form of unlicensed use of spectrum (Best, 2006). Of those countries that allow unlicensed use, including the U.S., U.K. and Canada, the proportion of spectrum set aside for such use is miniscule compared to the amounts of spectrum reserved for licensed commercial, military, and other public uses (e.g. public safety, navigation). In the U.S., for example, less than 2 per cent of available radio spectrum is allocated for unlicensed use (New America Foundation, 2003). Snider has argued that, in fact, there is now less unlicensed spectrum available in the more desirable frequency bands below 3 GHz than there was just a few years ago (Snider, 2006b). The U.K. spectrum regulator, Ofcom, currently protects 4.3 per cent of Britain's spectrum for unlicensed use, but has plans to increase this to 6.9 per cent over the next few years (Industry Canada, 2006b). Figures for Canada were not available at the time of writing. With the current and anticipated explosive growth in the use of low power wireless devices, however, open spectrum and community wireless advocates argue that existing government plans for the release of additional spectrum for unlicensed use are inadequate to meet the needs of consumers and communities, and to promote further technological and product innovation in the market for wireless devices that make use of open spectrum.

Unlicensed spectrum currently available, meanwhile, suffers from a number of disadvantages which make its use for community wireless broadband applications less than optimal. Firstly, most

unlicensed spectrum is allocated on a secondary and/or "no interference/no protection" basis, meaning that unlicensed spectrum users and uses are subordinated to primary (typically licensed) ones. No interference/no protection rules dictate that unlicensed spectrum users and radio systems must refrain from causing harmful interference to neighbouring licensed systems while at the same time enjoying no protection from harmful interference inflicted upon them by these same licensed systems. Such subordinate status places unlicensed uses and users at a clear disadvantage and reduces the attractiveness of adopting unlicensed spectrum and the devices and services which make use of it.

Secondly, unlicensed spectrum allocations tend to be in the higher frequency bands, where the propagation characteristics of electromagnetic energy are less favourable for many community wireless applications. Higher frequency radio waves need higher power to travel long distances, have more difficulty penetrating solid objects like buildings, walls and even tree canopies (limiting their use to indoor and line-of-sight applications), and are easily disrupted by weather conditions such as fog and rain. This is especially the case for the newer allocations in the 5 GHz range. As a result, higher frequency ranges are of less utility for some of the more popular and compelling applications of wireless technology, including 'last mile' community and/or municipal wireless broadband solutions (Lakshmipathy, 2006). While the 2.4 GHz bands have more favourable propagation characteristics, the bands themselves are increasingly crowded with devices, many of which are older technologies that do not "play nice," that is, that are less capable of sharing the band without interfering with other systems. Known as "junk bands," frequencies in the 2.4 GHz range are shared by an estimated 300 million consumer devices in the U.S. alone (Lakshmipathy, 2006).

A Digital Dividend? The Digital TV Transition and the Prospects for Increased Open Spectrum

Having said this, open spectrum advocates have identified a potential opportunity for the opening up of new unlicensed spectrum as a result of the transition from over-the-air analogue TV to digital television (DTV). Analogue TV broadcasting has absorbed large quantities of prime, low frequency spectrum for many decades, due to the necessity of maintaining wide swaths of empty spectrum between channels – so-called "guard bands" or "white space" – in order to eliminate interference between channels (Calabrese and Scott, 2005). With the DTV transition, many countries are poised to reap a "digital dividend" in the form of unused spectrum formerly assigned to TV broadcasting; low frequency spectrum that is ideal for wireless broadband applications. In the U.K. for example, Ofcom states that roughly one quarter of the prime, low frequency spectrum currently allocated to TV broadcasting will become available for reassignment (Ofcom, 2006). In the U.S., the F.C.C. has acknowledged the potential of the DTV "digital dividend" as a potential solution to the urban/rural broadband divide and has identified the expeditious release of portions of the analogue TV "white space" for unlicensed use as an F.C.C. priority. Open spectrum advocates in the U.S. have applied political pressure on Congress and the F.C.C. to implement the necessary legislation and regulations to open up portions of this spectrum for unlicensed use (Snider, 2006b). Canada has yet set a fixed date for completion of the DTV roll-out in its jurisdiction and continues to issue licenses for analog TV. As of 2006, a mere 24 of 723 TV stations (3%) have been authorized for digital broadcasting. Broadcasters are in no hurry to rush the DTV and it appears likely that analog TV spectrum in Canada will remain encumbered and unavailable for reallotment well after the U.S. completes its DTV in 2009, which will slow the introduction of new wireless services and applications (Rawat, 2006). Having said that, the influential federal Telecommunications Policy Review Panel has recommended that Canada facilitate greater access to licensed and unlicensed spectrum, however without making any explicit reference to or recommendations regarding Canada's DTV plans. In the Panel's view:

> It should be a goal of Canadian spectrum policy to ensure that adequate licensed and licence-exempt spectrum is made available in a timely fashion to permit increased choice, encourage innovation and facilitate the deployment of advanced fixed and mobile wireless services. (Industry Canada, 2006b)

However, without an effort at political and popular mobilization around opportunities like the DTV transition, as has been witnessed in the U.S., there is little guarantee that Canada's DTV and spectrum allotment plans will align with the priorities of open spectrum advocates and the interests of community wireless networks.

The following section provides and overview of the existing institutional, legislative and regulatory provisions for radiocommunication and spectrum policy in Canada, with a focus on licence-exempt spectrum use and its implications for community wireless networks.

Radio Spectrum Policy & Regulation in Canada

Governance

Radio spectrum policy and regulation in Canada are the responsibility of the federal Minister of Industry, who is empowered to set spectrum policy and regulations through the federal *Radiocommunication Act*. Section 5 of the Act identifies the Minister's role in "ensuring the orderly establishment or modification of radio stations and the orderly development and efficient operation of radiocommunication in Canada". Section 5(1) enumerates the Minister's powers, which include; issuing radio, broadcasting, and spectrum licenses, as well as fixing terms and conditions associated with such licenses; setting and enforcing observance of licensing terms and conditions; planning and allocating spectrum usage; setting and enforcing technical standards; and defending Canada's spectrum interests internationally .

Under the direction of the Minister of Industry, spectrum policy and regulation are implemented through the Spectrum Management and Telecommunications (S/T) Sector of the Department of Industry Canada. The S/T Sector "facilitates access to the radio frequency spectrum by issuing authorities for its use, securing Canada's access to it through international negotiations and by ensuring its continued health, in Canada, through the preparation and enforcement of standards" (Industry Canada, 2006c). Three departmental branches share these responsibilities: the Radiocommunications and Broadcasting Regulatory Branch (DGRB); the Telecommunications Policy Branch; and the Spectrum Engineering Branch.

As a resource that crosses international boundaries, radio spectrum is also subject to international governance and regulation. Canada is actively involved in a number of international bodies with concerns in spectrum policy and allocation, including the International Telecommunications Union (ITU), the Inter-American Telecommunications Commission, the World Radio Conference (WRC), and the World Trade Organization (WTO), in order to influence, advance and promote Canadian interests in use of the radio spectrum.

Spectrum policy and regulation within Canada is also heavily influenced by developments in the United States. Access to the U.S. market is vital to Canada's economic interests. The small size of Canada's domestic market in wireless products and services relative to the U.S. market demands that Canada and its domestic firms generally conform to U.S. standards and policies, for reasons of economies of scale. Canada follows developments in U.S. spectrum policy, equipment certification, and technical

standards closely, and has moved deliberately to harmonize Canadian policy, regulation and standards as closely as possible with those of the U.S.

Industry Canada regulates radiocommunication and the use of radio spectrum in two major ways: by requiring that radiocommunication devices be certified according to specific technical standards and performance requirements aimed at enabling spectrum sharing and minimizing interference between devices and systems; and by managing the use of radio spectrum in Canada through a system of frequency allocation, assignment and licensing (Gow and Smith, 2006).

Spectrum Management – From Administrative to Auction-based Licensing

In addition to licensing radio communication devices and systems, Industry Canada also manages and allocates the radio spectrum as a public resource. Historically, the Department and its predecessors operated on an administrative model, in which licenses were granted on a first-come, first-served basis, or, in cases where demand exceeded supply, on a competitive basis. In either case, licenses were granted on the basis of an administrative review of the applicants' proposed business plan, technology, and services, and the anticipated social and economic benefits to Canadians – a process often referred to as spectrum licensing "beauty contests". Departmental staff would conduct the evaluation and make recommendations to the Minister, who had ultimate authority to grant licenses.

In 1996, the *Radiocommunication Act* was amended to give the Minister of Industry the authority to conduct spectrum auctions as a means to allocate new spectrum licenses, as part of a broader shift toward market forces in the regulation of Canada's radio and telecommunications system. The introduction of spectrum auctions also reflected the government's desire to maximize the potential return to taxpayers for an increasingly valuable resource, particularly at a time when the federal government was grappling with large budget deficits, and to harmonize Canada's approach to spectrum allocation with that of the U.S..

Industry Canada's 2001 *Framework for Spectrum Auctions in Canada* lays out the general policy and conceptual framework for conducting spectrum auctions in Canada. The main principles contained in the framework are as follows:

- All auctions will be preceded by a full public consultation, with bidders having the fullest possible knowledge of the spectrum at issue and the auction procedures and rules prior to the auction.

- Licences will be available in geographical areas based on Statistics Canada Census Divisions and Subdivisions.

- Licensees will be given the maximum possible flexibility in their choice of services and technologies, with limits generally only for interference management purposes.

- Licensees will be allowed to transfer their licences in whole or in part (in both bandwidth and geographic dimensions) to eligible third parties.

- Licences will be assigned for an initial 10-year term, with a high expectation of renewal for subsequent 10-year terms.

- The Government will continue to possess all sovereign rights necessary to implement any required reallocation at any time, as per section 40 of the Radiocommunication Regulations. Any reallocation would only take place after full consultation.

- Payment of winning bids will be required in a lump sum amount a short period after the close of the auction.

- A simultaneous ascending auction format will be used.

Note: See also 1999 Spectrum Release Plan

Industry Canada Regulations for License-exempt Radiocommunication Devices and Spectrum Usage

The following describes the policy and regulatory provisions for licence-exempt radio devices and frequencies in Canada, with an emphasis on those related to the ownership and use of license-exempt WLANs.

Regulations Governing License-exempt Equipment & Its Use

Under the *Radiocommunication Act*, the use of almost all radiocommunication devices requires a licence, which must be obtained from Industry Canada. However, IC has allowed an exception to this requirement for the purchase and use of radio devices that operate at low power levels and within specially designated frequency bands. Users of LPDs specifically designed to operate within the 2.4 GHz and 5 GHz bands are exempted from the need to obtain a radio license.

Industry Canada designates and regulates wireless devices such as cordless telephones, baby monitors, walkie-talkies, garage door openers, and wireless local area networks (WLANs) or WiFi networks as ***low-power licence-exempt radiocommunication devices (LPDs)***. IC defines LPDs as "licence-exempt low-power radiocommunication devices … which have intentional and unwanted emissions of very low signal levels such that they can co-exist with licensed radio services." Users of such radiocommunication devices designed to operate in the 2.4 GHz and 5 GHz frequency bands, in particular, are exempted from the need to acquire a radio licence. Industry Canada recognizes the growing popularity of and demand for LPDs and applications associated with them on the part of citizens, consumers and businesses. Industry Canada has begun to explore possibilities for opening up new spectrum bands for license-exempt use.

Operators of licenced radio devices are required to provide Industry Canada with detailed technical information, to submit to interference and operational assessments, and to pay an annual licence fee. The operator's radio licence specifies the station's transmitting and receiving frequencies, operating parameters, and location and/or area of operation. Users of LPDs are exempted from these requirements.

Licence-exempt status is not dependent on power level but, rather, on whether or not the device has been tested, certified and found in compliance with IC technical standards, and on whether or not it operates using spectrum specifically designated as licence-exempt.

Licence-exempt Does Not Mean Unregulated

While LPDs and their use are exempted from IC licencing requirements and procedures, they are otherwise subject to all other relevant provisions of the *Radiocommunication* and *Telecommunications Acts*, among others. All radiocommunication devices, including LPDs, must comply with relevant IC policies, regulations and technical standards before they can be manufactured, imported, sold or used in Canada. LPDs are regulated and certified with respect to a number of criteria including transmission power level and capacity to cause interference. Device compliance must be demonstrated by the manufacturer, in most cases, through a certification process conducted either by IC or an authorized certification body. In other words, the exemption from the requirement to hold a radio licence is a conditional one resting on the use of compliant equipment and designated spectrum.

The *Radiocommunication Act* empowers Industry Canada with the authority to regulate radiocommunication in Canada, including authorization of the use of radio devices. All licence-exempt radio equipment must meet specific Industry Canada regulatory requirements and technical standards before it can be imported, sold or used in Canada. The process whereby equipment manufacturers demonstrate compliance with Industry Canada's technical standards is referred to as *certification*. Industry Canada's Certification and Engineering Bureau provides up-to-date information on all radiocommunication equipment certified for use in Canada. Certification information for specific types of radio devices can be obtained directly by reviewing Industry Canada's Radio Equipment List (REL) database or by contacting the Bureau.

The technical standards relevant to most licence-exempt radio devices are found in either of the following documents:

- **Radio Standards Specification – General (RSS-Gen) Issue 1, September 2005 - *General Requirements and Information for the Certification of Radiocommunication Equipment*** - sets out general requirements and provides information for the certification of radiocommunication equipment. Section 7 of RSS-Gen sets out the requirements for Low-power Licence-exempt Radiocommunications Devices. Document to be used in conjunction with other Radio Standards Specifications (RSSs) specifically relevant to the equipment for which certification is sought.

- **Radio Standards Specification 210 (RSS-210), Issue 6, September 2005 *Low-power Licence-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment***, sets out certification requirements for low-power licence- exempt radiocommunication devices that are Category I equipment.

- **Radio Standards Specification 310 (RSS-310), Issue 1, September 2005, *Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category II Equipment***, sets out standard requirements for low-power licence-exempt radiocommunication devices that are certification exempt.

Interference – "no interference – no protection"

One key regulatory concern for LPDs is the problem of radio interference. While operating a license-exempt LPD has certain advantages over licenced alternatives, including low cost and convenience, LPD owners and users are afforded less protection from receiving radio interference while they remain obligated *not* to cause interference to neighbouring licenced frequencies and services. Radio interference often results from signals emitted by devices (e.g. cordless phones and microwave ovens)

operating in the same licence-exempt bands, or by devices and services operating in neighbouring licenced bands. Interference can result in diminished radio network performance and outright system failure.

While IC's licencing procedures provide licenced spectrum users some assurance of interference-free operation, licence-exempt radio devices operate on a strict "*no-interference, no-protection*" basis in relation to all other radio systems. In other words, licence-exempt LPDs are prohibited from causing interference to other devices and services, while being unable to claim protection *from* any interference that they may receive. While Industry Canada reserves investigative and enforcement powers for protecting licenced devices and services from interference, it does not normally investigate reports of radio interference affecting licence-exempt devices and services.

Industry Canada normally relies on mandated power limits and equipment design in order to reduce the incidence of interference between licenced and licence-exempt equipment in particular. However, it does give priority to licenced devices and services when interference occurs. If a licence-exempt system causes interference to a licenced one, the former may be required to cease operation or submit to equipment modification and re-certification to ensure that it will no longer cause interference. In the event that a licence-exempt system receives interference from a licenced one, the former may identify and contact the operator of the latter in order to resolve the interference problem amicably, although the licenced operator is under no legal obligation to do so and IC offers licence-exempt LPD users no other recourse. In cases where interference arises between licence-exempt devices and users, Industry Canada gives no priority to one over another, and encourages the LPD owners to resolve interference problems with "goodwill and a spirit of mutual cooperation". The are technical limits to resolving such problems, however, as not all devices (particularly older ones) are sophisticated enough to "play nice" and share frequencies. Industry Canada relies on technical specifications for LPD equipment that enable devices to share frequencies while minimizing interference. Experience among LPD users, however, shows that such an approach is less and less effective as more and more LPDs crowd the licence-exempt bands.

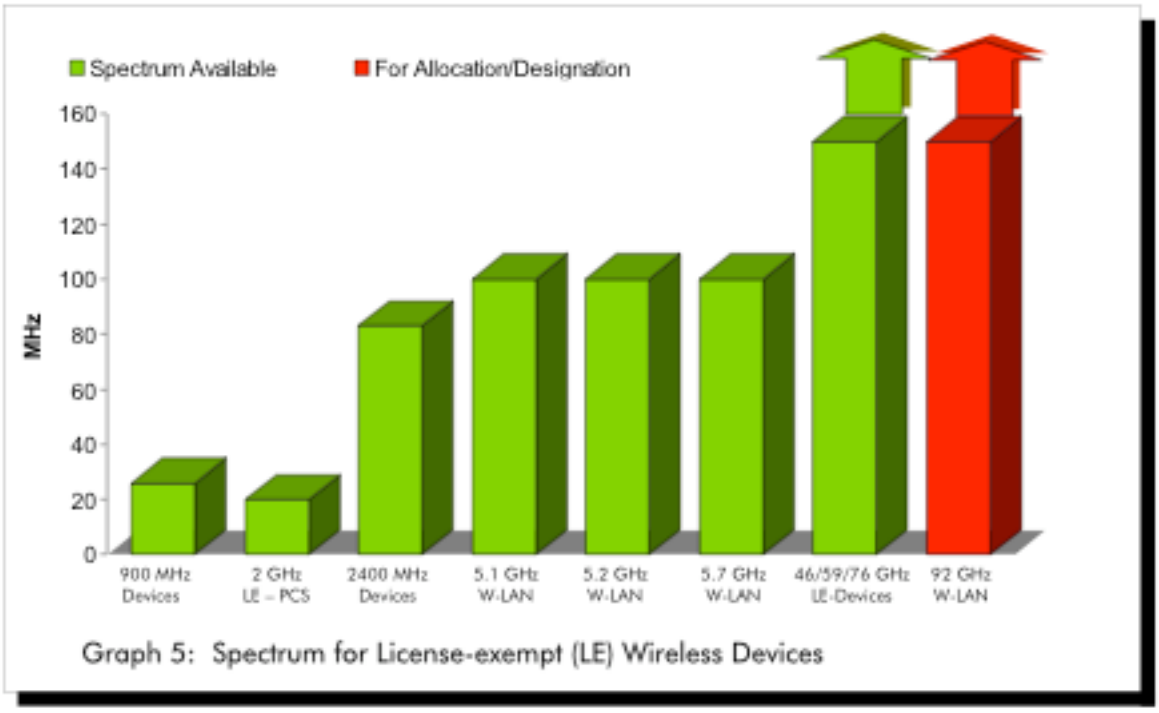
Spectrum Utilization Policy for WLAN Operation in Licence-exempt Bands

Over the years, Industry Canada has designated a number of frequency bands as spectrum for licence-exempt (LE) devices or systems and is considering further spectrum releases for licence exempt use (Industry Canada, 2001c). The following are some of the main licence-exempt frequency bands in Canada:

- **902-928 MHz (see SP-896 MHz)**
- **1910-1930 MHz (LE-PCS) (see SP-1910 MHz)**
- **2400-2483.5 MHz (see SP-2285 MHz)**
- **5150-5250 MHz, 5250-5350 MHz and 5725-5825 MHz (see SP-5150 MHz)**
- **59-64 GHz (see SP-47 GHz)**
- **46.7-46.9 GHz and 76-77 GHz (see SP-47 GHz)**

The Department consults on the potential designation of additional licence-exempt spectrum.

Graph: Currently Available and Anticipated Future Licence-exempt Spectrum in Canada



Source: Industry Canada (2001) *RP-020 2001 Edition (December 2001) - Guidelines on the Licensing Process and Spectrum Release Plan (2001 Edition)*, Spectrum Management and Telecommunications Policy, Radio Systems Policy.

Industry Canada has set aside two frequency bands for license-exempt radiocommunication with particular relevance to wireless local area networks (WLANs): 2.4 GHz and 5 GHz. Industry Canada's spectrum utilization policies set out the technical and operational requirements for services in these bands. The following sets out the requirements for WLAN operation in each of these bands.

SP-2285, June 2001 - Revisions to the Spectrum Utilization Policy for Services in the Frequency Range 2285-2483.5 MHz

2400-2483.5 MHz

In its June 2001 *Revisions to the Spectrum Utilization Policy for Services in the Frequency Range 2285-2483.5 MHz,* Industry Canada designated the 2400-2483.5 band for license exempt use on a no-interference/no protection basis by low power radio devices, including WLANs, and microwave transmitters, in order to encourage their proliferation and use so that Canadians will benefit from the services that they can potentially support, including wireless internet access. According to Industry Canada: "This arrangement of spectrum policies is expected to facilitate wireless communications services including access applications for connecting public institutions such as schools and libraries with high speed Internet" (Industry Canada, 2001a; 2001b). An additional concern was the need to harmonize spectrum utilization policies for the band with those of the U.S. in order to take advantage of the economies of scale of the larger U.S. market for Canadian equipment manufacturers (Industry Canada, 2001a; 2001b). Devices operating within the band must be compliant with RSS-210 and conform to regulations governing power limits etc.

The following describes the technical parametres for the operation of WLAN and other devices within the 2400-2483.5 MHz band[1].

Industry Canada's *SP-2285* decision opened up the 2400-2483.5 band for use by IEEE 802.11b and 802.11g networking devices (WLANs). The maximum EIRP is 4 Watts for point to multi point networks. Point to point networks do not have a restriction on antenna gain. All bands are limited to 1W output from the transmitter.

2400-2450MHz (Channels 1-8)

Under the old Industry Canada rules, use of 2400-2450Mhz was restricted to indoor use only (outdoor use required a license). Protection to licensed users was withdrawn in July of 2002.
2400-2450MHz is also used by some cordless telephones, motion sensors and microwave ovens. Amateur Radio operators also use this portion of the band.

2450-2483.5MHz (Channels 9-14)

Channels 9-14 (2450-2483MHz) were the only channels that may be used outdoors without a license. These channels are still preferable to use for outdoor and long range point-to-point links.

SP 5150 MHz, Issue 2, April 2005 - Spectrum Utilization Policy, Technical and Operational Requirements for Licence-exempt Wireless Local Area Networks and Other Radio Services in the 5 GHz Range

In April 2005, Industry Canada released a new spectrum utilization policy for license-exempt radiocommunication in the 5 GHz range, updating the previous policies for the band last amended in 1999. The new policies for the range dealt with, among other things, regulations governing the use of WLANs so as encourage the use and development of licence-exempt applications while minimizing interference with existing services and uses within the band, including Earth exploration-satellite (active) service, space research (active) service and radiolocation service. Since 1999, there has been a significant increase in the development of and demand for WLAN products and applications. Wireless broadband applications for 'last mile' and wireless rural connectivity are seen as especially promising. The 2005 policies are the result of recommendations coming out the June 2003 World Radiocommunication Conference (WRC-03) and subsequent public consultations conducted by Industry Canada. The following sets out the main requirements for WLAN operation in the various bands.

SP 5150 MHz, Issue 2, April 2005 allocates spectrum for licence-exempt WLANs in a number of sub-bands and specifies the power limits and interference mitigation requirements for each. The 5GHz spectrum (5150-5350 MHz and 5725-5825 MHz) is used by 802.11a technologies. This band allows for speeds over 54MBps+ and are ideal for backbone applications. The policy permits the operation of licence-exempt WLANs in the following sub-bands: 5150-5250 MHz, 5250-5350 MHz, 5725-5825 MHz and 5470-5725 MHz, to be operated on a non-interference / non- protection basis with respect to licensed

[1] The information presented here is based on descriptions of the technical parametres for operating licence exempt radio equipment in the band as interpreted by the British Columbia Wireless Network Society (BCWNS), available at: http://www.bcwireless.net/moin.cgi/Regulatory?highlight=%28CategoryLegalStuff%29

services. The following specifies the technical and operational requirements for devices operating in the band.[2]

5150-5250 MHz (Lower band)

The band 5150-5250 MHz is currently allocated on a primary basis to aeronautical navigation and fixed-satellite services. WRC-03 added a global allocation to the mobile service in the band for wireless access systems including WLANs on a no interference / no protection basis. Technical limits were imposed in order to ensure compatibility with other services. Research has demonstrated the feasibility of spectrum sharing among these different devices and services within the sub-band.

In the band 5150-5250 MHz, the maximum e.i.r.p. of a WLAN device shall be limited to 200 mW (further limited to 10 mW in any 1 MHz). All devices in this band must use an integral antenna (ie: no external antenna). The operation of the WLAN is restricted to indoor-only.

5250-5350 MHz (Middle band)

This band can be used for point-to-multipoint and point-to-point networks both indoors and outdoors. The maximum EIRP permitted is 1W, 250mW from the transmitter.

5470 - 5725 MHz (Upper band)

The band 5470-5725 MHz may be used for both indoor and outdoor WLAN operation. WLAN devices shall be limited to a maximum e.i.r.p. of 1 W with a maximum transmitter power of 250 mW. Each device must have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. in order to provide, on average, a mitigation factor of at least 3 dB on the maximum average output power of the system. Alternatively, if TPC is not used, then the maximum permitted e.i.r.p. limit shall be reduced by 3 dB. The maximum permitted e.i.r.p. limit is 1W with a corresponding maximum e.i.r.p. density of 50mW/MHz in any 1 MHz band. Therefore, devices with maximum e.i.r.p. of less than 500 mW are not required to implement TPC.

Other Regulations: Telecommunications, Public Health, and Antennae

Other areas in which LPDs and their owners are subject to regulation include telecommunications, public health, and the use of antennae and supporting structures.

Telecommunications

LPD owners and users may also, under certain circumstances, find themselves subject to regulations and requirements stipulated in the *Telecommunications Act*. If, for example, an LPD device is used to offer "telecommunications services to the public for compensation," its owner may fall within the definition of a "telecommunications common carrier" as per Sec. 2(1) the *Telecommunications Act*. Other language in

[2] The information presented here is based on descriptions of the technical parametres for operating licence exempt radio equipment in the band as interpreted by the British Columbia Wireless Network Society (BCWNS), available at: http://www.bcwireless.net/moin.cgi/Regulatory?highlight=%28CategoryLegalStuff%29

the *Act* referring to "transmission facilities" and "telecommunications services" could potentially encompass LPDs and their owners and require them to obtain a "Canadian carrier" licence from the CRTC. Limits on foreign ownership of telecommunications carriers would also potentially apply. The applicability of such regulations appears to hinge on whether or not an LPD is being used to offer services for compensation, which means that community wireless networks offering free internet access would be unaffected.

Public Health

For public health reasons, licence-exempt devices must comply with Industry Canada's radio frequency exposure compliance standard RSS-102, *Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)*. For the purpose of regulating exposure to radio frequency fields, Industry Canada has adopted Health Canada standards as laid out in the latter's guideline document: *Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 KHZ to 300 GHZ - Safety Code 6.*

Technical requirements for the regulation of ***radio frequency exposure (including licence-exempt) with respect to human health*** are specified in the following documents:

- **Radio Standards Specification 102 (RSS-102) Issue 2, November 2005 - *Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)***, sets out the requirements and measurement techniques used to evaluate radio frequency (RF) exposure compliance of radiocommunication apparatus designed to be used within the vicinity of the human body.

- **Health Canada (1999) *Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 KHZ to 300 GHZ - Safety Code 6***

Antennae and Supporting Structures

In addition, licence-exempt radio systems using antenna supporting structures may also be subject to Industry Canada procedures governing their installation and impacts on air navigation, the environment, and surrounding communities (see CPC-2-0-03 - *Environmental Process, Radiofrequency Fields and Land-Use Consultation* and CPC-2-0-02 - *Antenna Structure Clearance*).

Regulations governing ***antennae and supporting structures*** are laid out in the following:

- **Client Procedures Circular – CPC 2-0-02 - *Antenna Structure Clearance*,** provides information concerning the procedures for the approval of proposed radio station antenna supporting structures and for proposed changes to existing antenna supporting structures from a hazard to air navigation point of view.

- **Client Procedure Circular – CPC 2-0-03 - *Environmental Process, Radiofrequency Fields and Land-Use Consultation*,** sets out procedures for users of the radio frequency spectrum which give consideration to the following three areas: (i) the environment; (ii) Health Canada's *Safety Code 6* respecting radio frequency fields and human health; and (iii) land-use consultation.

Recent Policy Developments for Licence-Exempt Spectrum in Canada

Generally speaking, the major trends and developments in Canadian spectrum policy over the last decade include movement toward more flexible and market-oriented approaches to spectrum management (e.g. spectrum auctions), the designation of spectrum to uses rather than users, the development of technology neutral regulations and technical standards, and the release of new spectrum for licence-exempt applications (Industry Canada, 2006b)

Most recently there have been two developments with implications for Canadian policies and regulations governing license exempt spectrum and its use within Canada. The first of these is Industry Canada's 2005 public consultation on a renewed spectrum policy framework for Canada (Industry Canada, 2005e). The second is the series of spectrum policy recommendations made by the Telecommunications Policy Review Panel in its 2006 final report (Industry Canada, 2006b).

Industry Canada's Spectrum Policy Framework Review

The spectrum policy framework review was announced in May 2005 as part of the federal government's broader effort to "bring the Canadian policy and regulatory regimes overseeing the telecommunications and radiocommunication systems up to date to accommodate the increasing demand for wireless products by consumers and businesses" (Industry Canada, 2005f). To launch the review, Industry Canada released a consultation paper entitled, *Consultation on a Renewed Spectrum Policy Framework for Canada and Continued Advancements in Spectrum Management* (Industry Canada, 2005e). Along with a discussion of the overall objectives and guidelines for spectrum management in Canada, the consultation paper invited discussion on a range of questions, options and proposals concerning ways to increase the efficiency of spectrum use, introduce more flexible methods of spectrum allocation and use, and to facilitate access to spectrum for new technologies and services, including advanced wireless services and applications.

Specific topics addressed in the consultation paper include:

- accommodating new technologies such as cognitive radio, software-defined radio (SDR) and ultra-wideband (UWB) technology;
- increasing spectrum-usage flexibility;
- considering granting longer licence terms and secondary market privileges beyond licences that currently have these privileges;
- streamlining the first-come, first-served licensing process;
- adopting policies and procedures to further facilitate the provision of communications in rural and remote areas (e.g. relaxing technical standards of systems in rural and remote areas); and,
- Increasing the availability of licence exempt spectrum. (Industry Canada, 2006b)

With specific reference to licence exempt spectrum, the consultation paper acknowledged the need to make more spectrum available to meet growing consumer and business demand for wireless products and services making use of licence exempt frequencies. In its discussion, Industry Canada also described the Departments general approach regarding the development of spectrum utilization policy for licence

exempt bands as one of harmonization with U.S. and international trends. The paper justifies this approach on the following basis:

> "the Department is of the view that the Canadian market is not large enough in most instances to be able to support the design, manufacture and deployment of products for unique Canadian licence-exempt bands. […] The approach of the Department has been to anticipate the opening of new bands or frequencies for licence-exempt products for major markets such as in the United States or on a worldwide level. The Department then adopts a process to open similar spectrum resources on a timely basis and establishes the technical requirements to certify new consumer products for the benefit of the Canadian marketplace. This process ensures the economies of scale needed for products sold in Canada so that they are available at an affordable cost, and minimizes potential grey markets." (Industry Canada, 2005e)

Other issues discussed included debates about the need for technical regulation and oversight of licence exempt devices and their use, and of the risks of a "tragedy of the commons" scenario in the event that the Department were to forego regulation altogether.

The consulation paper's discussion of licence exempt spectrum concluded with a number of questions, on which stakeholders and memebers of the public were invited to comment. Some of the questions were as follows:

1. **What additional spectrum should the Department make available for licence-exempt devices and what regulatory and technical provisions should be adopted for their use? Does this include consideration of currently licensed spectrum, and if so, what provisions could be adopted to facilitate transition to licence-exempt operation or band sharing between licensed and licence-exempt operation? Would a device registration process provide sufficient safeguards to licensed operations?**

2. **What means could be developed to ensure that licence-exempt consumer equipment in the field operates within established limits (e.g. e.i.r.p, antenna directivity, channel bandwidth, out-of-band emissions) and what flexibility should be permitted?**

3. **Should the Department consider existing or new licence-exempt bands with a view to facilitating longer communications ranges for licence-free devices or system applications unique to the Canadian environment, such as rural and remote broadband fixed wireless access?**

The public comment period on the consultation paper and questions closed September 7, 2005. A total of 29 submissions were received, but to date no analysis of the submissions has been made available by the Department. The Department has yet to release a final report on the results of its review.

Telecommunications Policy Review Panel

In 2005, the Government of Canada launched its first major review of telecommunications policy in almost fifteen years. In March of 2006, after a brief public consultation, the 3-person Telecommunications Policy Review Panel (TPRP) issued its final report, calling for less regulation and increased reliance on market forces in order to promote the growth and competitiveness on Canada's telecommunications industry. Included in the TPRP's report are a discussion of spectrum policy and a number of recommendations regarding spectrum regulation, utilization and management designed to ensure access to sufficient spectrum to meet demand for new wireless services and in order to extend

broadband connectivity to all rural and remote communities in Canada. Among the TPRP's recommendations was an endorsement for releasing more spectrum for licence-exempt applications and use. The recommendations of the TPRP are currently being reviewed by the Conservative government. Early indications are that, along with U.S. policy developments, the TPRP report will exercise a strong influence on the direction of future telecommunications policy making, including spectrum policy, in Canada.

The TPRP expressed concern regarding Canada's status as a relative laggard in the development of markets for advanced products and services in wireless communications, particularly in relation to the U.S. and other OECD countries. Also of concern was the need to complete the task of extending broadband connectivity to rural and remote communities within Canada that remain unconnected. In order to address these and other concerns raised, the TPRP offered the following recommendations regarding spectrum policy and management in Canada for the government's consideration.

- Transfer current spectrum regulatory, licensing, and management functions of the Minister of Industry to the Canadian Radio-television and Telecommunications Commission (CRTC) to ensure a more consistent and unified regulatory approach to wireless and wireline telecommunications. Responsibility for spectrum policy should remain with the Minister;

- ensure that adequate spectrum, including licence-exempt frequencies, is available to meet demand for deployment of fixed and mobile broadband networks across Canada;

- rely as much as possible on market-based approaches to spectrum management;

- promote recovering and "refarming" of previously assigned spectrum that is unused or underutilized to accommodate new services;

- move toward establishment of market-based exclusive spectrum rights (i.e. the ability to buy, sell, lease spectrum holdings) and the elimination of barriers to the development of secondary markets in spectrum;

- streamlining and standardizing licensing processes;

- continuing the use of regulatory approaches to increase the opportunity for Canadians to have an expanded choice of service providers, such as spectrum caps and reservations for new market entrants;

- relaxation of limits on foreign ownership in telecommunications carriers, including wireless services. (Industry Canada 2006b)

Community wireless networking and other open spectrum advocates should welcome the Panel's endorsement of increased licence-exempt spectrum. However, a number of other recommendations, such as the turn to more market-based approaches like spectrum auctions and property rights in spectrum, are hostile to the interests of community wireless networking initiatives. The threat that such approaches pose to community wireless networking have been well documented. The implications of other recommendations, such as transferring the role of regulating spectrum to the CRTC, are less clear. In any event, the full implications of the TPRP's spectrum policy recommendations await detailed analysis by community wireless networking enthusiasts in Canada.

Conclusion

The preceding paper offers a very preliminary treatment of open spectrum policy and regulation in Canada in relation to community wireless networking. In addition to an overview of the status of community wireless networking in Canada, a survey of existing institutions and regulations governing the use of unlicensed spectrum was provided. In the course of this preliminary investigation a number of observations about the spectrum experiences, policy literacy and policy advocacy of Canadian community wireless networks can be offered. There is little if any documentation of the usage of licence-exempt spectrum by community wireless networks in Canada, along with associated challenges (e.g. levels of interference). While there appears to be some familiarity with spectrum policy and regulation pertaining to licence-exempt devices and uses on the part of a handful of networks and their members, there is little indication of spectrum policy advocacy on their part, or of the formation of a constituency for such work thus far. The contrast between the U.S. situation, where community network mobilization and advocacy around spectrum policy has become central to broader media and telecommunications reform campaigns, and the Canadian one invites closer study. Given the stakes for community wireless networks of emerging trends in open spectrum policy and regulation, the interests of the community wireless movement in Canada are not well served by the relative absence of technical documentation and policy knowledge and advocacy concerning licence-exempt spectrum.

In order to help rectify the current situation, CWIRP's future spectrum policy-related research will aim at creating the following resource materials to support community wireless networks in Canada:

- **Bibliography and literature review of academic research and government documents on spectrum policy trends and management regimes, with a focus on implications for community wireless initiatives;**

- **Preparation of popular education materials (e.g. policy/issue briefs) on spectrum policy trends and developments in Canada and the U.S., with a focus on implications for community wireless;**

- **Documentation of spectrum challenges faced by community partners (e.g. spectrum availability, crowding & interference, views on licensed vs. license-exempt);**

- **Policy recommendations to ensure that sufficient, high quality spectrum resources are available to existing and future community wireless initiatives, particularly in light of the recommendations of the TPRP and of Industry Canada's spectrum policy framework review, when complete.**

APPENDIX A

About the Community Wireless Infrastructure Research Project (CWIRP)

The ongoing deployment of public broadband and wireless networks by hundreds of communities and municipalities across North America and around the world (including for example Fredericton, Philadelphia, Toronto, San Francisco, Chicago, London and Paris) constitutes an important development in the evolution of public information and communication technology (ICT) infrastructure. As legislative battles over such networks at the local, state and congressional levels in the U.S. have recently demonstrated (Tapia, Stone, & Maitland, 2005), their deployment is sparking controversy and public policy debate. While governments consider the merits of municipal broadband and wireless networks (Gillett, Lehr, & Osorio, 2004; Strover, 2003), the telecommunications industries in the U.S. and, to a lesser extent, Canada, are attempting to block their expansion via the courts and legislatures (Gillett, Lehr, & Osorio, 2006a). At the same time, public wireless initiatives are flourishing. How can the research community contribute to the discussions around public broadband and wireless networks? What research has been carried out thus far and what are the major findings? What are the major models, benefits and challenges, as well as the risks, of municipal and other community-based wireless deployments? These are questions addressed by a new Canadian research initiative, the Community Wireless Infrastructure Research Project (CWIRP).

CWIRP seeks to better inform current policy debates about the role of communities and municipalities in ICT infrastructure provision. We utilize a variety of methodologies to conduct our research, including institutional and policy analysis and participatory action research. Institutional and policy analyses will draw from political-economic perspectives, broadly defined as studying the relationships between ICT industries and institutions and economic and political systems (Mosco, 1996). We follow Dutton's framework of 'an ecology of games', a model that investigates stakeholders in the policy process, the intended beneficiaries, and the process of policymaking, to examine various levels and agencies of governments, and the role of civil society groups (Dutton, Peltu, & Bruce, 1999). Identification of groups left out of the policy process, and the increasingly active role of public interest groups and citizens is also a focus.

CWIRP Community & Government Partners

CWIRP is a collaborative research project involving research partnerships between the academic co-investigators and both community and government partners. A brief description of each of CWIRP's partners, as well as our major funder, are provided below.

Keewaytinook Okimakanak - K-Net

An initiative of Keewaytinook Okimakanak (KO), a non-profit tribal council in northwestern Ontario, K-Net is an aboriginally-owned and managed community network established in 1994 to provide broadband services and ICT applications (telehealth, education, economic development, and community e-centres) to communities of the Nishnawbe Aski First Nations. K-Net uses satellite broadband, video conferencing, IP telephony, online forums, e-mail, and other web-based communication tools to link First Nations communities and their service organisations. KO was named as Industry Canada's Aboriginal Smart Communities demonstration project in 2000. K-Net also serves as the Regional Management Organization for First Nations School-Net programs across Ontario, and operates telemedicine services in

24 communities. K-Net servers host over 20,000 web pages and 30,000 e-mail accounts, and receive over 100 million hits per month.

K-net uses satellite and terrestrial wireless technologies for backhaul and wireless local loops in many of the communities it serves. CRACIn is conducting fieldwork in a number of communities in the Lac Seul First Nation. The Lac Seul Wireless Network project uses WLAN technology to provide band administrators and local residents with wireless internet access.

Île Sans Fil (ISF)

Île Sans Fil is an all-volunteer bilingual non-profit organization dedicated to the development of a free communication infrastructure to strengthen local communities in the greater Montreal region. Île Sans Fil is both a technical development project and a grass roots community group, involving professionals and students from diverse fields. Île Sans Fil has deployed 130+ free Internet hotspots in public spaces and local businesses (cafes, parks, etc.) in downtown Montreal, which currently have over 28,000 registered users. Open source captive portal software developed by ISF (WiFi-DOG) enables members to disseminate local content (e.g. arts, community news, local events) at its various hotspots.

Fredericton eZone

Wi-Fi in Fredericton, NB is the result of an extension to the fiber network that the City developed in 1999. Addressing issues such as high cost of Internet, necessity of communicating across a dispersed organization, and effectively sharing information and files led to the formation of a City-owned company known as e-Novations to build and manage a fiber network. Fred-eZone is now a free, community-wide Wi-Fi network providing residents, visitors and businesses with mobile broadband access within the city's downtown core.

Wireless Nomad (WN)

Wireless Nomad is a Toronto-based co-operative ISP established in 2005 to develop a community-based and cooperatively managed residential and commercial broadband network using WiFi "mesh" networking technology. The network is financed through fees paid by subscribers, who automatically become members of the WN co-operative, with full membership rights to participate in developing and managing the network. In addition, Wireless Nomad has developed captive portal technology which enables members to post locally-specific content to neighbourhood "splash" pages.

Industry Canada

Industry Canada is the main federal government department with both program and regulatory involvement in the deployment, adoption and use of advanced ICTs in Canada, and has been a long-standing funder of public/community based ICT initiatives in Canada, including SchoolNet and the Community Access Program. More recently, Industry Canada has managed the Broadband for Rural and Northern Development Pilot Program and, along with Infrastructure Canada, the National Satellite Initiative. In addition, radio-frequency spectrum allocation and management, including WiFi, are mandated responsibilities of the Department.

Infrastructure Canada

Infrastructure Canada coordinates federal government efforts focused on cities and communities, and supports infrastructure initiatives across the country. Together with Transport Canada and 16 Crown corporations, the department forms part of the larger Department of Transport, Infrastructure and Communities (TIC). TIC brings together the Government of Canada's activities in supporting the development of communities, the planning of our transportation systems and the renewal of infrastructure. Through collaborative efforts in developing the knowledge base and research networks relating to infrastructure and cities and communities, Infrastructure Canada is also contributing to leading-edge public policy and decision-making. CWIRP's research is funded through Infrastructure Canada's Peer-Reviewed Research Studies (PRRS) Program[3].

[3] Infrastructure Canada (2006) About Us, http://www.infrastructure.gc.ca/index_e.shtml

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