White Paper of CanWISP's Position on the Spectrum Outlook 2018 to 2022

Final Report

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Executive summary

Rapid technological change in the telecoms industry has vastly increased bandwidth and made possible a multitude of new applications for subscribers. However, these applications require ever increasing bandwidth for the provision of services. Globally, there is a 'connectivity deficit' in that citizens in rural and remote communities[1] do not enjoy the same access to broadband services as do those in urban areas as typically, incumbent operators have not found it viable to offer broadband services in those areas.

Globally, governments have recognized the need to address this connectivity deficit through a combination of incentive funding measures, release of spectrum and setting of national broadband accessibility goals. In Canada, all three government levels have adopted measures to improve connectivity to citizens in rural areas.

WISPs are a critical component in the delivery of broadband services in rural communities and have demonstrated their ability to provide broadband service to subscribers with innovative and cost-efficient service offerings. However, the current lack of access to adequate, dedicated spectrum will compromise WISPs' ability to deliver the next generation of broadband services to their subscribers. This an existential threat to Wireless Internet Service Providers' (WISPs) viability.

Currently, WISPs do not really have economically-viable access to secure, licensed spectrum save a few exceptions in the 2.3 or 3.5 GHz bands. In those bands, the licensing is through primary or subordinate licensing from operators which could have other plans for the spectrum. The amount of spectrum available to WISPs in the ''lightly licensed '' 3.65GHz band is already limiting WISPs ability to offer competitive service packages - much less the next generation of broadband services. WISPs access to unlicensed spectrum in the 900MHz, 2.4GHz and 5 GHz bands is also compromised by the intensification of other uses and thus, the provision of commercial-grade services by WISPs to their subscribers will become increasingly difficult.

In absence of a dynamic, competitive WISP sector in provision of telecommunications services in rural communities, the introduction of new and innovative services tailored to individual communities will be delayed, the price of broadband services will be significantly higher than in urban areas, and overall access to broadband services lower.

ISED needs to recognize the vital role WISPs play in delivering broadband services in rural areas and provide a regulatory framework that encourages investment, technology evolution and equitable access to spectrum. First and foremost, WISPs require additional secure, licensed spectrum. In the short to medium term, LTE bands 42 and 43 (covering the spectrum

[1] Source: Connect to innovate Program https://www.canada.ca/en/innovation-science-economic-development/programs/computer-internet-access/connect-to-innovate.html In this paper, we use both 'rural and remote and 'rural' interchangeably.

from 3.4 to 3.8 GHz) provides the best solution given the technological ecosystem and service offerings of WISPs.

Overall, WISPs are requesting that CanWISP provide favorable consideration for access to spectrum in the following bands:

1. LTE Bands 42/43
2. 3.65Ghz
3. Sub 1.0GHz bands
4. Subordinate Licensing and new Backhaul Spectrum pricing
5. Tier 5 for auctions

Most WISPs are using the lightly-licensed 3.65 GHz that is part of LTE band 43. The combination of access to a lightly-used frequency band combined with the ubiquitous LTE ecosystem and multiple proprietary FWA (Fixed Wireless Access) solutions has been instrumental in allowing WISPs to achieve their business plans.

In releasing new spectrum bands or reworking existing ones through the 2018 - 2022 timeframe, ISED should consider the role played by WISPs in bridging the connectivity deficit in rural areas and consequently, ensure they continue to have access to spectrum that is part of a commercial ecosystem. Given the characteristics of their rural and remote service areas, WISPs could accomplish a great deal for their subscribers with premium spectrum (below 1 GHz). As a general principle, ISED should consider the needs of WISPs in developing the licensing frameworks for bands that potentially address the connectivity deficit of citizens in rural and remote needs.

ISED should actively encourage subordinate licensing by operators and other primary license holders and harmonize the primary and subordinate license conditions. ISED should consider establishing a tracking and arbitration process to assist WISPs in accessing subordinate spectrum under reasonable terms and timeframes. ISED should also move forward quickly on its initiative to establish market-based fees for backhaul spectrum; the current regime based on speed rather than bandwidth does not foster an effective use of the resource.

Finally, as auctions are the primary vehicle for spectrum licensing, ISED should enable participation by WISPs and other smaller, ‘spectrum-poor’ service providers using simplified auction formats, Tier 5 service areas, spectrum caps and reserve prices and license conditions that reflect the economics of the rural telecoms markets.

ISED should adopt a permanent broadband funding program and ensure that the funding rules enable smaller service providers opportunities for funding equal to those of the national operators. ISED should consider funding cost efficient last mile solutions as well as the fiber – based backbone projects which tend to favor projects by the national operators.

ISED should work closely with CRTC’s funding in order to maximize the impacts in rural areas.

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1. INTRODUCTION

The evolution of wireless telecommunication technologies from 1 through 4 'generations' of technology[2] has resulted in significant improvements in connectivity, innovation in data-based wireless services and a general lowering of prices for basic services. This in turn, has driven demand for high bandwidth applications and 'anywhere, anytime' accessibility. In this vein, it is anticipated that the rollout of 5G fully-integrated wireline/wireless networks[3], and subsequent adoption of 5G technologies will transform key sectors in the global and Canadian economies and improve the quality of life for its 'digital citizens'.

However, a counterpoint to this rapid evolution of broadband technologies, has been the challenges of ensuring adequate broadband connectivity to ensure participation and opportunities in the 'digital economy' for citizens of rural areas - similar to those in metropolitan areas. These challenges have been widely recognized by governments globally and addressed as a public policy priority in concert with private sector service providers.

In continental-sized countries such as Canada, the US, and Australia, it has been recognized that traditional telecommunications service providers would not have viable business models to provide broadband service in rural areas of low population density and consequently, positive policy, funding and regulatory frameworks would be necessary to attract innovative, new services and service providers. The experience of Australia and the US is analyzed in Section 3.1. below.

The creation of the 802.11[4] committee and the release of Wi-Fi for consumers in 1997[5] coupled with the availability of spectrum in the unlicensed and licensed bands, enabled the entry of Wireless Internet Service Providers (WISPs) as a new service provider category[6]. This 'democratization' of wireless data equipment enabled entrepreneurs to bring innovative, low cost 'broadband' (over 2 Mbps) services to citizens.

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[2] Definitions according to 3rd Generation Partnership Project (3GPP) which is a group of 7 Telecom technical groups across the world. 3GPP specification which covers all GSM (including GPRS and EDGE), W-CDMA (including HSPA) and LTE (including LTE-Advanced and LTE-Advanced Pro) specifications, and the emerging 5G specifications. While 1G through 4G are wireless technologies, 5G promises a seamlessly integrated wireline/wireless network technology.

[3] 5G standard is to be ratified/released/frozen by 3GPP in September 2018, with equipment likely available sometime in 2019 and first deployments launching in 2020. See: http://www.3gpp.org/specifications

[4] http://tweakyourbiz.com/technology/2014/07/14/wifi-networks-evolution-years/

[5] https://purple.ai/history-wifi/

[6] Key unlicensed bands made available for WISPs include the 900MHz, 2.4GHz, 3.5GHz and 5GHz while the 3.65GHz is the main band where WISPs hold either primary or subordinated licenses.

As facilities-based service providers, WISPs have built cost-efficient, fixed wireless access (FWA) networks for citizens in rural and remote communities. WISPs are often the sole high-speed Internet service provider in these communities as incumbent operators have not upgraded their networks to provide broadband connectivity. WISPs have been innovative in the introduction of new technologies and services and are recognized for their efficient use of spectrum.

Today, CanWISP estimates that there are approximately 150 WISPs in Canada, of which some 53 are members and 100 non-members[7]. The 53 CanWISP members provide service to around 160,000 subscribers in hard to reach rural and remote areas across 8 provinces.[8] We estimate the approximately 100 non-member WISPs service another 150,000 subscribers for a total of some 310,000 subscribers and revenues of over $100M a year. More than 98% of the connections are wireless. Total subscribership for WISPs range from a few hundred to 25,000.[9] While the total subscribership of WISPs is a relatively small portion of total Canadian Internet subscribers, WISPs service a significant portion of subscribers in regional and remote areas and are thus essential to meeting the national broadband goals of 50 Mbps / 10 Mbps.

While the evolution of broadband technology over last 20 years has improved the situation allowing most residential and business subscribers in rural communities to move away from dial-up access, the ever-higher requirements of broadband services has meant that access to those services for citizens in rural and remote communities lags behind those in metropolitan areas. Sparsely populated areas attract less investment from national carriers. The ever-increasing broadband requirements for applications and underinvestment in rural areas means that citizens in rural and remote areas are increasingly falling behind their urban counterparts. WISPs have invested in building infrastructure and putting in place creative solutions in many rural and remote communities in an attempt to bridge this gap.

The federal government has recognized the infrastructure deficit and in particular, the needs of rural communities for better transportation and communication networks. In particular, in December 2016, the CRTC adopted 50 Mbps / 10 Mbps download / upload target speeds and unlimited data[10], as broadband connectivity goals for all Canadian residential internet service customers. ISED has also funded improved broadband connectivity through the Broadband Canada grant program in 2011-2012, the 2015 Connecting Canadians and the 2017 Connect-

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[7] CanWISP members based on membership data for members. Non-members based on information from equipment suppliers, assessment of competitors, ISED, etc. Source: CanWISP Board.

[8] BC, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia. Source: CanWISP membership list.

[9] Excluding Xplornet.

[10] ISED's CTI program specifies 5/1 Mbps as a target for last mile: "A portion of Connect to Innovate program funds also support "last-mile" connectivity projects to households, at speeds of at least 5 Megabits per second (Mbps), where gaps continue to persist." Source: https://www.canada.ca/en/innovation-science-economic-development/programs/computer-internet-access/connect-to-innovate.html

to-Innovate funding windows. In setting the connectivity goals and in the selection of service providers for funding, ISED has recognized the role of smaller ISPs and WISPs in ensuring the delivery of broadband services at the target speeds in rural communities.

On one hand, WISPs have been faced with the burgeoning requirements for spectrum in order to provide services at competitive speeds while on the other, WISPs have witnessed the successive degradation of licensed-exempt bands. The 900MHz, 2.4GHz, and the 5GHz are progressively becoming more crowded and thus less reliable for the provision of commercial-grade wireless services. The WISPs increasingly must rely on the lightly-licensed 3.65MHz band or try to subordinate unused licensed spectrum. However, as the lightly-licenced spectrum is not exclusive, there is a risk associated with its use as licences are renewed every year, which increases the financial risk for investors. Cases where WISPs were successful in becoming primary or subordinate licensees are currently the exception. For instance, because of the uncertainty created by upcoming review of the 3.5GHz band by ISED and the renewal of 3.5 GHz licences on a yearly basis until the review, primary licence holders are hesitant to enter into subordinate relationships. The uncertainty also deters service providers from upgrading their existing equipment and investing in the expansion of broadband to currently underserved areas.

This makes delivery of new, high-bandwidth applications such as video streaming, high speed data, application of sensor technology, Internet of Things, etc. difficult for WISPs. Even the current access to bandwidth in the lightly-licenced 3.65GHz band could be compromised as primary licensees – frequently the incumbent operators, have also indicated interest in this band for their own 5G applications[11]

Secure access to adequate spectrum as a critical resource is an existential issue for WISPs. Without adequate access, WISPs will no longer be able to provide innovative services at competitive speeds and prices. This will compromise WISPs viability as service providers and the access to broadband services to their subscribers in rural communities. The telecommunications market in rural communities will become increasingly concentrated with attendant lessening of choice in service providers, slower rollout of innovative services tailored to the individual communities and overall increase in prices for subscribers. This trend risks compromising ISED's core policy goals of accessible and affordable broadband services to all Canadians as digital citizens and notably, the attainment of 50Mbps/10Mbps speeds for all residential users across Canadians in rural and remote areas.

It follows that ISED as both policymaker and spectrum regulator, needs to provide WISPs with access to adequate, licensed spectrum in order ensure this vital category of competitive

[11] TELUS has announced its interest in using 3.5G bands for its 5G applications. Source:

https://www.telus.com/en/about/news-and-events/media-releases/scorching-fast-5g-performance-achieved-in-live-environment-as-telus-successfully-tests-ghz-spectrum

service providers continues to provide innovative and affordable services to Canadians in rural and remote areas.

In this White Paper, we demonstrate the critical role – current and potential of WISPs in providing innovation and competition in the telecommunications market and in particular, in attaining ISED's and CRTC's common goal of 50Mbps/10Mbps for citizens in rural and remote communities. The White Paper is based on primary and secondary research including the results of a customized survey to provide an overview of WISPs' current service areas, households served, spectrum usage and services. It makes the case for additional, secure spectrum for WISPs and the corresponding changes required in spectrum policy.

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2. ASSESSMENT OF WISPS' ROLE AND ABILITY TO MEET NEW BANDWIDTH DEMANDS

In this section, we examine current demand trends, role of WISPs in the telecoms market, technology trends and technology used by WISPs in the Canadian landscape and in benchmarked countries.

2.1. Trend line of bandwidth usage

The major global telecoms equipment suppliers (re. Ericsson, Huawei reports) are forecasting increases in bandwidth usage at between 30% - 40% per annum over the next 5 years. These increases are being driven by consumer demand for new bandwidth heavy applications. While rural wireless networks are still a mixture of 3 and 4G technologies, 5G networks are on the door-step and will provide significantly more bandwidth and operational efficiencies through the use of mm Wave spectrum, as well as network slicing and other technologies[12]. 5G networks are currently being tested and are planned for roll out starting in 2020. In rural and remote areas, however, existing 3G and 4G networks ability to meet the anticipated increases in consumer demand will be severely constrained by spectrum limitations.

WISPs are facing significant increases in subscribers' demands for, higher bandwidth services, and uninterrupted service. WISPs are also facing demand for triple play service offerings: data, voice, and video.

OTT video – in particular, Netflix is a major driver of subscriber demand. Several WISPs have plans to become license-exempt BDUs (Broadcast Distribution Units) in order to be able to offer packages of linear and over the top video programming. Almost half the WISPs surveyed have also indicated that they offer VOIP services. Ultimately, with the evolution of technology and creation of lower cost gear ecosystems, WISPs would have the potential to add mobility and provide complete service bundles to their subscribers as the technology and cost barriers are overcome.

However, WISPs need additional licensed spectrum to satisfy subscribers' demand for bandwidth and remain competitive with the large ISPs which are owned by 'spectrum-rich', vertically-integrated operators. WISPs will need spectrum to offer 50Mbps to support multiple audio/ HD video streams to a single subscriber.

[12] Network slicing allows a network operator to provide dedicated virtual networks with functionality specific to the service or customer over a common network infrastructure. Thus, it will be able to support the numerous and varied services envisaged in 5G. Source: https://www.rcrwireless.com/20170106/internet-of-things/network-slicing-5g-tag23-tag99

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Current demand profiles of WISPs and in particular, CanWISP members demonstrate a wide range of bandwidth speeds correlated to the particular type of system equipment used.

A significant number of CanWISP members have started to launch LTE networks in order to meet the increased subscriber demand.

2.2. Role of WISPs in the Canadian telecommunication market

There is a significant 'broadband deficit' in access to broadband services for Canadian citizens in rural and remote areas in comparison to those in urban areas. According to the CRTC Communications Monitoring Report (CCR)[13] at the end of 2016, 16% of total Canadian households do not have access to broadband internet services meeting the new CRTC accessibility criteria: 50 Mbps down and 10 Mbps up along with unlimited data for residential subscribers. Not surprisingly, the availability varies greatly between urban and rural areas, with only 39% of rural households having access to broadband service versus 96% in urban areas. 'Rural' areas were defined in the CMR report as having populations of less than 1,000, or fewer than 400 people per square kilometer.[14] These figures tell us that approximately 21% of Canadian households are considered 'rural' and 79% 'urban' based on the CMR report.

The CMR report also states that fixed wireless access is an important component (major source) of broadband Internet connectivity in rural areas, since 31% of rural households rely on fixed wireless service providers (WISPs) as the only service provider (other than satellite) available for access to broadband internet i.e. alternative fiber, cable, or DSL services are not present or can't provide broadband internet services. Thus, at the end of 2016, 6.5% of total Canadian households (31% of 21%) had fixed wireless as the only mean of accessing broadband services.

Based on CRTC's previous basic service objective (BSO) target speeds (5 Mbps download speeds and 1 Mbps upload), the CMR report indicates that - excluding satellite services, 95% of total Canadian households have access to service offerings meeting those speeds. If we assume that all urban markets have access to services based on the 5Mbps / 1 Mbps target speeds and the gap is essentially in rural areas. As 21% of households are rural, the 5% of total Canadian households translates to 24% of rural Canadian households (5% x 100% /21%) not having access to 5Mbps/1Mbps (except via satellite).

Considering that the sole means of accessing broadband is fixed wireless for 31% of rural households 2017 CMR report) and only 76% of those rural households have access

[13] Source: CMR data published by the CRTC in November 2017. See: http://www.crtc.gc.ca/eng/publications/reports/policymonitoring/2017/cmr.htm

[14] In this paper, the term 'rural areas' is used to designate low population density areas. In many cases, the service areas of WISPs have significantly lower population densities than the definitions (populations of less than 1,000, or fewer than 400 people per square kilometer) used by the CRTC. Typically, these low population density areas are also located in regional and remote areas making access difficult. Thus, the challenges of overcoming the connectivity deficit in rural areas are even higher.

to 5 Mbps/1 Mbps (calculation above), it follows that fixed wireless was the only broadband solution for nearly 41% of rural households at the end of 2016 (31%/76%).

Given that the new target speed for access to basic broadband connectivity have been increased to 50Mbps/10Mbps, the proportion of rural households having broadband access drops to only 39% according to the CMR 2017 from the 76% (old target). It follows that the role of WISPs in ensuring access in rural areas is ever more critical as wireless is often the only economical way of reaching the most remote rural communities.

The important conclusion from this analysis is that Fixed Wireless Access (FWA) technology and WISPs - as service providers, have, and will continue to play an essential role in helping the government achieve its rural connectivity policies and in ensuring a dynamic and competitive rural telecoms market.

In the future, fixed wireless service providers are likely to play an even bigger role than they play today in the provision of broadband connectivity as alternative platforms are either non-viable, unable to deliver the bandwidth capacity or present characteristics that are incompatible with the services and applications of the future:

- Operators are increasingly abandoning their legacy copper networks in rural areas;
- Provisioning of broadband services over fibre is often not a viable option in low-density rural and remote areas;
- Satellite, even with improvements in transponder capacity, can't handle the overall volume of traffic from rural households and businesses and the latency inherent to satellite connectivity is incompatible with the latency requirements of many mission critical applications in eHealth, autonomous vehicles, etc.

The global equipment providers are forecasting yearly traffic increases of some 40% in the years to come due to bandwidth hungry applications and services. Demand in a digital economy are expected to be measured in Gbps and not Mbps. In this context, the higher 50Mbps/10Mbps broadband speed targets in December 2016 can only temporarily accommodate bandwidth needs of households and businesses. Even with these relatively modest bandwidth targets, the proportion of rural households meeting the basic service objective target speeds decline from 76% to 39%.

It is clear that a prerequisite for ISED (and the CRTC) to achieve their broadband policy objectives, it will need to recognise the critical role in ensuring broadband connectivity in rural areas and consequently, make more spectrum available to FWA service providers.

While the role of WISPs in providing broadband services in low density rural and remote areas is well known, it should be noted that they also provide services in fringe areas of urban markets where there are coverage gaps. In some areas, the WISPs role is likely to be transitory as incumbent operators have simply not yet upgraded their ADSL networks to fiber and generally WISPs generally can't match the access speeds and service packages offered by the incumbents. However, in other cases, the population densities in the gaps simply don't justify fiber investment and WISPs will be long term

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competitors. The very presence of WISPs offering competitive services encourages the incumbent operators to upgrade networks, offer services at affordable prices and speed the introduction of new services – all to the benefit of consumers.

2.3. Profile and trends in Internet services provided by WISPs

The profile of WISP's services is drawn from primary survey research and secondary research sources (notably the CMR report).

2.3.1. Key findings from the CanWISP Survey

Primary research on services and technologies used by WISPs was a key element in the development of this White Paper. Thus, Nordicity undertook a survey in collaboration with CanWISP, targeting small WISPs (Wireless Internet Service Providers) - both CanWISP and non-CanWISP members. Of a total CanWISP membership of 53, 33 responded or 62% of the membership. In addition, 9 non-CanWISP members responded for an overall total of 42 WISPs or 28% of approximately 150 WISPs in Canada[15].

2.3.1.1. Availability of WISP services

The CanWISP survey demonstrates that WISPs provide fixed wireless access services to subscribers in rural communities over a vast territory. The 42 responding WISPs (33 members, 9 non-members) provided service to 94,439 subscribers in all or part, of 888 municipalities[16] across at least 8 provinces, and their service areas covered 1,011,780 square kilometers. Overall, it is reasonable to assume the total 150 (member and non-member) WISPs in Canada provide services in rural and remote areas in all the provinces.

While the total number of subscribers serviced by the 150 plus WISPs is counted in the hundreds of thousands – a relatively modest share of 13.9 M Canadian households[17], in rural communities, WISPs account for a significant portion of total subscribership and are thus essential to meeting the national broadband standards of 50Mbps/10Mbps and the early roll out of enhanced broadband networks.

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[15] Source: CanWISP Board membership data for members and data from equipment suppliers and competitive analysis.

[16] CanWISP survey data provided by respondents in answer to question on Geographic service areas (Q4)

[17] Source: CMR Report Section ii Subscriber Data, p. 195.

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Given adequate, reliable spectrum, WISPs could provide additional competitive services to their current subscribers and also act as a competitive force in keeping prices down and ensuring early availability of services – especially in the outlying areas next to small and medium sized towns.[18]

2.3.1.2. Current WISP service offering (Q5)

WISPs offer a range of services to both residential and business customers in rural communities.

WISP Residential Service Offerings –(Q5a)

Under the previous CRTC / ISED goal of 5Mbps/1Mbps, WISPs demonstrated their ability to deliver bandwidth speeds that met and exceeded those targets.

WISPs have also demonstrated that they can deliver the new enhanced 50Mbps/10Mbps broadband speed targets using currently available technology if provided with adequate spectrum: 3 of our 42 responding WISPs deliver download speeds of at least 50 Mbps (i.e. equal or better than the new CRTC target) over wireless technology. If we consider those WISPs offering 25Mbps or above (although under the new target), the number increases to 11 WISPs.

Download speeds packages of WISPs fastest offerings generally range between 20 and 25 Mbps with a few exemptions at 10Mbps. Correspondingly, upload speeds of the fastest packages generally range from 1Mbps to 5Mbps with a median at 2Mbps. The fastest WISP upload speed is 60Mbps and there are a few exceptions only delivering 256kbps.

Residential monthly data limits vary between 10GB and unlimited in basic packages, and between 100 GB and unlimited in the fastest plans. (Q5a)

It is clear that with additional clean spectrum, WISPs will need to improve their existing residential service offerings in order to meet the target speeds of the new CRTC basic service criteria. The next section describes WISPs business services.

WISP Business Service Offering

WISPs have demonstrated their ability to deliver broadband services to businesses that met and exceeded the previous CRTC/ISED targets of

[18] The survey data indicate that that the respondent WISPs service area ('homes passed') included approximately 15% or 2M of the 13.3M dwellings in Canada (source: Google, 2017. However, the likely explanation is that rural WISPs such as ABC 'covers' Prince George (population 150,000) and similarly, Storm 'covers' Ottawa (population 900,000) whereas, the market for Internet services in these cities are dominated by the large operators.

5Mbps/1Mbps. WISPs have also demonstrated their ability to meet or exceed the new enhanced targets of 50Mbps/10Mbps speed for business services using currently available technologies - but only in the cases where adequate spectrum is made available. Currently, 13 WISP respondents offer a package that meets the CRTC download target of 50 Mbps and 15 respondents are offering a package that meets the upload target of 10 Mbps. WISPs' fastest business package speeds generally range from 10Mbps to 100Mbps for download and 2Mbps to 50Mbps for upload.

It is possible for WISPs to achieve even higher speeds for business service offerings by dedicating spectrum to point-to-point installations. However, for most business and residential subscribers, this solution is not affordable. It would also compromise WISP's ability to reuse spectrum and thus not optimal in the long run.

For the majority of wireless service providers, business customers represent a much smaller proportion of WISPs' subscribers than residential customers. It would be an error to conclude that, because their current access to spectrum allows some WISPs to meet the new CRTC speed targets for basic broadband service, they would be able to extend this service to residential subscribers. The quantum of spectrum at their disposal is simply insufficient to achieve this.

When asked about monthly data limits for business packages in the survey, the responding WISPs, indicated that the limits vary between 40 GB and unlimited on basic packages and between 250 GB and unlimited on fastest plans. (Q5b)

2.3.1.3. Trends in WISPs service offering

WISPs recognize the need to provide additional bundled service packages to residential and business subscribers in order to meet demand for new services and to remain competitive in their markets. Bundled services would also increase average revenues per subscriber and lower subscriber 'churn', thus adding to financial stability and ability to attract investment in new technologies.

As indicated above, 19 of 42 or 45% of WISPs have already expanded their service offering to include VOIP service.

As indicated in section 2.1 Trendline in Bandwidth Usage, some WISPs are becoming BDUs (Broadcast Distribution Units) in order to offer IPTV entertainment packages. 3 respondents mentioned in their answers to Q15, that they needed more spectrum to make IPTV work. Netflix is also a major driver of subscriber demand. Several WISPs have plans to become BDUs under CRTC's license-exempt category for service providers with less than 20,000

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subscribers.[19] This status enables the ISP/BDU to offer packages of scheduled local and network programming as well as 'over-the- top' (OTT) video programming offered by Netflix, Amazon Prime Video. Several IPTV service providers offer bundles of scheduled and OTT programming at relatively low cost.[20] The CRTC filing process is relatively simple and conditions of license (CoLs) requirements essentially are essentially limited to the carriage of the 'skinny basic' service package of community, local and network services.

In order to offer a complete 'triple-play' to their subscribers, WISPs are also considering mobility. When asked if they would consider mobility in their territory if they had access to spectrum under 1 GHz, two thirds of respondent said they would.

Mobility as part of WISPs' service offering makes particular sense in remote communities and other niche markets such as certain aboriginal reserves, where there are no other service providers[21] although this requires both spectrum and corresponding commercial license upgrade. We note there are precedents in the resource industry (mines, forestry, etc.) for private mobile networks based on LTE technology, which is also used by an increasing number of WISPs. The fact that Xplornet will be providing mobility in Manitoba (an outcome of the acquisition of MTS by Bell) is also an indication that the line between FWA and mobility is getting thinner.[22] In the next wave of technology, the frontier between fixed and mobile networks will fall making the provision of mobility by WISPs significantly easier and cost efficient. Pending availability of suitable spectrum, some WISPs are considering becoming mobile virtual network operators (MVNO) as subcontractors to incumbent operators.

2.4. Profile of WISPs networks and technologies

2.4.1. Evolution of FWA technologies

FWA technologies have been in constant evolution thus Canadian WISPs have been pre-occupied with the access to new technologies, network coverage and the ability to deploy technology in order to maintain and enhance competitive service offerings.

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[19] Broadcasting Regulatory Policy CRTC 2015-543 and Broadcasting Order CRTC 2015-544. Source: http://www.crtc.gc.ca/eng/archive/2015/2015-543.htm

[20] Nuvyyo, Zazen and other service providers offer ISPs low cost packages of local and conventional stations, OTT programming from Netflix, etc.

[21] BCBA submission to ISED - Licensing Framework for Residual Spectrum Licenses in the 700 MHz, 2500 MHz, 2300 MHz and PCS-G Bands, Section 5.1 - https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11354.html

[22] http://www.competitionbureau.gc.ca/eic/site/cb-bc.nsf/eng/04199.html

In the second half of the last decade, as the number of broadband technology solutions increased, price points became more affordable and entrepreneurs started to build commercial networks using those technologies to reach subscribers.

Wireless broadband technologies (mobile or fixed) employed by WISPs can be segmented in 2 categories: standards-based and proprietary.

Although most of the subscribers served by the WISPs who responded to our survey are served through the use of proprietary technology (78%), there is a trend to return to standards-based technology was observed among the respondents.

Standards-based technologies

Standards-based solutions present the advantage of being available through a large number of manufacturers, which tends to lower the cost of acquisition and ensure a measure of compatibility among various sources when considering upgrades and technological pathways. These solutions include technologies used by mobile operators as well as by consumers for their wireless LAN.

The multiple releases of Wi-Fi (802.11) and WiMAX (802.16), along with EVDO, HSPA, HSPA+ and LTE and their evolutions such as HSPA+ and LTE Advanced (including LTE-U, LAA and to come MuLTEfire) form the main standards-based wireless broadband technologies.

EVDO, HSPA and HSPA+ have been almost exclusively used by mobile operators and are at various stages of being sunset in favor of LTE. They will not be discussed further in this report.

WiMAX has been available in Canada as far back as 2006[23] and is still used by WISPs in Canada (4 of the 27 respondents who shared their technology mix in the survey are using it). However, based on the survey comments and conversations with several WISPs, WiMAX is being transitioned to LTE or at least replaced by LTE in new deployments.[24]

Wi-Fi, which uses licence-exempt spectrum and is a global standard for wireless LANs (for connectivity in households, businesses and public places) has been evolving for over 20 years now. One of the most interesting characteristics of Wi-Fi is its backwards compatibility with previous releases when a new one comes out. The combination of licence-exempt spectrum, relatively low costs and compatibility between equipment from various manufacturers has greatly contributed to the success the Wi-Fi ecosystem[25].

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[23] Sources 1) https://www.itbusiness.ca/news/alberta-government-to-provide-wimax-based-internet-in-rural-areas/8690. 2) https://www.businesswire.com/news/home/20051207005261/en/Nortel-Build-WiMAX-Network-Canada-Alberta-Special

[24] All 4 respondents to the survey who deployed WiMAX technology to serve they subscribers have now started to use LTE. 10 of the 42 respondents have been contacted via telephone to clarify answers to the survey. From those, 2 were part of the 4 operators who had been deploying WiMAX and they confirmed that LTE is now replacing their WiMAX deployments.

[25] http://www.economist.com/node/2724397

The Wi-Fi standard also continues to evolve. Security enhancements such as the upcoming introduction of WPA3[26] and new features such as MU-MIMO (Multi-User Multiple Input Multiple Output)[27], OFDMA (Orthogonal Frequency Division Multiple Access) and WiMAX technologies[28] are expected to improve overall spectral efficiency and higher order 1024 QAM modulation support for increased throughput.

Although generally thought of as a technology of shorter range, many WISPs have been using Wi-Fi successfully to serve customers. 5 of the 27 respondents who disclosed their technology mix are using Wi-Fi wireless access to reach customers.

The first LTE deployments in Canada were commercially launched in September 2011 when Bell and Rogers launched 4G LTE mobility services. Since then, the adoption of the technology (globally and in Canada) has increased every year. WISPs have also started to use the technology shortly after for fixed wireless access as OEMs started to shift their WiMAX products towards LTE around 2012 - some even supported both standards simultaneously on the same product.

The LTE standard is still being improved with every release corresponding to higher speeds, new features and improved capabilities: 4x4 and 8x8 MIMO, carrier aggregation, Licence Assisted Access, etc. Some CanWISP members are planning LTE deployment that will deliver 100 Mbps throughput on 20 MHz LTE access points. Bandwidth speeds are expected to double with Category-6 customer premise equipment (CPE) that uses 4x4 MiMO. WISPs expect to be able to offer their subscribers service packages that meet and exceed 50 / 10 Mbps, on a 50 MHz channel using 4x4 MIMO.

The use of licence-exempt spectrum with LTE technology has improved over the last few years. The latest versions: LTE-U and LAA (LTE Unlicensed and Licenced Assisted Access) enable the efficient use of the 5 GHz spectrum - as a supplement to licenced spectrum, through the use of LBT (Listen Before Talk) technology to protect Wi-Fi users. The breakthroughs of such LBT technology when applied to other frequency bands should enable regulators to experiment with priority licencing and dynamic spectrum access.

To date, LTE-U and LAA still require the operator to anchor the LTE control channel to licensed spectrum before it can aggregate the licence-exempt 5GHz band with it.

The new Qualcom MuLTEfire standard should enable the use of LTE technology strictly with licensed-exempt spectrum, without the need to anchor the control channel to a

[26] https://www.theverge.com/2018/1/9/16867940/wi-fi-alliance-new-wpa3-security-protections-wpa2-announced

[27] MU-MIMO was originally introduced as an optional feature of 802.11ac to enable the Wi-Fi access point to communicate simultaneously with several users
Source: https://www.pcworld.com/article/2928725/networking/how-mu-mimo-wi-fi-works.html

[28] WiMAX technologies as an advancement in the upcoming 802.11ax - to be released in 2019. Source: https://en.wikipedia.org/wiki/IEEE_802.11ax

licenced band. Nokia announced it would demonstrate a MuLTEfire small cell and end-to-end private LTE network at the upcoming Mobile World Congress event in 2018 ahead of planned commercial availability in the second quarter of 2018[29]. This MuLTEfire technology will enable service providers access to standards-based LTE equipment capable of handling spectrum in the 5GHz license-exempt band.

With 4G LTE and upcoming 5G technologies, mobile and FWA architectures will converge. This will open significant opportunities for WISPs to offer new services and features as well as techniques to share spectrum or increase spectrum efficiency.[30]

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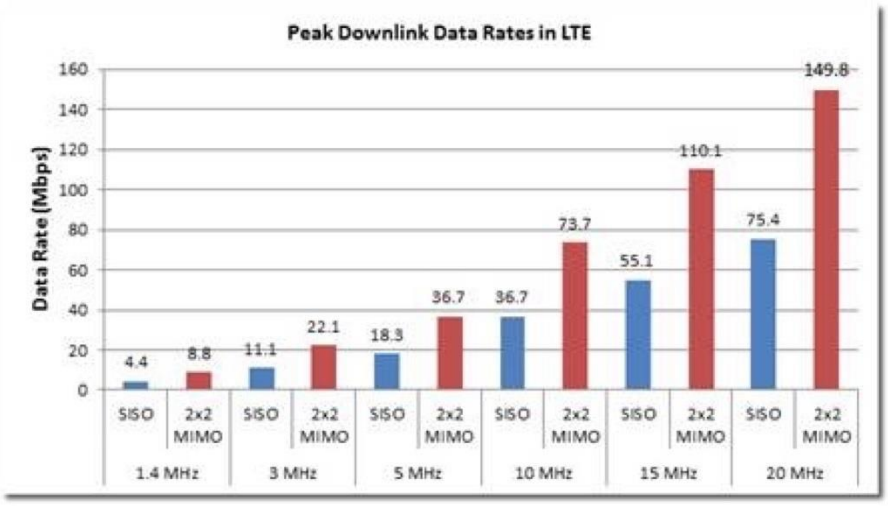
[29] https://www.rcrwireless.com/20180125/carriers/nokia-small-cell-multefire-private-lte-tag17

[30] https://www.ericsson.com/en/publications/ericsson-technology-review/archive/2016/fixed-wireless-access-on-a-massive-scale-with-5g

LTE performance[31]

LTE downlink peak throughput for LTE UE Cat. 4 devices were calculated based on information published by 3GPP[32] and as presented in the following figure:

Figure1: Peak Downlink Data Rates in LTE



Depending on minor variations on the assumptions used with respect to the percentage of overhead bits, the industry will commonly refer to LTE downlink peak throughput over 5 MHz using 2x2 MIMO and 64 QUAM modulation to be in the range of 36-37 Mbps, and 10 MHz of downlink spectrum under the same conditions to be 73-75 Mbps.

If we apply the same rationale to the use of 4x4 MIMO, the peak throughputs calculated above (on devices category 5 and above), would double to 75 Mbps over 5MHz and 150 Mbps over 10 MHz, 300 Mbps over 20 MHz and so on.

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[31] References:

https://www.pcmag.com/article/348825/fastest-mobile-networks-canada-2017

3GPP document 36.213, Table 7.1.7.1-1, Table 7.1.7.2.1-1 and Table 7.1.7.2.2-1

http://niviuk.free.fr/ue_category.php

https://en.wikipedia.org/wiki/Comparison_of_wireless_data_standards

http://lteuniversity.com/get_trained/expert_opinion1/b/hongyanlei/archive/2010/02/18/how-to-calculate-peak-data-rate-in-lte.aspx

http://frankrayal.com/2011/06/27/lte-peak-capacity/

PCTEL Maximizing LTE MIMO Throughput Using Drive Test Measurements Ppt.

[32] Source: 3GPP document 36.213, Table 7.1.7.1-1, Table 7.1.7.2.1-1 and Table 7.1.7.2.2-1

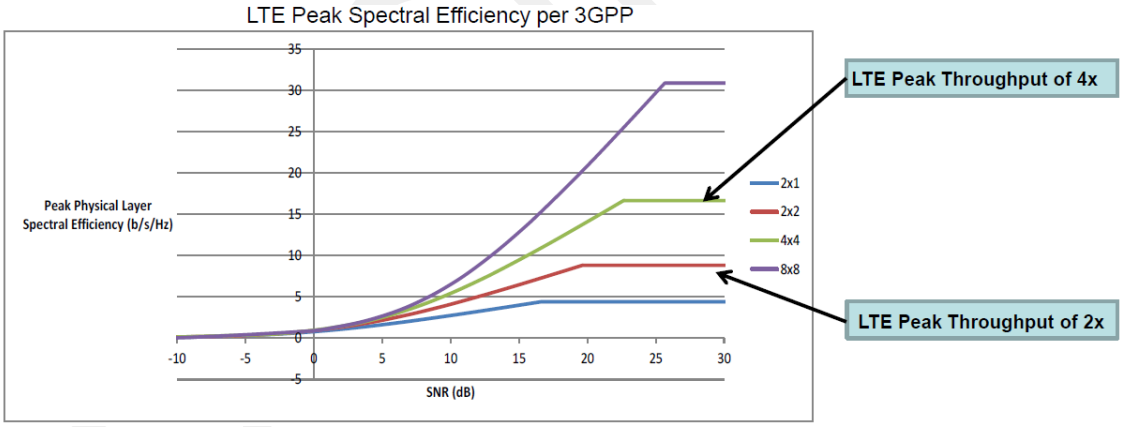
It should be noted that these values represent theoretical peak throughputs, that is, they can only be achieved in ideal radio conditions with optimal modulation schemes and with a single user using the sector at any one moment in time. These peak values are also limited by the capabilities of the device or CPE.

In practice, average throughputs will be significantly less than peak values: CPE and UEs on the network will have different capabilities (not all will do 4x4 MIMO), several users will share resources at any given instant and radio conditions will not allow for the highest modulation schemes to be used at all times. This is particularly true for spectrum that does not offer protection to the licensee - such as the 3.65 GHz band.

The level of interference, the number of users on the network and the device/CPE category mix will therefore have a significant impact on the average throughput delivered by a FWA network.

Additionally, 2x2 and 4x4 MIMO technology are also more stringent on spectrum quality than LTE SISO (single-input, single-output). In other words, even when WISPs invest in 4x4 MIMO technology, the equipment cannot be effectively used without clean spectrum. The SNR requirement for 2x2 and 4x4 MIMO are depicted in the figure below:

Figure 2: LTE Peak Spectral Efficiency per 3GPP



This further demonstrates the requirement for clean spectrum by WISPs as they invest and upgrade their networks in order to maximize the use of the technology and provide the type of services that rural Canadians envy from their urban peers.

This demonstration of the relationship between clean spectrum and efficient use of technology for LTE, a standards-based technology was only possible by access to public domain technical information easily accessible through 3GPP and other sources. It would be possible to demonstrate the same relationship for proprietary technologies as well, if one had access to relevant proprietary documentation.

Proprietary technologies

Manufacturers such as Cambium Networks, Ubiquiti, or TV White space equipment manufacturers such as Carlson Wireless technologies, 6Harmonics as well as other manufacturers of proprietary FWA technologies all have roadmaps for new products that are more resilient to interference, more spectrally efficient - in other words better equipped to face the evolving needs of WISPs.

For example, Ubiquiti Networks has announced the imminent launch of its Airfiber LTU technology[33], showcased at the Wispalooza trade show in October 2017. Another example is the Automatic Channel Selection feature (ACS) used by Cambium Networks products to dynamically assign the least-interfered RF channel to the access point. Cambium Networks also included the Wi-Fi technology advances described in the previous section in their products roadmap and other manufacturers have or are expected to follow suit.

For over 15 years now, proprietary FWA equipment manufacturers have built equipment intended for outdoor use to mitigate the shortcomings of Wi-Fi technology in FWA situations. Proprietary FWA technologies have been and will continue to be important for WISPs. The CanWISP survey indicated that 78% of the respondents are served using those proprietary FWA equipment. Some WISPs have reported that standards-based equipment such as LTE eNodeB are not always economically viable - depending on the subscriber density of the area requiring service.

A common characteristic of proprietary FWA technology is that the AP and CPE equipment are often similar, which allows for lower capital spending as the WISP is building its infrastructure. A potential challenge for proprietary FWA equipment providers in the future could be to find the economies of scale to deliver CPE pricing that will match the requirements of the growing IoT market.

2.4.2. FWA technologies currently deployed by Canadian WISPs

27 of 42 respondents to the CanWISP survey, listed the technologies they currently use in their network (Q9).

WISPs are frequently using several technologies to deliver service: Technology evolution and adapting to specific situations in the most economical manner are the 2 main reasons cited by respondent for the simultaneous use of multiple technologies. Our respondents have indicated the use of 2.23 technologies on average.

Among the proprietary fixed wireless access technologies, Cambium Networks and Ubiquiti are clearly the most commonly deployed as shown in the figure below. 14 WISPs indicated the deployment of standards-based LTE technology.

Figure3: Technologies used (based our analysis from the subscriber breakdown)

[33] Proprietary technology, unrelated to LTE or LTE-U but with similar performances according to Ubiquiti. See https://community.ubnt.com/t5/airFiber-Stories/New-LTU-AirFibers-shown-at-Wispalooza-Show/cns-p/2092600 for more

Technology	No. Subscribers	WISPs
LTE (Telrad, Huawei, ZTE, etc.)	14611	14
WiMAX	4150	4
Wi-Fi (including Cambium Ubiquiti and Cisco Wi-Fi)	2104	4
Cambium (including Motorola)	62837	18
Ubiquiti	7824	8
Alvarion[34]	300	2
Mikrotik	1945	3
Mimosa	25	1
TV White Space	50	1
RRBS	85	1
Other Proprietary	508	2
TOTAL	**94439**	

Source: CanWISP Survey

One respondent indicated deployment of technology capable of using the RRBS (remote rural broadband system) spectrum and another respondent indicated the use of TVWS (TV White Space) technology from Carlson Wireless Technologies and 6Harmonics. This WISP had been using RRBS licences with TVWS equipment before the moratorium on RRBS licences.[35] This WISP continues to deploy the technology using temporary White Space licences available from ISED. TVWS offers an opportunity for WISPs and ISED should consider making it more accessible. Among the measures ISED could take to improve access to spectrum for WISPs would be to

- Accelerate the designation and licensing process for this band; and,
- Undertaking trials in cooperation with equipment suppliers and service providers to better understand whether technologies such as LBT (Listen Before Talk) would be better suited than a centralised database to manage the spectrum.

Only 1 out of 42 respondents to the survey mentioned TVWS in their answers. Another one who used to provide service using RRBS licences had to halt deployments of new customers because of the moratorium on RRBS licences. This WISP was unaware that they could potentially ask for a temporary TVWS licence and continue adding new customers if the licenses are granted. ISED could do a better job in ensuring easy access to this kind of information for WISPs and in turn help deployment of services to Canadians in rural and remote areas. As mentioned earlier, WISPs are small operations and do not necessarily have the resources to research alternatives to a moratorium on spectrum they have been using.

[34] Alvarion was bought by Telrad and thus the legacy equipment will likely be migrated to LTE.

[35] http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10062.html

A few of the most commonly-used proprietary technologies in Canada include

- Cambium Networks with its PMP line of products, an evolution of the Canopy technology originally commercialised by Motorola,
- Ubiquiti with a suite of easy to install/plug and play products aiming at simplifying installation processes for WISPs,
- Mikrotik, a company from Latvia that produces routers switches and wireless broadband equipment for ISPs.[36]

2.4.3. Benchmarking of technologies in use by WISPs in Benchmark Countries

The technological advances in fixed wireless access equipment are determined by the global market economics and correspondingly, the market is dominated by global suppliers: Cambium, Ubiquiti, Huawei, Telrad, etc.[37] The technology windows and timing of availability of gear offered to Canadian WISPs is thus largely determined by demand in the larger markets – in particular, in the US.

We compared the technologies current and planned of Canadian WISPs with those of their global counterparts in benchmark countries: Australia, UK and USA to ascertain the trends in technology and equipment offerings and whether there were significant lead/lags in the Canadian market vis-à-vis the benchmark countries.

Technologies used, and services provided by the WISP are similar in the three countries reviewed on our benchmarking study.

In Australia, WISPs specialize in underserved communities and they are currently using long range fixed point to multi-point wireless, in some cases the very same 4G – LTE used for mobility, Ubiquiti, Mikrotik, Wi-Fi and WiMax are also being used by Australian WISPs.[38] World Without Wires (WISP) services are "delivered using a variety of Point to Point and Point to Multi-Point wireless technologies including Wi-Fi, LTE and WiMax."[39]

In the United States, the Association of Wireless Internet Service Providers have explained that "*vendors have taken advantage of the semiconductors mass-produced for Wi-Fi and use adapted hardware and high-gain antennas along with software optimized for outdoor use. They have created outdoor radio systems that combine the low cost of Wi-Fi with the high performance that only a few years ago required specialized*

[36] Source: equipment suppliers & WISP members. TD: 50/10GHz with current technology – 6-8 customers going to Cambium multi-user

[37] Alvarion previously a significant supplier to Canadian WISPs was purchased by Telrad.

[38] https://www.acma.gov.au/-/media/Spectrum-Transformation-and-Government/Issue-for-comment/9-2017/World-Without-Wires-submission-pdf.pdf

39 http://www.wiresbroadband.com/files/forms/Critical-Information-Summary-Fixed-Wireless.pdf

microwave radio systems costing thousands of dollars per unit. These have empowered WISPs to bring low-cost service to subscribers who may be several miles away from the nearest access point or tower." [40] Likewise, WISPs are using WiMAX[41], Cambium, Ubiquiti and Mikrotik. Cambium and Ubiquiti are prevalent suppliers of US WISPs with key advantages in powerful backhaul, access, and routing equipment.[42]

2.4.4. Planned investments in technology and networks by Canadian WISPs

WISPs have made significant investments in their networks and technology and a strong majority indicated, that they are familiar with, and intend to adopt the new technologies.

33 of 42 respondents indicated planed updates to the current technologies or adoptions of new technologies that will affect their spectrum usage in the 2018-2022 period (Q10). The key motivating reason for these investments were:

- ISPs want to move to LTE
- Introducing new APs capable of handling frequency reuse
- Replacement of technology with GPS sync capable technology to use less spectrum
- Introducing TV White Space technology
- Migrating to licensed backhaul to free 5GHz spectrum to serve customers[43]
- Objective to offer 100 Mbps to subscribers, need 40 to 80 MHz channels
- Introducing dual polarity antennas
- Bringing fiber to sites to eliminate wireless interference,
- Increase backhaul bandwidth.

When respondents were asked *if they plan to invest in new technology in the 2018-2022 period (Q16),* 40 of 42 respondents answered "yes" and specified the following technologies:

- LTE and LTE Advanced
- 5G or an architecture similar to the proposed 5G architecture
- Upgrade and expand equipment and towers
- TV White Space technology

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40 http://www.wispa.org/Portals/37/Docs/white_papers-case_studies/WISPA-Essential_Role_of_Fixed_Wireless.pdf?ver=2015-10-15-093501-263
41 http://www.broadband.gov/plan/5-spectrum/
42 https://apps.fcc.gov/edocs_public/attachmatch/DOC-329969A1.pdf
43 Due to backhaul licensing regime charged by DSO that has yet to be fixed by ISED

- Massive MIMO technology
- More fiber to towers
- New access equipment
- FTTH

The majority of respondents who specified what technology they were to invest in mentioned LTE or 5G. In order to do this, they will need spectrum.

When WISPs were asked about *Expected changes in technology and/or operation of their networks beyond 2022 (Q18)*, 27 responded that they were considering transitioning to the various key technologies needed to remain competitive. Here's a brief summary of answers:

- hard to say without understanding what ISED will be providing WISPs to work with (the situation is clearly creating uncertainty for WISPs),
- 5G technology,
- multiband aggregation,
- LTE,
- FTTH,
- wide area IoT markets,
- invest to fulfill high bandwidth demand (above 1 Gbps) and video streaming packages,
- mobility,
- massive MIMO,
- multi-band technologies,
- carrier aggregation,
- multi-band and intra-band aggregation,
- added redundancy for network and power,
- fiber to existing and new towers, follow industry trend,
- TV White Space technology,
- cellular roaming (mobility),
- small cell,
- interested in what happens in the US and Canada with CBRS,
- premium spectrum under 1 GHz.

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Among the 42 respondents, WISPs own - or in some cases lease, a total of approximately 3,456 towers[44] or approximately 20 subs / tower[45]. As facility-based competitors, WISPs have invested in access and backhaul networks, etc.

Addition of Mobility to WISPs' Service Package

When asked about the *Impact on the WISPs of ISED's decision of having mobile designation added (Q12)*, of the 40 responses, only 5 saw the arrival of mobility in the band as a potential opportunity either because they feared that the introduction of mobility would mean taking spectrum away from current services or their priorities were focused on cleaner spectrum to serve their current subscribers. WISPs understand that they need access to premium spectrum (under 1 GHz) given its efficiency in service delivery over the vast distances typical of their service areas in order to consider adding mobility to their portfolio of services, they also understand that allowing mobility in the 3.65 GHz band without an access to this premium spectrum would simply mean increased competition for spectrum in the 3.65 GHz band, service degradation, etc., without any new business opportunity.

When asked *if they would consider providing mobility services in their territory if they had access to spectrum under 1 GHz*, Q19 two thirds (22 out of 33 respondents) of respondent said they would. Almost 50% (19 out of 42) of the respondents to our survey already offer a VOIP over FWA solution.

The technology, regulatory and cost barriers that previously prevented WISPs from considering mobility have been significantly reduced.

- Virtualisation of LTE Core Network equipment and the ability to run network functions on generic hardware have significantly lowered price points and allowed small LTE mobile operations, enterprise mobility solutions using LTE and private LTE networks to emerge in recent years. Mining operations and large industrial complexes are running their own private LTEs further reducing the cost base.
- Mandated roaming adds to the conditions that favor such innovation; small operations can now access roaming services outside of their territory.
- The increasing use of LTE technology (as confirmed in the survey results) removes another of the barriers of entry to the mobility market.

WISPs also have a subscriber base and provide customer service and technical support in their service areas. The most important remaining barrier to WISPs entering the mobility market is access to premium spectrum (under 1 GHz) to ensure coverage

[44] Calculation of total towers based on an average radius of <10 Km per tower assuming the coverage was OMNI

[45] Based on 4500 subs /240

continuity between tower sites, something that is not practical to do using 3.65 GHz spectrum in rural settings.

Overall, respondents emphasized that their ability to add new services such as video, mobility and/or upgrade or change network technology depended on the access to spectrum and long-term viability of the WISP itself.

2.5. Assessment of spectrum used by the WISPs

2.5.1. Current usage of spectrum by the Canadian WISPs

2.5.1.1. Access Bands

WISPs use multiple bands to access subscribers however, for the most part these are licence-exempt and/or lightly-licenced bands with only a handful of respondents who have been able to secure and use licenced spectrum (2.3 or 3.5 GHz) - as summarized in the table below.

Figure4: Access Bands Used by WISPs

Bands currently in use by WISPs	Number of Respondents using each band *& Status*	Percentage of Total Responding WISPs using a particular band out of total (N= 42) Respondents*
2.3 GHz	2 respondents *(1 though spectrum subordination)*	5%
3.5 GHz –	3 respondents (2 *through spectrum subordination)*	7%
3.65 GHz –	40 respondents	95%
900 MHz	35 respondents	83%
2.4 GHz	33 respondents	79%
5 GHz	34 respondents	81%

Note: the number exceeds 100% given multiple bands in use by WISPs

Licence-exempt and/or lightly-licenced bands offer no protection, priority use or exclusivity and consequently are subject to interference. This means that the vast majority of WISPs need to compete with other simultaneous users of the band and constantly have to fight off and solve interference-related issues. As a result, it is difficult for WISPs to ensure quality, commercial-grade services to their subscribers.

Scarcity of clean spectrum also creates operational challenges for WISPs. A good example is of that is technology upgrades: when a WISP decides to upgrade say for example WiMAX customers to LTE, both technologies need to operate concurrently in the

same area until the WISP has been able to access all customer premises to replace WiMAX CPE with LTE. This can easily span over several months and will have impact on quality of service until the migration is complete.

Despite being lightly licenced with no protection, the 3.65GHz band provides the cleanest spectrum and is thus considered to be the 'workhorse' for commercial services.

2.5.1.2. Backhaul bands

The most popular backhaul band used by WISPs is the 5GHz, followed by 24GHz, 18GHz, 11GHz and 60GHz bands (as shown in the figure below). Most backhaul spectrum used by WISPs is licensed-exempt or lightly licensed.

The long-awaited changes promised by ISED on the licensing regime of backhaul spectrum, if it was favorable to WISPs in rural in remote areas, should help alleviate this situation and liberate spectrum for access use.

Figure 5: Backhaul Bands Used by WISPs

Bands used by WISPs	Number of Respondents & Status	Percentage of Total WISPs using a particular band out of total 42 respondents
900 MHz (unlicensed)	1 respondent	2%
2.4 GHz (unlicensed)	1 respondent	2%
3.5 GHz (licensed)	2 respondents*	5%
3.65 GHz (lightly licensed)	4 respondents	9%
5 GHz (unlicensed or lightly-licensed for U-NII-1)	37 respondents	88%
6 GHz (licensed)	2 respondents	5%
11 GHz (licensed)	10 respondents	24%
15 GHz (licensed)	4 respondents	9%
18 GHz (licensed)	11 respondents	26%
23 GHz (licensed)	3 respondents	7%
24 GHz (unlicensed)	28 respondents	67%
60 GHz (unlicensed)	9 respondents	21%

Notes: the number exceeds 100% given multiple bands in use by WISPs. 9 respondents selected the ''licenced backhaul'' box, meaning that they are using something else

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2.5.2. Spectrum usage by WISPs and related issues in benchmarked countries

Spectrum deployed by WISPs in the 3 countries: US, Australia and the UK was examined so as to provide a useful benchmark to that of Canadian WISPs.

USA

In the United States, WISPs use a variety of licensed and unlicensed bands due to increasing interference on the unlicensed, lack of adequate bandwidth on licensed bands and increasing subscriber demands for bandwidth. According to one operator, *"basically, we need to use lots of bands because things are so crowded."*[46]

Among the unlicensed bands, the 2.4 GHz is most widely used although the 5 GHz band is becoming more popular and the 900 MHz is not widely used due to interference.[47]

FCC established Citizens Broadband Radio Service (CBRS) for shared wireless broadband use of 3550-3700 MHz band (3.5 GHz Band), which includes our Canadian lightly-licensed 3.65GHz band. Among the licensed bands, this band, has been very popular among WISP operators due to the relative 'quietness' (lack of interference) compared to unlicensed ones"[48] which is similar to the case among WISPs in Canada. On April 17, 2015, FCC further defined three levels[49] of priority access for assigning the use of the CBRS spectrum. The new rules made additional spectrum available for flexible wireless broadband use, and leaded to improve broadband access and performance for WISPs[50].

On March 29, 2016, FCC commenced the "incentive auction" designed to repurpose spectrum (authorized by Congress) for new uses. This is a Tv Broadcast Spectrum Reverse Auction for 600MHz Mobile Broadband Spectrum. The bidding in the auction closed on March 30, 2017, repurposing 70 MHz for licensed use and 14 MHz for wireless microphones and unlicensed use[51]. This auction enabled US WISP extra spectrum to provide their services in the 600MHz band.

Similarly, in the US, the FCC in its Notice of Enquiry, sought input on potential opportunities for additional flexible access — particularly for wireless broadband services

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[46] Ibid, pg. 5

[47] http://www.netkrom.com/legado/wireless_frequency_spectrum.php?item=resources

[48] The university of Berkley performed two surveys in the year 2012 and 2014 and their results are based on 75 respondents across the US – see pg. 5 for spectrum use https://www1.icsi.berkeley.edu/~barath/papers/celerate-dev15.pdf

[49] Incumbents, Priority Access Licenses, and General Authorized Access: https://www.leverege.com/blogpost/what-is-cbrs-lte-3-5-ghz

[50] https://www.fcc.gov/wireless/bureau-divisions/broadband-division/35-ghz-band/35-ghz-band-citizens-broadband-radio

[51] https://www.fcc.gov/about-fcc/fcc-initiatives/incentive-auctions

— in spectrum bands between 3.7GHz and 24 GHz. The FWCC (Fixed Wireless Communications Commission) proposed changes to the FCC in 2016, with regards to the coordination procedures that govern FSS and FS co-existence in the 3.7-4.2 GHz band. The FWCC based their arguments on the spectrally inefficiencies of current procedures.[52]

In its response to the Notice of Inquiry, the Dynamic Spectrum Alliance submitted that the 3.7–4.2 GHz Band was extremely underutilized in the US and urged the FCC to leverage dynamic spectrum sharing techniques to enable more Intensive use of the band.[53] Given the similarities between Canada and US geography and spectrum management policies and the evidence presented by the CRTC, it is easy to conclude that similar action is likely required by ISED.

UK

As of 2017 in the UK, Ofcom the spectrum regulator, made it easier for WISPs by providing service providers with additional spectrum and favorable licensing conditions as follows:

- Additional channels in the 5.8 GHz (5725 – 5850 MHz band - aka Band C); however, this band is shared with weather and military radars
- A light -licensing regime: "The fee is £1 per terminal, subject to a minimum fee of £50 per license. There is no maximum limit on how many terminals you can have on one license."[54]
- Provide WISPs and other operators a searchable interactive database to identify licensed spectrum in use. [55]

Ofcom has a comprehensive approach to spectrum packaging and auction design[56].

- Recently in January 2018, Ofcom planned to award of wireless telegraphy licenses[57] for use of the 2.3 GHz band (2350-2390 MHz) and the 3.4 GHz band (3410-3480 MHz and 3500-3580 MHz) via an auction, in light of the

[52] Federal Communications Commission FCC-CIRC1708-04 Notice of Inquiry the FCC made public on July 13th, 2017.

[53] Comments of Dynamic Spectrum Alliance, GN Docket No. 17-183, October 2, 2017

[54] https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/fixed-wireless-access

[55] https://www.ofcom.org.uk/consultations-and-statements/category-1/call-for-inputs-fixed-wireless-spectrum-strategy/interactive-data

[56] https://www.ofcom.org.uk/spectrum/spectrum-management/spectrum-awards

[57] Ofcom uses the term 'wireless telegraphy' as a general term to cover all spectrum including satellite, FWA, etc. Each Wireless Telegraphy license issued by the Ofcom under section 8 of the Wireless Telegraphy Act 2006 ("the WT Act") authorizes the licensee to establish and use stations or install or use apparatus for wireless telegraphy, subject to the terms, provisions and limitations of that license. (https://www.ofcom.org.uk/__data/assets/pdf_file/0023/77081/licensing-procedures2010.pdf)

significant and strong demand for access to the spectrum. The auction planned to hold in 2017 but delayed by litigation brought by Three and BT/EE.[58]

- License-exempt wireless access systems are permitted in the 2.4 GHz ISM band.[59]
- In November 2000, the Radiocommunications Agency auctioned several 28 GHz Broadband Fixed Wireless Access licenses. It offered license packages of 2 x 112 MHz in each of 11 English regions, plus Scotland, Wales and Northern Ireland.[60]
- The existing fixed wireless authorization approaches in the 57 – 66 GHz band are designed for point to point links and do not facilitate point to multipoint/mesh topologies.[61]

Australia

ACMA re-allocated 3.6 GHz from June to August of 2017 and commenced processes to spectrum license the 3.6GHz band in metropolitan and regional Australia[62]. The ACMA also announced a range of mitigation measures for affected incumbent 3.6 GHz band apparatus licensees, including

- a commitment to developing arrangements for site-based wireless broadband services in the 5.6 GHz; and,
- a commitment to investigate the possibility of making arrangements for site-based fixed wireless broadband services in parts of the 28 GHz band in regional areas.[63]

The 3.6 GHz (3575–3700 MHz) band is most likely to be re-farmed for 5G.[64]

5 GHz wireless channels co-exist with some Radar frequencies. Under the limitation that the Wi-Fi gear must have: DFS - a mechanism to automatically detect Radar, and move off to a different channel, and TPC - a mechanism where the TX power can be reduced at least 6 dB below the maximum permitted[65].

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[58] https://www.ofcom.org.uk/about-ofcom/latest/media/media-releases/2018/auction-regulations-update

[59] https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/mobile-wireless-broadband

[60] https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/mobile-wireless-broadband

[61] https://www.ofcom.org.uk/__data/assets/pdf_file/0027/108594/Fixed-Wireless-Spectrum-Strategy.pdf

[62] https://www.acma.gov.au/theACMA/-/media/E5FF79D30AAE4D0C9D013F8046832CD1.ashx

[63] https://www.acma.gov.au/theACMA/-/media/E5FF79D30AAE4D0C9D013F8046832CD1.ashx

[64] Page 10 - https://www.acma.gov.au/theACMA/-/media/E5FF79D30AAE4D0C9D013F8046832CD1.ashx

[65] http://www.wisp.net.au/5ghz-channel-spectral-width-australia-pm-16.html

- In Australia, the point to point (5.8 GHz band) licensing option is typically used to authorize fixed links with up to 200 Watts EIRP in rural areas.[66]
- As part of an initiative to support the deployment of broadband wireless access (BWA) systems in rural areas, the ACMA has made available spectrum in the 1900-1920 and 2010-2025 MHz frequency bands for apparatus licenses.[67]

5.8 GHz – some WISPs operate in this band. UKWISP gave an update on their October 2017 member meeting. The update indicated RTTT Spectrum obstruction in 5.8GHz band. Progress was being made, and they expected a relaxation of the rules in early 2018.[68]

In late 2015, the ACMA decided to reallocate the 850 MHz 'expansion' band for spectrum licenses configured for wireless broadband. A significant portion of the band will be available for use from mid-2021 and is expected to be fully cleared by 2024.[69]

The fee for 5.8GHz is £1 per terminal, subject to a minimum fee of £50 per license. There is no maximum limit on how many terminals you can have on one license.70

A comparison of the licensing regimes for backhaul bands in Canada and the 3 benchmark countries is provided in the following figure.

Figure 6: Licensing Regime for Backhaul

Frequency bands used		***Canada***	***UK[71]***	***US***	***Australia***
900MHz	*902MHz-928MHz*	*License exempt*	*Mobile designation*	*Unlicensed, but share with licensed LMS operator*	*Digital Cellular Mobile Telephone Service & Radiolocation[72]* *Class licensing arrangement[73]*

[66] https://www.acma.gov.au/theACMA/radiofrequency-spectrum-fixed-licences#4

[67] https://www.acma.gov.au/theACMA/radiofrequency-spectrum-fixed-licences#4

[68] https://ukwispa.org/ukwispa-october-2017-update/

[69] https://www.acma.gov.au/theACMA/-/media/E5FF79D30AAE4D0C9D013F8046832CD1.ashx

[70] https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/fixed-wireless-access

[71] http://hub.silexamerica.com/unwired/changes-to-the-5ghz-wi-fi-band-in-the-uk

[72] https://www.acma.gov.au/-/media/Licence-Issue-and-Allocation/Information/pdf/900mhz-pdf.pdf?la=en

[73] https://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/About-spectrum-planning/wireless-access-services-spectrum-planning-acma

Frequency bands used		Canada	UK[71]	US	Australia
1.5GHz		Mobile designation[74]	Radiocommunication license[75]	N/A	License exempt[76]
2.4 GHz		License exempt	License exempt	License exempt[77]	Licensed
3.65 GHz		Lightly licensed	Licensed	Licensed	Licensed[78]
5GHz	5150-5250MHz	Lightly license	Light licensing	License exempt	License exempt
5GHz	5250-5350MHz	License exempt	License exempt	License exempt	Licensed
5GHz	5470-5600MHz and 5650-5725MHz	License exempt	License exempt	License exempt	License exempt
5GHz	5725-5850MHz	License exempt	License exempt	License exempt	License exempt
5.8GHz		License exempt	Lightly licensed	License-exempt	Licensed[79]
Lower 6 GHz		Licensed	Radio local area network (RLAN)[80]	Licensed [81]	Licensed [82]
11 GHz	10.7-11.7 GHz	Licensed	N/A	Licensed	Licensed

[74] http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf08174.html

[75] https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/pmse/pmse-technical-info/audio-links/fees

[76] https://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/About-spectrum-planning/wireless-access-services-spectrum-planning-acma

[77] http://www.aowireless.com/blog/bid/38658/Wireless-Interference-The-Effect-on-Unlicensed-Wireless-Backhaul

[78] https://www.acma.gov.au/theACMA/release-of-the-36-ghz-band-in-regional-and-remote-areas

[79] https://www.acma.gov.au/Industry/Broadcast/Television/Licence-fees-and-charges/fixed-licence-overview#point%20to%20point%20(5.8%20ghz%20band)

[80] https://www.ofcom.org.uk/__data/assets/pdf_file/0027/108594/Fixed-Wireless-Spectrum-Strategy.pdf

[81] http://www.aowireless.com/blog/bid/40954/Unlicensed-24GHz-Point-to-Point-Wireless-Backhaul-Option

[82] https://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/Current-APs-info-and-resources/point-to-point-6-ghz-band

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Frequency bands used		Canada	UK[71]	US	Australia
15 GHz	14.50-15.35 GHz	Licensed	Defense Spectrum[83]	N/A	Licensed[84]
18 GHz	17.8-18.3 and 19.3-19.7 GHz	Licensed	Amateur full license[85]	Licensed	Licensed[86]
23 GHz	21.8-22.4 and 23.0-23.6 GHz	Licensed	Mobile backhaul	Licensed	Licensed (fixed point-to-point links and Television Outside Broadcast (TOB) services)[87]
24GHz		License exempt	Mobile backhaul	Unlicensed[88]	Unlicensed[89]
60GHz		License exempt	License exempt	Unlicensed	Licensed for distance/speed measurement[90]

Source: Nordicity compilation based on public information from regulators' websites

The most frequently used spectrum by CanWISP for backhaul is 5GHz, which is similar to the benchmarking countries. Most spectrum in 5GHz are license-exempt, with light-license spectrum in the band 5150-5250MHz. Other popular spectrum used in Canada, like 11GHz and 18GHz is licensed which give advantage to CanWISP to provide better service. 5.8 GHz in UK and Australia are allocated as a licensed spectrum, which provide more advantages to WISPs in these two than that in Canada and US.

In addition, New Fixed Service bands 'W band' (92 – 114.5 GHz) and 'D band' (130 – 174.8 GHz) are being studied in UK for very high capacity (e.g. n x 10 Gbps) fixed wireless links applications including backhaul for next generation mobile networks.

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[83] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/35937/dsm_consultation_report.pdf

[84] https://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/Current-APs-info-and-resources/temporary-fixed-link-15-ghz-band

[85] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/35937/dsm_consultation_report.pdf

[86] https://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/Current-APs-info-and-resources/point-to-point-18-ghz-band-1

[87] https://www.acma.gov.au/-/media/Spectrum-Engineering/Regulation/pdf/Appendix-1---22g-Plan-pdf.pdf?la=en

[88] http://www.aowireless.com/blog/bid/40954/Unlicensed-24GHz-Point-to-Point-Wireless-Backhaul-Option

[89] https://www.telcoantennas.com.au/site/category/products/microwave/unlicensed-band-ism/24ghz-0

[90] https://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Class-licences/spectrum-opportunities-for-short-range-devices

2.6. Impacts of WISPs limited access to spectrum

2.6.1. Impacts of limited access for Canadian WISPs

The overwhelming majority of WISP respondents indicated that the spectrum currently available is inadequate in terms of both the quantum (MHz) and licensed bands and this in turn, was limiting their ability to respond to subscriber demands and resulted in suboptimal service offerings and technology decisions.

Thus, 36 of 42 respondents, answered "Yes" when asked *if the availability (quantum) or quality of spectrum limited your ability to serve your subscribers* (Q8). Explanations included:

- Interference
- lack of availability for spectrum under 1 GHz or 2 GHz for hard to reach subscribers; and,
- Difficulty to transition to better technology without counting with the available spectrum - two competing technologies need to share the spectrum during the transition. (e.g. WiMAX to LTE)

29 respondents answered "yes" when asked *if they have encountered technical or regulatory problems affecting their operations* (Q7) and the following problems were cited:

- Lack and insufficient of available clean spectrum
- Licencing process to get clear spectrum too cumbersome and expensive
- no coordination between licensing and funding network deployments
- backhaul spectrum fees too high, no reward to use spectrum efficient backhaul
- interference due to power restriction on licensed-exempt and lightly licensed spectrum
- Difficulty in sublicensing the unused licenced spectrum from bigger players and the absence of process to support this
- Lack of mediation from ISED in the issues on the 3.65 GHz band when several users overlap
- Lack of mediation from ISED at the subordination renewal
- RRBS moratorium an issue for WISPs in being able to expand services-to-hard to reach customers.

In WISPs' struggle to obtain 'clean' spectrum, some WISPs have tried using bands that are licenced for backhaul, and correspondingly, abandon licence-exempt or lightly-licenced bands. However, the current fee structure - as applied by ISED under the current regime i.e. having backhaul prices based on throughput (multiple of DS0s)

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instead of bandwidth used, results in fees that are cost prohibitive to most WISPs - even if the spectrum was made available.

In some cases, WISPs have indicated that ISED's current backhaul pricing regime has made fiber runs in rural areas less expensive than deploying point-to-point backhaul.

When asked what operational improvements would results from having access to more spectrum (ref. Q15c), several WISPs listed the ability to plan better, be less reactive and offer guaranteed service levels.

Technology migration and long-term viability are at the heart of WISPs preoccupations. WISPs 'spectrum-poor' status creates tremendous problems when comes the time to migrate towards more recent or spectrally efficient technologies. The nature of the fixed wireless access FWA business is such that legacy systems need to be 'on air' and transmit until all premises have been upgraded with CPEs compatible with the new technology being rolled out. The self-inflicted interference resulting from such process increases the complexity of technology upgrades for WISPs. And those upgrades happen: with the increase in throughput demand the market is facing, the evolution of the definition of basic services and the fact that WISPs operate several technologies in parallel (respondents to our survey operate 2,23 technologies on average).

2.6.2. Impacts of limited spectrum access for WISPs in benchmarked countries

WISPs in the 3 benchmarked countries share the challenges of using multiple bands due to interference in the unlicensed, lower bands in particular. The 3.6 licensed band is the preferred band for WISPs in all 3 countries. In the US and the UK, the Regulators have taken favorable steps towards providing additional spectrum for WISPs in the 5GHz bands. However, in Australia, the Regulator has proposed re-farming the 3.6GHz band and licensing a sole service provider thus depriving WISPs of an essential band.

USA

In the US, the biggest concern of WISPs – as is the case in Canada, is access to affordable, secure spectrum. According to a study by the University of Berkley (2015) "Of 43 respondents to the question: "*What is the biggest challenge your organization faces?*", 22 (51%) expressed concerns relating to spectrum and another 16% expressed related concerns about affordability of upstream bandwidth and backhaul (for a subtotal of 67%. Another (23%) expressed concerns around business development [91]. Many respondents expressed a desire to have spectrum set aside for WISPs due to overcrowding in the unlicensed bands. In particular, WISPs have asked the FCC for access to the C-band spectrum.

[91] https://www1.icsi.berkeley.edu/~barath/papers/celerate-dev15.pdf

The FCC has moved towards accommodating WISPs needs by providing unlicensed spectrum in the 5GHz band.[92] In April 2014, the FCC made several rule changes with regards to (U-NII) devices in the 5 GHz band. This included lifting restrictions on the lower U-NII-1 channels (5.15-5.25 GHz) which had previously been limited to low power indoor use.[93] It also reiterated the necessity for radios operating on certain U-NII 5GHz channels to use Dynamic Frequency Selection (DFS), a standard for sharing spectrum between radar systems and Wi-Fi devices (the primary and secondary users of this band, respectively).

Australia[94]

In Australia, WISPs use a combination of 2.3GHz, 2.5Ghz, 700Mhz and 3.6GHz spectrum – the latter being the most popular given the lower level of interference. WISPAU is the rural WISP association whose members provide services to some 200,000 regional Australians in low density areas. Regional ISP's have created significant and effective infrastructure and customer driven services, without government funding and in the face of government initiatives to overbuild their networks.

ACMA, the regulator has proposed an exclusive license model and re-farming of all of the 3.65 GHz band to a sole provider. In reaction, WISPAU has proposed that the Government adopt a dynamic spectrum licensing model focused on Regional Australia. In its regulatory brief to ACMA, WISPAU has indicated this prescriptive approach would generate significant disadvantages in terms of spectrum efficiency, service to subscribers and viability of the WISPs themselves.

- *Spectrum will lay abandoned in regional Australia.*
- *Regional commercial innovation will cease in this band.*
- *Privately funded commercial regional infrastructure will become worthless.*
- *The commercial impact on regional businesses dependent upon communications will be negative.*
- *The removal of neutral host capacity will create new blackspots.*

[92] In Canada, ISED has licensed this band – a designation supported by Canadian WISPs in order to minimize interference.

[93] In Canada, similarly ISED allowed higher ERIP in June 2017 from ¼ Watt to 4 Watts. https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11294.html

[94] https://www.acma.gov.au/-/media/Spectrum-Transformation-and-Government/Issue-for-comment/9-2017/WISPAU-submission-pdf.pdf

UK

In the UK, the UK Wireless Internet Service Providers Association (UKWISPA)[95] is the official trade body recognized by UK Authorities.

At present, Broadband Fixed Wireless Access (BFWA) ISPs' services are restricted from using the frequencies between 5795-5815MHz in order to protect road tolling systems, although in July 2017, the regulator found that such systems only make light use of these frequencies in the United Kingdom. However, Ofcom confirmed that they decided to release an extra 20MHz notch of radio spectrum in the 5.8GHz band (5725-5850MHz) for use by related internet access providers.[96]

2.7. Canadian WISPs spectrum needs and potential benefits

In the CanWISP survey, respondents were provided with the opportunity to identify desired bands and bandwidths and correspondingly, the benefits to their subscribers and operations. Overall, the responding WISPs demonstrated their knowledge of and intent to adopt the evolving technologies and services in the case that affordable and secure spectrum were to be made available.

In response to the 'Spectrum Ask' (Q11), 36 respondents made specific requests for additional spectrum and specified bandwidth. Cumulatively, this would total 208MHz of spectrum per band in 10 of the 25 bands listed including both access and backhaul spectrum. We note however, that the actual spectrum requested is much less as this figure does not account for spectrum re-utilization in different service areas. In sum, significant additional spectrum would certainly allow WISPs to improve their Quality of Service, expand their service portfolios and respond to increasing bandwidth demands from their subscribers.

The important point for ISED here is to ensure that WISPs are recognized as infrastructure-based service providers and that future licensing frameworks in the 2018-2022 timeframe consider the role WISPs play in bridging the urban/rural connectivity gap, thus ensuring WISPs are provided with the tools they need to play this role. This is even more relevant when the spectrum, made available possesses a technology ecosystem that WISPs can benefit from.

In response to being asked *about improvement or new service offerings if additional spectrum was made available in the 3475-3650 MHz and 3650-3700 MHz bands (Q13),* 35 respondents stated they would provide new plans featuring faster throughput and higher reliability. This would enable most if not all WISPs to add a service package that meets the new CRTC basic services targets.

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[95] www.ukwispa.org

[96] https://www.ispreview.co.uk/index.php/2017/11/ofcom-uk-make-5-8ghz-spectrum-available-wireless-broadband.html

In response to being asked about *expansion of your service area if spectrum was made available (Q15a),* 32 respondents indicated the following benefits in coverage, new services and service quality, bandwidth and/or new investments:

- Improve coverage - Reach more customers and provide better service to those already served
- Cover all of our territory with LTE-A and eventually 5G
- Penetrate through vegetation
- Offload existing equipment
- Meet CRTC's goals
- Migrate to better technology
- Increase capacity to 25-50 Mbps DL
- Up to 10K more subscribers in First Nation Communities
- Longer backhauls which means more money for access
- Larger data bundles
- Faster speeds
- New equipment towers

In response to being asked about *Overall impact on number of subscriber with more access to spectrum (Q15b)*, 33 respondents agreed that more and better spectrum would translate into more subscribers with most estimates ranging between 35 to 80% more, some talked about doubling the number of subscribers (100% more) and one said up to 10 times more subscribers (900% more).

In response to being asked about *operational efficiencies that would materialize with access to this additional spectrum (Q15c)*, 26 respondents out of 42 provided an answer to the question. In summary, Canadian WISPs believe that additional spectrum would provide the following benefits:

- Less truck rollouts,
- Cleaner spectrum means more efficient per tower,
- Better planning of networks and implementation of standards (under the current regime, they can only try to find the cleanest channel and operate),
- Less time on interference issues,
- Less time dealing with customer complaints,
- Minimize the number of vendors,
- Better purchasing power,

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- Technology swaps would be more effective (no need to build a new tower a few miles away, same tower can be reused),
- More bandwidth with same radios,
- Less coordination with competitors,
- Enabling concentration of service thus lowering operational costs and enabling more investment in growth,
- Using the same equipment longer

In response to the question of whether they would expand their service portfolio to offer mobility if they had access to sufficient premium spectrum - sub 1 GHz - (Q19), 33 respondents provided an answer to the question: 6 respondents clearly stated they were not interested, 5 said they might, but it was not in scope or part of their current business plan and 22 (67%) said they would. From those, some mentioned the difficulties in negotiating decent roaming rates, working with ILECs or sourcing expensive smartphones. Some also talked about MVNO as a potential outcome.

The point here is that not only WISPs see the convergence between FWA and mobile technology, they are in the middle of it. They also understand industry trends such as private LTE networks and enterprise mobility and see the potential associated with adding new convergent services to their existing portfolios.

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3. ASSESSMENT OF, AND PROPOSED CHANGES TO THE CURRENT POLICY AND FUNDING FRAMEWORKS FOR BROADBAND ACCESS

Spectrum is essential to the delivery of broadband services and thus will be a key enabler of the digital economy. According to a report by the International Telecommunications Union titled Impact of Broadband on the Economy (April 2012), the average impact of broadband on GDP growth in medium penetration countries (including Canada) is 0.014%.[97] For high penetration countries, the average effect is 0.023%.

3.1. Overview of Broadband Access Policy Frameworks in Australia, the US and UK

The experience of the US and Australia are of particular interest given the similarities in vast spaces, scattered communities in low population density areas outside metropolitan areas, broadband deficits and recognition of the need for policy measures to compensate for market failures in broadband access in low density areas.

Australia

In Australia, in 2009 the federal government announced its plan for the National Broadband Network (NBN) based on the wholesale model, covering 100% of the population with the then target of 12Mbps – since increased to 100Mbps. The NBN system consists of the provision of broadband services over a mix of three technologies: optic fiber, fixed wireless, and next-generation satellite. [98] The policy stated objectives are summarized as follows:

"to encourage competition, serve and cross-subsidize the remote and rural regions, and achieve a faster infrastructure with higher quality and lower retail prices".[99]

While the implementation of the wholesale broadband network has been slower than anticipated and the funding cut back, the ultimate goal of equal access to broadband for all citizens remains the core objective and correspondingly, the need for significant public investment where there is market failure.

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[97] In 2016, Canada's GDP was proximately $1.53 trillion USD.

[98] The Government committed to public equity investments totaling AUS$43B over eight years subsequently reduced to AUS$30.4B. $ The NBN is being developed as a wholesale service which in turn is accessed through retailers. Source: https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/rp/BudgetReview201314/NBN

[99] Centre for Public Impact. The National Broadband Network in Australia Case Study, September 5, 2017. Source: https://www.centreforpublicimpact.org/case-study/national-broadband-network-australia/

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US

In the US, *Connecting America: The National Broadband Plan* - a Federal Communications Commission (FCC) plan was initiated in 2010 in order to provide 'affordable access' to broadband with download speeds of at least 100 megabits per second and actual upload speeds of at least 50 megabits per second for 100 million American households with access to 100 Mbit/s connections by 2020.[100] Other goals to provide "every American should have affordable access to robust broadband service, and the means and skills to subscribe if they so choose" and "*Every American community should have affordable access to at least 1 gigabit per second broadband service to anchor institutions such as schools, hospitals, and government buildings.*"[101]

UK

The UK broadband framework is interesting in that Ofcom has developed a variety of innovative measures such as the use of whitespace spectrum to encourage broadband access in rural areas[102] – which constitute a significant portion of the UK landmass. Ofcom has cut the wholesale price that BT charges Internet Service Providers (ISPs), in a move that should see a fall in monthly broadband bills for those living in rural areas.[103]

Ofcom revised their proposals for its fourth-generation mobile spectrum auction in 2012. The regulator said the winning bidder will have to provide the high-speed coverage to current "not-spot" areas, which covered remote rural areas in UK.[104]

Ofcom is also taking a range of steps to help improve broadband coverage and speeds, including:

1. Promoting industry-wide investment in full-fibre networks.
2. Supporting plans for universal broadband.
3. Ensuring better information for customers.[105]

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[100] Source: Broadband.gov (FCC website). On this website, provides regular updates on the implementation of the NBP, performance of ISPs and Internet access for citizens in locations across the country.

[101] Ibid

[102] *Feasibility Study of Whitespaces Broadband Services in Lancaster, UK*. Study for Digital Britain, UK Technology Strategy Board (TSB) by Nordicity, in partnership with Storey Creative Industries Centre and Advanced Interactive (AI), an ISP specializing in wireless broadband solutions.

[103] http://www.silicon.co.uk/workspace/rural-broadband-prices-to-drop-following-ofcom-move-34693?print=pdf

[104] http://www.bbc.com/news/technology-16527490

[105] https://www.ofcom.org.uk/about-ofcom/latest/media/media-releases/2017/connected-nations-2017-scotland

Canada

In Canada, governments of all levels have been active in promoting the deployment of internet services in rural areas for well over a decade through a combination of policy and financial incentives - including public-private service partnerships at the municipal level.

3.2. Impacts of Broadband Funding Programs in Canada

In this section, we assess the impacts of ISED and CRTC broadband funding programs together.

3.2.1. ISED Broadband Access Funding Programs

ISED has funded two 'windows' of funding to service providers for enhanced broadband access in rural areas: Broadband Canada grant program of 2011-2012, Connecting Canadians (2014-15) and Connect to Innovate (2016-17).

On July 22nd, 2014, Industry Canada launched its Connecting Canadians program[106] to bring high-speed Internet to 280,000 Canadian households then deemed without Internet or with slower access. The government was to invest up to up to $305 million between that time and 2017 to extend access to broadband Internet at speeds of 5 Mbps to 98 percent of Canadian households, mainly in rural and remote communities. IC established a target speed of 5 Mbps for the program except in Nunavut and the Nunavik region of northern Quebec where the target speed was 3 Mbps[107].

Since that time, 87 projects covering approximately 322 439 households were approved by the program, for 56 different organizations and the funding awarded amounts to a total up to $207.18 million.

Projects awarded ranged in size from 35,000 to 41,000 in number of households and from $8500 to $35 million in terms of capital dollars that could be invested[108].

As ISED launched its second funding window: Connect to Innovate program on December 15th 2016, a few days before the CRTC decision to declare broadband internet access services as basic telecommunication services, it decided to dedicate a portion of the program funds to support "last-mile" connectivity projects to households, at speeds of at least 5 Megabits per second (Mbps), where gaps continue to persist, despite the fact that the program's focus was to be on new backbone infrastructure. ISED mentioned that during extensive consultations it conducted, stakeholders had identified additional needs

[106] https://www.canada.ca/en/news/archive/2014/07/harper-government-launches-program-bring-high-speed-internet-additional-280-000-canadian-households.html

[107] https://www.canada.ca/en/news/archive/2015/03/connecting-canadians-digitally-build-stronger-economy.html

[108] https://www.ic.gc.ca/eic/site/028.nsf/eng/50044.html#fnb1

that warrant eligibility. As such, eligibility included backbone capacity upgrades and resiliency, as well as last-mile infrastructure projects to households and businesses. The program is committed to providing up to $500 million by 2021 to extend and enhance broadband service in rural and remote communities. [109]

As of the date of this report, the program approved 97 projects and the funding awarded amounts to a total up to $260.87 million. The approved projects vary in size from $19 940 to $49.9 million[110] and ISED continues to post new awards regularly.

A significant number of WISPs applied under both funding windows. However, delays in announcements from ISED's original and the lack of an easily accessible, centralized data base of funded projects has resulted in considerable uncertainty and delays in plans and service deployments - especially to smaller players in rural markets. Service providers, whether applicants or non-applicants have had to delay or cancel deployments, for fear that winning applicants will be build overtop of their networks.

3.2.2. CRTC Funding of Broadband Access

In its decision rendered on December 21, 2016 - Telecom Regulatory Policy CRTC 2016-496 - the CRTC declared broadband internet access services ''basic telecommunication services'':

…the following services – which form part of the universal service objective – are hereby basic telecommunications services within the meaning of subsection 46.5(1) of the Telecommunications Act *(the Act): (i) fixed and mobile wireless broadband Internet access services, and (ii) fixed and mobile wireless voice services.*

In the same decision and pursuant to its legislative mandate, the regulator also established the following universal service objective along with criteria to measure success:

''Canadians*, in urban areas as well as in rural and remote areas, have access to voice services and* ***broadband Internet access services*** *[our emphasis], on both fixed and mobile wireless networks. To measure the successful achievement of this objective, the Commission has established several criteria, including,*

Canadian residential and business fixed broadband Internet access service subscribers should be able to access speeds of at least 50 megabits per second (Mbps) download and 10 Mbps upload, and to subscribe to a service offering with an unlimited data allowance; and

the latest generally deployed mobile wireless technology should be available not only in Canadian homes and businesses, but on as many major transportation roads as possible in Canada."

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[109] https://www.canada.ca/en/innovation-science-economic-development/news/2016/12/enhanced-broadband-access-coming-rural-remote-communities-across-canada.html

[110] https://www.canada.ca/en/innovation-science-economic-development/programs/computer-internet-access/connect-to-innovate/announced-projects.html

The decision also included the creation of a new fund of $750 million in the first 5 years, over and above existing government programs, to support projects in areas that do not met these targets.

In the absence of permanent funding, it is difficult for service providers in rural areas to attract investment capital or otherwise secure funding for long term investments. Also, in many cases the funding from the ISED windows appears to have been captured by larger operators and service providers such as Bell, Xplornet, etc. rather than by local service providers such as the WISPs.

The CRTC broadband fund of $750M over 5 years - to replace the existing funding of voice-based essential services, this amount is very modest in comparison with the capital requirements for rolling out broadband in rural areas.

The following recommendations address both ISED and CRTC funding of broadband.

It is incumbent for ISED - as the policy ministry, to provide permanent funding programs that are commensurate with the funding needs of its own broadband policy.

ISED should ensure that the funding rules enable smaller service providers opportunities for funding equal to those of the national operators.

ISED should consider funding cost efficient last mile solutions as well as the fiber – based backbone projects which tend to favor projects by the national operators.

ISED should ensure that announcements are clear and concise and include timelines and exact coverage information as well as information regarding the method and costs of open access - if it is a condition of funding.

ISED should provide an easily accessible, centralized data base of funded projects.

ISED should work closely with CRTC's funding in order to maximize the impacts in rural areas.

In the various funding windows, some of funding has resulted in over-building of existing networks and/or projects that would be built anyway. This was a concern of many respondents to CRTC 2017-112. Some of the incumbent operators such as Rogers, Eastlink, and Xplornet have also expressed concern.

ISED should use the mapping database to determine eligibility of areas and eliminate case of overbuild and where existing service providers contest the eligibility of service areas, there should be a dispute process.[111]

Finally, we note that the broadband access 50Mbps/10Mbps goals for rural areas can only be ensured by combining stable, long term funding with access by WISPs to reliable, inexpensive spectrum.

[111] BCBA supported a similar dispute resolution process in its submission to ISED.

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3.3. Spectrum license fee calculation

Currently ISED's spectrum fee policy for backhaul is based on equivalent DS0 or 64 kbps channels i.e. tied to speed and quoted as annual fees $/Mbps. As indicated in the Spectrum Usage section above, the current method used by ISED to calculate license fees for access or backhaul spectrum results in inefficient use of spectrum and investments and limit WISPs' ability to use wireless technology. ISED has indicated that it is in the process of reviewing its spectrum fee policy.

90% (38/42) of respondents indicated that current backhaul licence fee calculations prevent effective use of spectrum while 21% (9/42) indicated problems with both access and backhaul spectrum fees. Most respondents called for backhaul fees based on bandwidth used rather than DS0 multiples.

There is a consensus amongst WISPs, that the calculation of spectrum fees based on the current methodology results in a fee structure that is too high, prevents efficient use of spectrum and in some cases, a barrier to WISPs in accessing spectrum. This is a particular problem for fees associated with high capacity links. Fees should be based on market valuation.[112]

In benchmarked countries[113], fees are based on market value – typically auction events and are quoted in $/MHz, not as $/Mbps. In the US, the FCC approach[114] results in much lower fees than In Canada.

In order to address these issues, ISED should consider the following approach:

Spectrum fees should be based on market valuation and quoted in $/MHz; [115]

Fees should be higher for lower spectrum bands;

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[112] In the January 2018 RABC meetings, there appeared to be general consensus to accept fees based on market valuation.

[113] Australia, UK and US set spectrum fees based directly, or indirectly on market valuation – generally prices paid in auctions. Ofcom: https://www.ofcom.org.uk/about-ofcom/latest/media/media-releases/2015/2016-spectrum-auction. Ofcom also decided the price based on WT Act fees framework (cost based fee): https://www.ofcom.org.uk/consultations-and-statements/category-1/cbfframework

ACMA: https://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Spectrum-licences/spectrum-auctions-list-spectrum-planning-acma

[114] US FCC *sets spectrum fees according to bandwidth.*

[115] BCBA in its submission called for 4 measures: 1. Annual fees should be quoted in $/MHz, not $/Mbps 2. Fees should be less $ for higher frequencies 3. Annual fees should be discounted for less congested areas 4. current fees associated with high capacity links are too high.

ISED should consider a congestion-based fee structure that would result in a fee reduction in rural and remote areas;

ISED should consider a reduction in current fees associated with high capacity links used by WISPs in rural and remote areas based on the economic value to the service providers; and,

ISED should charge spectrum licensees higher spectrum fees in the case that the spectrum is underutilized or simply not utilized at all.

3.4. Spectrum licensing and access policy

3.4.1. Spectrum planning

Spectrum is scarce; thus, it is important that spectrum licensing and usage policies maximise the benefits to all Canadians: competitive pricing, choice of service providers and early rollout of new services and applications. Efficient spectrum usage increases broadband access and downstream benefits of GDP growth and innovation in the economy.[116]

Incumbent operators - such as Bell, benefited from various non-competitive licensing processes (first come, first serve, beauty contests or qualitative review of applicants, etc. to acquire their spectrum. These operators are not only 'spectrum rich' with vast spectrum holdings across the country but also have a significant portion of those holdings underutilized.

In many low-density, rural areas residential and business users have witnessed 'market failure' insofar as the large operators have not found it economical to transition from copper networks in order to provide broadband services.

The benefits of broadband access for citizens in the rural areas have been well-documented in Canada and global telecoms marketplace [117] ISED and the CRTC have set a new 50Mbps/10Mbps broadband access goal for all Canadians – including those in rural areas. WISPs demonstrated their ability to play an essential role in the fulfilment of ISED (and CRTC) broadband access policy goals for citizens in low density, rural areas under the previous 5Mbbps/1Mbps targets where it is not economical for larger operators to provide service. While at the national level, WISP capture only a small portion of total subscribership, in rural areas where WISPs count several hundred thousand subscribers, they constitute a key competitive force in the market

[116] Source: see CCI submission – likely sourced to OECD report re. GDP increase in highly connected countries

[117] Queens – benefits of EORN David Fell https://www.eorn.ca/en/resources/EORN-Consulting-Services-Final-2017-11-17.pdf

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place. However, ISED has not provided WISPs with the corresponding spectrum resources to effectively reach those new higher goals.

ISED should formally recognize the WISP contribution in delivering broadband in rural areas, their current status as 'spectrum poor' and actively promote WISP access to affordable, secure spectrum in their service areas.

When asked in the CanWISP survey, CanWISP members emphasized the need for access at affordable prices to the 3.5GHz and 3.65GHz bands – the 'workhorse bands' for WISPs (re. Q13).[118]

In the immediate future, ISED should promote access for WISPs to the 3.5MHz and 3.65MHz bands – the 'workhorse bands' for WISPs (re. Q13). In the longer term, ISED should promote access for WISPs in both lower (e.g. 600MHz) as well as the additional bands that ISED intends to render available in the 2018-2022 timeframe such as 800MHz, 900MHz and other mm Wave bands above 24 GHz - *as they become available for spectrum auctions.*

We note that the incumbent operators are potential rivals to WISPs for these bands. Telus has been advancing their current network towards 5G speeds, consequently testing the 3.5 GHz spectrum as customers demand more of their wireless network and this spectrum provides increased capability to cover wide urban areas and inside buildings to deliver true 5G speeds.[119] However, ISED should consider that the national operators already have significant spectrum holdings that are not fully utilized. Perhaps Telus' claim to the 3.5 GHz band for its 5G operations is not incompatible with the needs of WISPs who mostly operate in rural and remote areas of Canada.

In the 2018-2022 Spectrum Outlook consultation document, ISED stated in paragraphs 141 and 142 that it plans to expand the consultation on the 3500 MHz band to the whole 3400 – 4200 MHz range given the global interest in that band for 5G and the expected decline of Fixed Satellite Service (FSS). The 3400 – 4200 MHz range has the potential to increase the bandwidth currently assigned to FWA by more than 250%. Not that the whole band would necessarily be assigned to 5G or FWA operations, but there is certainly a possibility to reserve some spectrum for WISPs. The 3GPP LTE bands 42 and 43 (3400 to 3800 MHz) represent on their own almost twice as much spectrum than what is currently available for FWA use in the 3.5 and 3.65 GHz bands in Canada.

In the near future, ISED should consider experimenting with priority licensing for WISPs in rural and remote areas. For example, ISED could expand the 3.65GHz band to include a portion of the C band (3.7GHz to 3.8GHz) with similar licensing conditions

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[118] Source: *Based on the what we know of ISED priorities and your industry knowledge, what is a 'realistic ask' that we'd included in the White Paper – especially in the key bands: 3475-3650 MHz and 3650-3700 MHz bands* (*Survey Q13).*

[119] https://www.telus.com/en/about/news-and-events/media-releases/scorching-fast-5g-performance-achieved-in-live-environment-as-telus-successfully-tests-ghz-spectrum

and ensure fixed satellite (FSS) stations that are using the spectrum, have protection from FWA operations.

The existing FWA ecosystems (both standard-based and proprietary) would allow WISPs to take advantage of this much-needed additional spectrum immediately to increase serve levels in rural and remote areas without having to wait for ISED's review of the 3400MHz to 4200MHz band.

ISED managed spectrum subordination process

ISED should consider tightening its rules against warehousing of spectrum and primary licence holders should be encouraged to make available subordinated spectrum to small service providers – especially in rural areas.

ISED should consider a managed process where all requests for subordinated spectrum would be tracked from the initial request through to final response by the primary licence holder. Thus, both refusals and agreements for subordinated licensing would be tracked and the requesting party would be able to have recourse to 3rd party arbitration in the case where they feel their request was arbitrarily refused (either by ISED or 3rd party arbitrator). This would go a long way in helping WISPs getting access to spectrum they need.

Experimenting with Dynamic spectrum access and Priority Licencing

LBT (Listen Before Talk) technology has the potential to replace the need for centralized databases and regulatory oversight.

ISED should continue to monitor the technological progress made on features such as LBT and consider implementing pilot projects (similar to the TV White space initiative) to continue to find ways of increasing the efficiency of spectrum allocation in Canada.

3.4.2. Auction frameworks

ISED auction frameworks and rules have generally been designed to favor participation by large, well-funded, service providers. Smaller service providers such as WISPs that are efficient and responsive in providing broadband services in low density rural areas are often neglected in the auction design.

In previous licensing and in particular in past auctions, set-asides and caps were put in place to foster competition - at the expense of some auction revenues. However, the beneficiaries of set asides have been the regional operators – Videotron, Eastlink, Public Mobile, Shaw, not the smaller players such as the WISPs. Similarly, the use of large, highly aggregated licence areas by ISED in auction processes continues to favour acquisition of spectrum by large, well-financed operators over smaller players such as ISPs and WISPs.

Auction formats used by ISED such as the combinatorial clock auctions (CCA): 700MHz auction 2014 and the 2500MHz in 2016 and the upcoming (May 15, 2018) single

envelop residual auction with its 500 potential bid combinations have been complex and require significant financial and professional resources which are out of reach for many smaller firms.

In order to effectively promote participation in auction processes for WISPs, ISED should consider simple auction formats along with a combination spectrum set asides or spectrum caps.[120] *The use of spectrum caps and/or set asides that would effectively prevent 'spectrum rich' operators from hoovering up the spectrum.*

ISED has used Tier 3 and 4 mapping to delimit lot sizes for its auction events. These larger lots are simply too expensive for WISPs. In some cases, the lots include larger towns that are targeted by incumbent operators and are thus too expensive for WISPs to bid.[121] In other cases, the service areas include the smaller towns that WISPs need in order to be viable i.e. WISPs business case requires a mix of smaller towns and villages along with rural households.

ISED should consider the delimitation of smaller licence areas for auctions that better correspond to WISPs service areas. Development of smaller license areas such as Tier 5 would encourage access for WISPs at an affordable price and promote development of services to rural customers.

ISED should consider setting reserve prices lower for lots in rural areas as a means to lower the cost base of service providers in the roll out of new infrastructure and development of telecommunication services[122]

ISED should consider other auction formats such as simultaneous, multiple round, ascending auctions (SMRA) and single-envelop auctions that have simple, straight-forward rules. Such auctions would favour participation of smaller players – including WISPs.

3.4.3. Spectrum license conditions

WISPs struggle with ISED's current framework governing licence condition as these do not recognize the market and operating challenges in rural and remote areas. WISP service areas typically have much lower household density, lower disposable income and lower average revenues (ARPU) than urban and suburban service areas. WISP service areas require significant investment in backhaul infrastructure just to connect their service areas over long distances to major towns where they can connect to the Internet.

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[120] CanWISP's recommendation for auction set asides concords with the BCBA submission to ISED.

[121] Survey Q 20.

[122] CCA submission to ISED Spectrum 2018-22 Consultation Section 5.4.3 & 5.4.4; http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11333.html#s4

ISED should consider varying spectrum license conditions (CoLs) such as roll out requirements, etc. for smaller service providers in order to reflect the market conditions and correspondingly the financial viability of services and sustainability of service providers.

CanWISP also agrees with the BC Broadband Association (BCBA) proposals as follows: for smaller service providers with turnover of $50M or less ISED should consider lighter regulatory requirements (ISED and CRTC reporting); and reduced application and reporting processes associated with grant programs for small projects.

Currently, WISPs that are subordinate licence holders must deal not only with the commercial terms set by the incumbent licence holders – typically, the national operators but also with different licence periods of primary and subordinated spectrum licences that do not correspond.

The licence periods of primary and subordinated spectrum licences should correspond.

As indicated previously, incumbent licence holders – typically, the national operators are 'spectrum rich' with 100MHz plus spectrum holdings in their service areas. There is very little incentive for these operators to share unutilized or underutilized spectrum with spectrum needy service providers such as WISPs. In some cases, the primary licence holder has made only minimal infrastructure investment in towers and base stations in order to be able to claim to ISED that it is 'servicing' subscribers in the licence area.

While ISED does have rules against warehousing spectrum, the application of re-farming - take back of spectrum and re-licensing in a higher economic use has only been applied occasionally in obvious cases such as Inukshuk - the joint Rogers-Bell holdings.

ISED should consider tightening its rules against warehousing of spectrum and primary licence holders should be encouraged to make available subordinated spectrum to small service providers – especially in rural areas. An ISED managed process where spectrum subordination requests would be tracked, preventing them from being dismissed by incumbents without a valid reason would go a long way in helping WISPs getting access to spectrum they need.

ISED spectrum management policy should be measured by the intensity of use of spectrum by service providers and correspondingly, access to broadband services by citizens across the country.

With the rapid evolution of 5G networks[123], wireline and wireless network platforms will be fully integrated, and WISPs will eventually share a common technology platform with mobile carriers. This will enable WISPs to deliver much higher speeds and ability to run more complex applications.

[123] 5G standard is to be ratified/released/frozen by 3GPP in September 2018, with equipment likely available sometime in 2019 and first deployments launching in 2020. See: http://www.3gpp.org/specifications

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In order for WISPs to fully participate in this new technology window, CRTC's policy framework needs to be changed to promote access by WISPs to operators' networks based on the wholesale pricing model. Similarly, ISED's policy framework need to be changed to promote the active 'sharing' of spectrum between operators and WISPs in rural areas.

By making spectrum available for the smaller, innovative WISPs, ISED will be facilitating a more diverse group of spectrum holders that will drive increased broadband penetration across Canada.

3.4.4. Spectrum license fee framework

License fees are part of a regulator's toolkit to encourage access and efficient use of spectrum. ISED's current license framework is based on a mix of indexing dating back years and fees based on market valuation including auction events. ISED has indicated that it will be reviewing its spectrum fee policy.
As indicated in the Spectrum Usage section above, the current method used by ISED to calculate license fees for access or backhaul spectrum is based on equivalent DS0 or 64 kbps channels i.e. tied to speed. This method results in inefficient use of spectrum and investments with current and limit WISPs' ability to use wireless technology.

90% (38/42) of respondents indicated that current backhaul licence fee calculations prevent effective use of spectrum while 21% (9/42) while indicated problems with both access and backhaul spectrum fees. Most respondents called for backhaul fees based on Channel Width used rather than DS0 multiples.

There is a consensus amongst WISPs, that the calculation of spectrum fees should be based on market valuation[124] as is the case in benchmarked countries[125].

[124] In the January 2018 RABC meetings, there appeared to be a consensus for fees based on market valuation.

[125] Australia, UK and US set spectrum fees based directly, or indirectly on market valuation – generally prices paid in auctions. Ofcom: https://www.ofcom.org.uk/about-ofcom/latest/media/media-releases/2015/2016-spectrum-auction ACMA: https://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Spectrum-licences/spectrum-auctions-list-spectrum-planning-acma.

4. CONCLUSIONS AND RECOMMENDATIONS

WISPs are critical component in the delivery of broadband services in rural communities and have demonstrated their ability to provide broadband service to subscribers with innovative and cost-efficient service offerings. However, WISPs current lack access to adequate, dedicated spectrum will compromise their ability to deliver the next generation of broadband services to their subscribers.

In absence of dynamic, competitive WISP sector in provision of telecommunications services in rural and remote communities, the introduction of new and innovative services will be delayed, the price of broadband services will be significantly higher, and overall access to broadband services lower.

WISPs require enhanced access to additional secure, licensed spectrum in a number of bands. Currently, WISPs do not really have access to secure, licensed spectrum save a few exceptions in the 2.3 or 3.5 GHz bands. In those bands, the licensing is through primary or subordinate licensing from operators. In the latter case, operators can pre-empt the subordinate licensees thus compromising WISPs technical plans and business viability.

ISED should consider expanding the amount of spectrum made available to WISPs in the 3.65GHz band in order to enable them to enhance their current service packages and roll out the next generation of broadband services. ISED should continue to expand the spectrum available in the 5GHz band[126] as regulators in the US and the UK have done and consider WISP needs in the 2.4GHz, 3.5GHz, 11GHz and other bands.

Recommendations

Access of affordable and secure spectrum for WISPs and correspondingly, access to affordable and innovative services in rural and remote areas, requires a combination of policies and funding mechanisms. In this section, we summarize the recommendations from previous sections that constitute an integrated approach to spectrum planning, management and funding.

Funding of Broadband Access

It is incumbent for ISED - as the policy ministry, to provide permanent funding programs that are commensurate with the funding needs of its own broadband policy. ISED should ensure that the funding rules enable smaller service providers opportunities for funding equal to those

[126] See https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11294.html

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of the national operators. ISED should consider funding cost efficient last mile solutions as well as the fiber – based backbone projects which tend to favor projects by the national operators.

ISED should work closely with CRTC's funding in order to maximize the impacts in rural areas.

ISED should use the mapping database to determine eligibility of areas and eliminate case of overbuild and where existing service providers contest the eligibility of service areas, there should be a dispute process.[127]

Spectrum planning

WISPs play an essential role in the fulfilment of ISED (and CRTC) policy goal of broadband access for citizens in rural areas. ISED has asked service providers to transition from 5Mbbps/1Mbps to the new 50Mbps/10Mbps broadband access goal. However, ISED has not provided WISPs with the corresponding spectrum resources to effectively reach those new higher goals.

ISED should formally recognize the WISP contribution in delivering broadband in rural areas, their current status as 'spectrum poor' and actively promote WISP access to affordable, secure spectrum in their service areas.

In the immediate future, ISED should promote access for WISPs to the 3.5MHz and 3.65MHz bands – the 'workhorse bands' for WISPs (re. Q13). In the longer term, ISED should promote access for WISPs in both lower (e.g. 600MHz) and higher bands (mm Wave bands) as they become available for spectrum auctions.

ISED spectrum management policy should be measured by the intensity of use of spectrum by service providers and correspondingly, access to broadband services by citizens across the country.

In the near future, ISED should consider experimenting with priority licensing for WISPs in rural and remote areas. ISED could expand the 3.65GHz band to include a portion of the C band (3.7GHz to 3.8GHz) with similar licensing conditions and ensure fixed satellite (FSS) stations that are using the spectrum, have protection from FWA operations.

Auction processes

As auctions are the primary vehicle for spectrum licensing. In order to be effectively promote access for WISPs, ISED auction terms would need to be adapted to WISPs 'spectrum poor' status and financial resources.

Thus, in order to be effectively promote participation in auction processes for WISPs and other smaller, 'spectrum-poor' service providers, ISED should consider simple auction formats such as simultaneous, multiple round, ascending auctions (SMRA) and single-envelop auctions that

[127] BCBA supported a similar dispute resolution process in its submission to ISED.

have simple, straight-forward rules which would favour participation of smaller players – including WISPs.

ISED should consider a combination spectrum set asides or spectrum caps.[128] *would effectively prevent 'spectrum rich' operators from hoovering up the spectrum.*

ISED should consider the delimitation of smaller licence areas for auctions that better correspond to WISPs service areas. Development of smaller license areas such as Tier 5 that reflect the economics of the rural and remote telecoms markets would encourage access for WISPs at an affordable price and promote development of services to rural customers.

ISED should consider setting reserve prices lower for lots in rural areas as a means to lower the cost base of service providers in the roll out of new infrastructure and development of telecommunication services[129]

ISED managed spectrum subordination process

ISED should consider tightening its rules against warehousing of spectrum and primary licence holders should be encouraged to make available subordinated spectrum to small service providers – especially in rural areas.

ISED should consider a managed process where all requests for subordinated spectrum would be tracked from the initial request through to final response by the primary licence holder. Thus, both refusals and agreements for subordinated licensing would be tracked and the requesting party would be able to have recourse to 3rd party arbitration in the case where they feel their request was arbitrarily refused (either by ISED or 3rd party arbitrator). This would go a long way in helping WISPs getting access to spectrum they need.

Licensing conditions

ISED should consider varying spectrum license conditions (CoLs) such as roll out requirements, etc. for smaller service providers in order to reflect the market conditions and correspondingly the financial viability of services and sustainability of service providers.

For smaller service providers with turnover of $50M or less ISED (and CRTC) should consider lighter regulatory including reporting requirements and reduced application and reporting processes associated with grant programs for small projects. CanWISP agrees with the BC Broadband Association (BCBA) proposals to ISED for

The licence periods of primary and subordinated spectrum licences should correspond.

In order for WISPs to fully participate in the 5G technology window, CRTC's policy framework needs to be changed to promote access by WISPs to operators' networks based on the

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[128] CanWISP's recommendation for auction set asides concords with the BCBA submission to ISED.

[129] CCA submission to ISED Spectrum 2018-22 Consultation Section 5.4.3 & 5.4.4; http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11333.html#s4

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wholesale pricing model. Similarly, ISED's policy framework need to be changed to promote the active 'sharing' of spectrum between operators and WISPs in rural areas.

Experimenting with Dynamic spectrum access and Priority Licencing

ISED should continue to monitor the technological progress made on features such as LBT (Listen Before Talk) and consider implementing pilot projects (similar to the TV White space initiative) to continue to find ways of increasing the efficiency of spectrum allocation in Canada. ISED should considered experimenting with priority licensing in rural and remote areas, not only through the use of centralised databases, but through technology that actively monitors that the spectrum is unused before using it.

Licence Fees

The calculation of spectrum fees should be based on market valuation and quoted in $/MHz

Fees should be higher for lower spectrum bands;

ISED should consider a congestion-based fee structure that would result in a fee reduction in less congested rural and remote areas;

ISED should consider a reduction in current fees associated with high capacity links used by WISPs in rural and remote areas based on the economic value to the service providers; and,

ISED should charge spectrum licensees higher spectrum fees in the case that the spectrum is underutilized or simply not utilized at all.

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