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Consultation on the Technical and Policy Framework for Radio Local Area Network Devices Operating in the 5150-5250 MHz Frequency Band

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I. Introduction and Summary

Cisco Systems, Inc. (Cisco) hereby provides its comment in support of advancing changes in technical regulations for Radio Local Area Network (RLAN) devices in the 5150-5250 MHz band. Cisco applauds Innovation, Science, Economic Development Canada for raising important spectrum policy questions that will, if adopted, optimize this band for RLAN use by Canadian consumers while protecting incumbent interests.

Cisco is deeply committed to Canada. In operation since 1990, Cisco Canada has approximately 1700 employees across the country and offices in Toronto (HQ), Ottawa, Kanata, Montreal, Vancouver, Calgary, Edmonton, Winnipeg and Halifax. Cisco's Kanata R&D facility is home to approximately 600 employees and is one of only four R&D facilities for Cisco globally. Cisco's Toronto Innovation Centre which opened in January 2016 and is focused on digital innovation, is one of nine for Cisco worldwide and the only one in North America. Additionally, Cisco Canada supports 292 Networking Academies with over 22,000 students currently enrolled, funds 12 university research chairs, has launched a $150M venture capital fund and supports CSR programming such as our Connected North program and Women's Entrepreneurs Circle.

The 5150-5250 MHz band in its current configuration opened to RLAN use in 2005. In 2005, Facebook was celebrating its first birthday, Instagram would not be available until 2010, and Snapchat would not be born until 2011. Smartphone technology was brand new. Live streaming a program off the Internet was nascent. As for Wi-Fi, the most commercially significant of RLAN technologies, it was using the IEEE 802.11a technology, with an average

throughput of around 20 megabits per second. Wi-Fi was interesting, growing in popularity, but it wasn't yet viewed as economically important. For that reason, RLANs using the band were, and continue to be, restricted to indoor use with a maximum e.i.r.p. of 200 mW.

Twelve years later, we stand in a different place. Wi-Fi is the workhorse of the Internet, carrying more traffic to and from client devices than either fixed wired technologies or cellular mobile technologies. In Canada, Cisco projects that by 2021, 55 percent of all IP traffic will begin or end on a Wi-Fi network. Distinguished economists have studied regulatory systems that support widespread Wi-Fi, and found that such regimes contribute to positive changes in Gross Domestic Product. Consumers and businesses alike demand robust Wi-Fi, and the technology has become key to business operations as varied as manufacturing to banking to agriculture. Demand for Wi-Fi has soared, and based on Cisco's projections, will continue to increase for the foreseeable future.

The questions that ISED raises in this consultation, therefore, are both timely and important for Canadian citizens and the economy. The first question – looking at the benefits of raising power levels for RLANs in the 5150-5250 MHz band – is critical. Allowing higher power levels that will support outdoor uses –and that also allow *indoor deployments* to operate at power higher than 200 mW – will spur the use of Wi-Fi throughout the Canadian economy, and will benefit consumers who increasingly rely on Wi-Fi for broadband connectivity. The second question – whether incumbent satellite users can be protected – is also important, and can be answered in the affirmative. Provided ISED adopts the proposed mitigations of an

outdoor antenna mask that has been proven in other jurisdictions, and adopts a light licensing approach, ISED can proceed with confidence that it is doing no harm – now or in the future – to satellite incumbents. Third, ISED asks questions about the regulatory regime it could or should adopt. In Cisco's view, ISED should strive for a regime that is as close as possible to the US regulations adopted in 2014, recognizing that the underlying legal foundations may be somewhat different.

Other countries are beginning to recognize the wisdom of maximizing the Wi-Fi opportunity. Not only has Canada's southern neighbor changed its policy in 2014, but that change is now being adopted in other regional economies. Panama has recently adopted a US rule approach.[1] In the United Kingdom, a panel of experts has recently recommended to Ofcom to take up the question of higher power (subject to mitigations to protect incumbents).[2]

In this submission, Cisco will first discuss how demand has changed profoundly for Wi-Fi and where Cisco forecasts demand to be through 2021. The projected demand increases through 2020 and 2021 show that consumers and businesses continue to reach for Wi-Fi as their connection of choice to the Internet. Cisco will then review the economic literature around Wi-Fi deployment, which concludes that nations that have robust and advanced Wi-Fi capability experience economic growth associated with the value that Wi-Fi brings to the

[1] Resolucion AN No. 10784 – Telco, Autoridad Nacional De Los Servicios Publicos, Gaceta Oficial Digital, martes 27 diciembre de 2016 pagina (page) 15-16.
[2] http://www.techuk.org/insights/reports/item/10050-industry-priorities-for-making-best-use-of-5ghz-spectrum

broadband ecosystem. Improved access to Wi-Fi will help Canada take full advantage of this effect. This comment also reviews the technological changes in Wi-Fi to demonstrate the need to adjust rules to accommodate, and take advantage of, the current generation of technology. Cisco will also review the record amassed by the US FCC on use of the antenna mask to protect satellite incumbents, as well as the US registration system. With these factual predicates, Cisco will respond to the three questions raised in the consultation: (1) Cisco believes there is both demand for and economic benefits to allowing HPODs in the 5150-5250 MHz band ahead of WRC-19 and urges prompt action on this consultation; (2) Cisco believes that utilizing an elevation mask will protect satellite systems from interference; and (3) Cisco believes a regulatory approach similar to that adopted by the US FCC will ensure timely deployment, while also protecting existing and future services in the band. Finally, Cisco respectfully requests that ISED also consider adjusting its rules for indoor operations in the band to permit higher power levels.

II. Demand, economic benefits, and technology requirements support maximizing access to Wi-Fi today

A. Demand

When considering access to spectrum for unlicensed devices, Cisco believes the starting point is an understanding of the demand-based changes occurring in the use of unlicensed spectrum. Where, as here, demand is growing sharply, it is important to act promptly to improve access to the radio spectrum resource. Each year, Cisco releases a rolling five-year forecast called the “Visual Networking Index”, including both a study that looks exclusively at mobile data demand and unlicensed offloading (released in February), as well as a study of all

types of IP or Internet traffic that also looks at demand for fixed applications of unlicensed (released in June).[3] To date, the dominant technology in the unlicensed category has been Wi-Fi. Cisco's forecast has proven to be highly accurate over time, and is widely used by regulators globally in considering a range of issues that relate to how demand will be growing in the future.

First, Wi-Fi in Canada, like most developed economies, is the most-used technology platform by which consumers and businesses access the Internet:

- Canada's fixed/Wi-Fi (Wi-Fi at the edge of a fixed broadband connection) represents 57.6 percent of Canada's total Internet traffic in 2015, and will be 64.9 percent of Canada's total Internet traffic in 2020.
- While mobile data traffic is growing, it remains a fraction of Wi-Fi traffic. Canada's Mobile data was 4.6 percent of total Internet traffic in 2015, and will be 9.9 percent of total Internet traffic in 2020.
- The remainder of traffic is fixed/wired traffic. Of note, Canada's fixed/Wi-Fi Internet traffic will be 2.6 times larger than fixed/wired Internet traffic by 2020.

Second, Wi-Fi technologies are increasingly used by Canadian mobile phone subscribers to offload traffic from licensed mobile networks to Wi-Fi networks.

- Without offload, Canada's mobile data traffic would grow at a compound annual growth rate of 41 percent instead of 36 percent, creating additional congestion on mobile networks (assuming other factors such as spectrum allocations do not change).
- 71 percent of Canada's mobile data traffic was offloaded in 2016.
- 75 percent of Canada's mobile data traffic will be offloaded by 2021.
- These trends are driven by the increasing uptake of smartphones. The amount of traffic offloaded from smartphones will be 78 percent by 2021, compared to 69 percent at the end of 2016.

[3] www.cisco.com/go/vni The landing page allows a user to select either the Mobile Visual Networking Forecast tool (February 2017) or the Complete Visual Networking Forecast tool (June 2016). Either tool allows you to filter the data by country and to select Canada.

From these statistics, it is easy to see that Canada stands in a similar position to most developed countries in terms of how its citizens and visitors are increasingly depending upon Wi-Fi for connectivity, and how demand will continue to increase through 2021.

B. Economic benefits

Economic benefits of maximizing access to Wi-Fi are also a key factor, underscoring just how important unlicensed use is to economic growth, to consumer welfare, and to helping to control the cost of mobile networks through offloading. While there are no studies specific to Canada, a brief review of the literature demonstrates why Canadian policymakers should be interested in maximizing the use of unlicensed spectrum for technologies such as Wi-Fi. By any measure, the numbers listed below are large – whether they are an attempt to measure macro-economic effects or the benefits to operators of offloading.

- Value of Unlicensed Spectrum in the US – Katz (2014) In this study, the author reviewed four economic studies of the value of unlicensed spectrum. He notes that "unlicensed spectrum should be considered a critical production factor that generates value across four dimensions:
    - complementing wireline and cellular technologies, thereby enhancing their effectiveness;
    - providing an environment conducive to the development of alternative technologies, thus expanding consumer choice;
    - enabling the launch of innovative business models;
    - expanding access to communications services beyond what is economically optimal by technologies operating in licensed bands.

  The compilation of effects outlined above indicates that the technologies operating in unlicensed spectrum bands in the United States generated a total economic value of $222 billion in 2013 and contributed $ 6.7 billion to the nation's GDP.[4] "

[4] Value of Unlicensed Spectrum, Katz (2014) available at http://www.wififorward.org/wp-content/uploads/2014/01/Value-of-Unlicensed-Spectrum-to-the-US-Economy-Full-Report.pdf at 6-8.

In nominal GDP terms, if Canada's economy is roughly 8% of the US economy, the total economic value of unlicensed technologies in Canada is easily on the order of 20-$25 billion Canadian dollars.

- The Economic Significance of Unlicensed to the Future of the Internet, Thanki (2012).[5] Thanki finds that on a global basis, Wi-Fi substantially enhances the value of fixed broadband, increasing take-up and allowing connections to be effectively shared between multiple individuals. He states that 439 million households – 25 percent of all households worldwide – have home Wi-Fi networks, and that each household may derive a yearly benefit from Wi-Fi of $118 to $225 resulting in a total economic gain for all households of around $52 to $99 billion annually. Without Wi-Fi, the value of fixed broadband would be lower and would result in the disconnection of perhaps 50 to 114 million fixed broadband connections around the world. At Annex 3, Thanki presents a calculation of the total number of mobile operator cell sites needed to meet demand in the absence of Wi-Fi offloading – for Canada, up to 27,000 depending on frequency and customer usage. Per ISED, there are today about 13,000 cell sites.[6]

- Future-Proofing Wi-Fi: The Case for More Spectrum, Plum Consulting (2013) at Appendix D.[7] In a study to support expansion of unlicensed spectrum to meet higher bandwidth requirements in Europe, Plum found: "Since expanded access to spectrum enables higher speeds, we obtain a Net Present Value (NPV) benefit estimate for Europe of €12.3 billion in terms of gains in speed by giving access to contiguous spectrum at 5 GHz…. We obtain an NPV benefit estimate for Europe of €4.0 billion from cost savings due to additional mobile offload." The total NPV therefore exceeds €16 billion.

- Future Use of License-Exempt Spectrum UK – Plum Consulting (2016).[8] This study stands for the general need to maximize use of the 5 GHz band, but did not specifically recommend a change in 5150-5250 power levels. "Plum estimated the

[5] The Economic Significance of Unlicensed to the Future of the Internet, Thanki (2012) available at: http://www.wirelessinnovationalliance.org/index.cfm?objectid=dc8708c0-d1d2-11e1-96e9000c296ba163

[6] See http://www.ic.gc.ca/eic/site/ic-gc.nsf/eng/07422.html

[7] "Future-Proofing Wi-Fi: The Case for More Spectrum," Plum Consulting (2013) Appendix D, available at: http://plumconsulting.co.uk/future-proofing-wi-fi-–-case-more-spectrum/

[8] "Future Use of License-Exempt Spectrum UK," Plum Consulting (2016) at page 11, available at http://plumconsulting.co.uk/future-use-licence-exempt-spectrum/

economic value of Wi-Fi access in Europe in 2013 to be approximately €15 Billion. Based on the assumptions that the percentage of households with fixed broadband would grow to 95% and that the value per household would grow by a further 30% in real terms to reflect the increased number of digital devices in the home, the projected value for 2023 was expected to grow to €23 billion."

- Study on the impact of traffic offloading and related technological trends on the demand for wireless broadband spectrum, European Commission DG Communications Networks, Content & Technology (2013).[9] This study looks at how the annualized cost of mobile networks would be significantly greater in the absence of users' ability to offload to Wi-Fi, finding results on the order of €15-50 billion depending on country.

Cisco can think of no reason why the economic impacts of better access to unlicensed spectrum in Canada would be any different in kind than that of Europe or the US.

C. Technological imperatives

Just as LTE and other technologies are evolving to meet growing consumer demand for data, so is Wi-Fi. The current standard for Wi-Fi is IEEE 802.11ac, which provides for various channel widths of up to 160 MHz wide, along with a host of other technological improvements.[10] It is worth emphasizing that 802.11ac technology has been designed to ONLY operate in the 5 GHz band where broader channelization is possible, and does not operate in the unlicensed band at 2.4 GHz.

[9] "Study on the impact of traffic offloading and related technological trends on the demand for wireless broadband spectrum," European Commission DG Communications Networks, Content & Technology (2013) at pages 153-154 available at http://bookshop.europa.eu/en/study-on-impact-of-traffic-off-loading-and-related-technological-trends-on-the-demand-for-wireless-broadband-spectrum-pbKK0113239/

[10] Industry is already working on IEEE 802.11ax, the next generation of Wi-Fi, which will contain technical improvements that, for example, increase the ability of networks to support larger number of users. But 802.11ax will not change the basic channelization introduced in 802.11ac. Products with the 802.11ax designation will begin appearing in 2017.

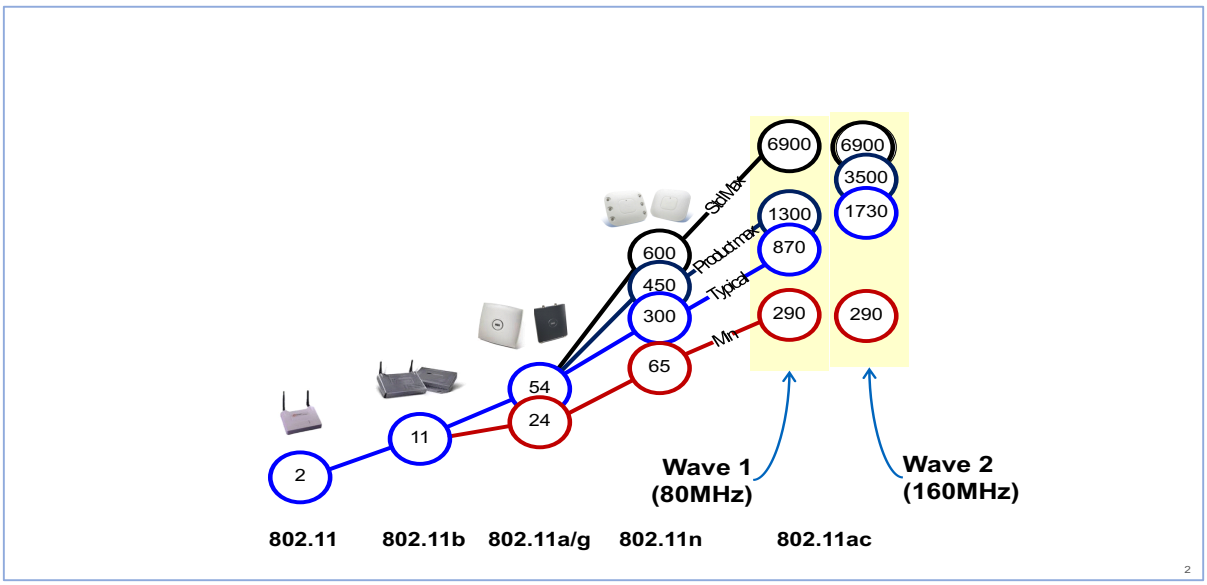
- Unlike 802.11n, which is limited to a maximum channel bandwidth of 40 MHz, 802.11ac permits channel bandwidths of 80 MHz and 160 MHz, which increase speeds by 117% and 333%, respectively;

- 802.11ac employs higher-density modulation, accommodating up to 256 quadrature amplitude modulation (QAM), as opposed to the maximum 64 QAM permitted under 802.11n (for a 33% speed burst at shorter, yet still usable, ranges); and

- Whereas 802.11n allowed only four simultaneous spatial data streams, 802.11ac provides for eight (for another 100% increase in speed).

The "real world" relevance of these improvements in IEEE 802.11ac is manifest. As illustrated by the following graphic, for the minimum permissible 802.11ac product configuration, speeds will be 4.4 times faster than the corresponding 802.11n product. Mid-tier and higher-end 802.11ac products are nearly three times faster than their 802.11n counterparts.

Evolution of Wi-Fi Technology

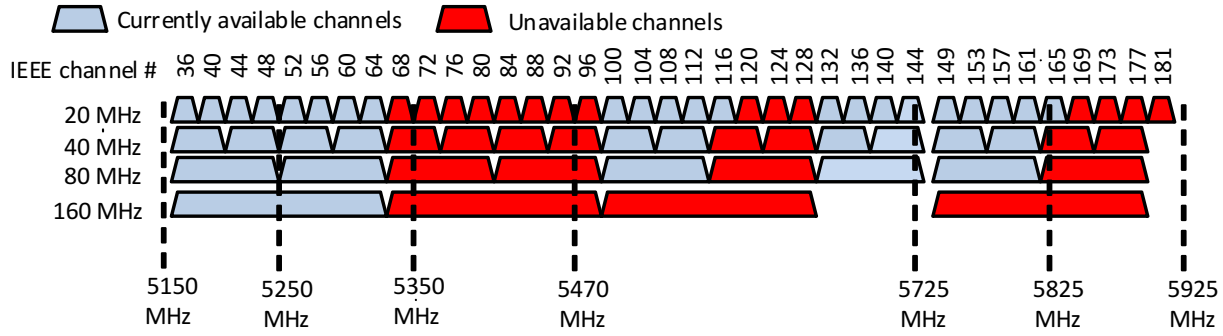


Source: Cisco[11]

[11] This chart was originally presented in a white paper "802.11ac: The Fifth Generation of Wi-Fi Technical White Paper" which can found at:

These improvements have real value as networks are increasingly used to transmit high definition video, a trend that Cisco continues to track in its VNI forecast.[12] In Canada specifically, Internet video traffic will grow three-fold from 2015 to 2020, a compound annual growth rate of 27 percent. Consumer Internet *video* traffic will be 83 percent of consumer Internet traffic in 2020, up from 71 percent in 2015. As discussed in the Demand section above, the majority of that video will originate or terminate on a Wi-Fi network.

Yet Canadian consumers today have access to only five 80 MHz wide channels, and no contiguous 160 MHz channels are available for use outdoors. In addition, the 80 MHz channel contained within the 5150-5250 MHz band is today permitted only at very low power. Canadians are therefore making limited use of the latest generation of Wi-Fi, a situation that can and should be remedied. Below is a chart showing the available channels in Canada.



http://www.cisco.com/c/en/us/products/collateral/wireless/aironet-3600-series/white_paper_c11-713103.html

[12] http://www.cisco.com/c/m/en_us/solutions/service-provider/vni-forecast-highlights.html#

The need for prompt action to improve access to radio spectrum is underscored by a recent spectrum needs study from the Wi-Fi Alliance.[13] That study, by Quotient Associates, found that globally, nations should be looking to add between 500 MHz and up to 1 GHz of spectrum for unlicensed technologies by the year 2025 to meet network demands during the Internet "busy hour." The study further stressed the importance of contiguous spectrum to take advantage of current and future iterations of technology that require wide channelization. In Cisco's view, the first place to look for that spectrum is to improve the ability of consumers to use spectrum within the 5 GHz band.

III. Comparative view: US regulatory history of 5150-5250 MHz

As ISED considers improving access to 5150-5250 MHz, it is worth understanding the history of the debate in the United States. In 2014, the US regulator faced the same conundrum as ISED. Despite sharp increases in demand for Wi-Fi, new spectrum allocations had not been made for nearly 10 years. During that time, Wi-Fi technology itself had changed substantially, specifically with new requirements for wide channelization that existing 5 GHz spectrum allocations were challenged to meet. Moreover, the entire Wi-Fi ecosystem had matured considerably, with players as diverse as private wireless internet service providers,

[13] Wi-Fi Spectrum Needs Study, Quotient Associates (2017) available at: http://www.wi-fi.org/news-events/newsroom/additional-unlicensed-spectrum-needed-to-deliver-future-wi-fi-connectivity

cable operators, municipalities, and even wireless operators deploying more Wi-Fi not just indoors, but increasingly out of doors. Without Wi-Fi offloading, mobile operators would be experiencing network congestion more often. Decisions that had been taken to minimize radio energy from radio local area networks (RLANs) more than a decade earlier in anticipation of satellite deployments appeared ripe for re-balancing in light of the relatively light use of 5150-5250 MHz by satellite. And, it was clear that Wi-Fi had become and would likely remain the technology workhorse of the Internet, originating or terminating more data than any other technology.

What is significant about this history is that the Wi-Fi industry and the satellite incumbent were largely able to agree on the conditions under which Wi-Fi could make improved use of the band. It is noteworthy that the decision was not appealed by any party. As a result, it is worth understanding the agreement that was reached in the US and why it worked to address all private interests and to support the public interest as well.

In the case of the US rules, the elevation mask rule was the product of a negotiation involving both cable operators and Globalstar. The rule addresses Globalstar's concern that aggregate radio energy from HPODs would adversely impact its satellite operations. By keeping the HPOD radio energy near a horizontal plane, the aggregate HPOD energy that the satellite processors will receive is considerably lessened, enabling both uses to share the same spectrum effectively.

The US antenna elevation mask rule first aired in an ex parte filing from the National Cable and Telecommunications Association, a document that makes three proposals salient to the ISED consultation:

(1) "[B]ase stations must use an antenna that limits effective isotropically radiated power ("EIRP") to no more than 125 mW in areas beyond 30 degrees above the horizontal plane. In other words, this requirement would impose a restriction that is equivalent to -9 dBi peak gain, and, as a result would further reduce energy received by Globalstar satellites."[14]
(2) Indoor deployments are exempt from the antenna mask rule, and can operate up to 1W. Building materials will attenuate the signals sufficiently well to protect satellites.
(3) Devices that do not support the antenna mask, or that are not indoors, could operate at 250 mW, representing a small increase from the existing 200 mW limit under existing FCC rules. NCTA made this proposal because it would allow devices used in other 5 GHz bands to be immediately deployed in 5150-5250 MHz and would further support deployment of IEEE 802.11ac technology with its wide channelization.

In response, Globalstar reported that it met with FCC staff and "reiterated Globalstar's general support for the antenna standard recently proposed by [NCTA}…."[15] While agreeing with the antenna elevation mask, Globalstar indicated its preference for making other modifications to the NCTA proposal:

[14] Ex Parte of the National Cable & Telecommunications Association in FCC ET Docket No. 13-49, filed March 4, 2014 at page 2. The ex parte also discusses the use of point-to-point links in the band, arguing that these highly directional antenna deployments are also not likely to impact satellite operations. The FCC ultimately adopted this view in its final rules, but because the issue is not raised in the ISED consultation document, we do not address it in our comment.
[15] Ex Parte of Globalstar, Inc. in ET Docket 13-49, filed March 18, 2014.

NCTA antenna mask	Globalstar – agreement
NCTA indoor operations at 1W	Globalstar – did not address as a concern
NCTA allow devices with no mask up to 250 mW	Globalstar – "Commission should only permit already deployed outdoor … access points to operate up to the proposed 250 mW conducted power level without complying with the new antenna standard." FCC should require a "permissive change" procedure to require operators to disclose where and how many of these devices will be in operation, as well as technical parameters.
	Globalstar advocated for operators deploying more than 100 outdoor access points to notify the FCC about the particulars of their deployments, to describe how they could mitigate if issues later arose, and commit to cooperating fully should harmful interference occur.

As a result, the issues in the FCC proceeding were boiled down to two: (1) whether and to what extent to allow existing devices in the 5725-5850 MHz band to operate at 250 mW in the 5150-5250 MHz band without an antenna mask and (2) whether to require some form of registration system for large outdoor deployments.

In its decision, the FCC said the following:

Antenna mask/outdoor use/1W conducted power: the mask as proposed makes it "far less likely that harmful interference will occur, even for proliferation of access points greater than presumed in either party's earlier analysis."[16]

Indoor use: access points deployed indoors may operate at 1W of conducted power with a 6 dBi antenna gain and no reduction in vertical antenna gain coupled with a requirement for a 1 dB reduction in conducted power for every 1 dB that the antenna gain exceeds 6 dBi.[17]

Use of access points outdoors with up to 250 mW of conducted power: while the FCC encouraged device manufacturers to meet the antenna mask requirement and thereby

[16] Report and Order, ET Docket 13-49 at para 36.
[17] Report and Order, ET Docket 13-49 at para. 44.

> allow access points to operate at 1W, the FCC did allow previously deployed systems at 5725-5850 MHz to operate at up to 250 mW in the 5150-5250 MHz band if the operators sought and received a waiver to do so. The FCC noted that it expected to act favorably and promptly on waiver requests submitted within 30 days of the date the new rules took effect.[18]
>
> Notification of large deployments: before deploying outdoor systems consisting of more than 1,000 access points, companies must submit a letter to the FCC acknowledging that should harmful interference occur, they will be required to take corrective action.[19]

At the time the NCTA proposed the antenna mask rule and the FCC adopted it, most antennas in use commercially could not meet the FCC's requirement. In Cisco's view, however, there was no technological barrier to creating such a mask. Since the effective date of the order, a variety of devices from multiple manufacturers have been successfully brought to market. As a result, equipment is available for the Canadian market should ISED choose a similar approach.

The relaxation of indoor limits further supported the FCC's desire to have its rules better align to the capabilities of current and next generation Wi-Fi, including to take advantage of improved throughput due to wide channelization. Together, these revised rules for outdoor and indoor use of RLANS represent a substantial adjustment in FCC regulation to recognize and support advancements in Wi-Fi technology. As a result, US consumers and businesses have access to a speedier and more modern version of Wi-Fi technology than they did under the old rules, and Wi-Fi can continue to play an important role in the growing the US economy.

[18] Report and Order at para. 41.
[19] Report and Order at para. 38.

IV. Issue A: Both unlicensed demand and economic benefits compel ISED to act ahead of WRC-19

ISED should act promptly to improve access to spectrum by unlicensed technologies in the 5150-5250 MHz band. As the discussion Section II illustrates, use of Wi-Fi by consumers and businesses has reached a critical mass in Canada. Wi-Fi networks are the platform of choice for accessing the Internet and IP networks more generally (e.g., enterprise networks). [20] Canadian users prefer Wi-Fi more than fixed connections and more than mobile connections when transmitting data. The demand for Wi-Fi shows that consumers and employees want to consume data at a place of their convenience, which is not necessarily tethered to a wall with a fixed wired Internet connection. Wi-Fi makes it possible for them to consume data throughout their homes, places of business, and public spaces as well. A Wi-Fi router positioned at the end of a broadband connection is now expected, for consumers and enterprises large and small. And public Wi-Fi is increasingly common, as the Consultation document discussed.[21]

Demand for Wi-Fi will continue to grow, as Cisco's VNI projects. This has been true in a period when unlimited data caps have been in vogue for wireless services, and when they have not. And while carrier pricing will influence the rate of growth, the undeniable trajectory for demand is up. That is reflected in the Cisco VNI 2017 projection that Canadians would offload 75 percent of their mobile data traffic to Wi-Fi by 2021. Improvements in Wi-Fi, and its ability

[20] The VNI looks at how Wi-Fi is being used for both Internet traffic and more generally, for all types of IP traffic. Wi-Fi represented 57.6 percent of Internet traffic and 40 percent of IP traffic. By 2020, Wi-Fi will represent 52 percent of IP traffic.
http://www.cisco.com/c/m/en_us/solutions/service-provider/vni-forecast-highlights.html#

[21] Consultation at 5 (citing Cisco data that public and home hot spots will increase 13-fold from 2015 to 2020, or from 0.8 million to 10.2 million).

to handle both higher video volumes and density in users and devices that will be serviced by an access point, will also continue to support the upward demand trajectory as the user experience improves.

The economic studies reviewed in this comment for the most part present benefits in terms of snapshots in time, and demonstrate large economic benefits. For example, Katz (2014) calculates a total economic value of Wi-Fi in 2013 of $222 billion for the US and a GDP growth of $6.7 billion. With Wi-Fi becoming more important to the Internet ecosystem, those estimates would, if made today, likely be larger. Plum Consulting (2013) found a net present value to Europeans of €12.3 billion simply by allocating a continuous block of spectrum for unlicensed. Thanki (2014) and Plum (2016) looked at positive economic benefits to households arising from unlicensed use. Plum includes a projection through 2023 for Europe estimating a €23 billion net benefit to households.

Offloading increases consumption of broadband and reduces carrier cost in promulgating cell sites. Both Thanki (2014) and EC/DG Communications Networks, Content, and Technology (2013) find large savings, with the latter study noting savings of €15-50 billion per country from offloading. In the absence of Wi-Fi, there would either be less connectivity because added cells would not be built, or much higher carrier cost if cell sites were used to remedy 100 percent of demand pressures.

Of course, these studies do not answer the narrow question posed in the consultation about the benefits of allowing increased unlicensed access to spectrum in Canada at 5150-5250 MHz through higher power levels. In Cisco's view, attempts to allocate these economic benefits

to improvements in unlicensed access at 5150-5250 MHz are unnecessary. What these studies stand for is the substantial body of economic evidence that unlicensed technologies make an enormously valuable contribution to national economies and benefit consumers, both from improved connectivity and lower cost to mobile services generally. It logically follows that improving access to spectrum for unlicensed technologies improves upon the benefits already accruing to Canadian consumers from the use of Wi-Fi. ISED should be confident in making such a finding.

As summarized in the technology discussion above, current 5 GHz allocations do a poor job of letting Canadian consumers and businesses utilize current generation unlicensed technology. Only five 80 MHz channels are available – one of which is restricted to indoor use and very low power. No 160 MHz wide channel is available. Given the demand for Wi-Fi and the broad economic benefits of maximizing the utilization of unlicensed technologies, ISED should act to improve the rules for 5150-5250 MHz immediately. Delay until sometime after WRC-19 is a missed opportunity. Not only would ISED be turning a blind eye to consumer preference for Wi-Fi, but real economic benefits would be foregone. For that reason, ISED should act now.

V. Issue B: An outdoor antenna mask and exclusion zones will protect satellite incumbents

The consultation document proposes that should the regulations change for the 5150-5250 MHz band to allow higher powered devices outdoors, it will be necessary to require those

devices to support an elevation mask to protect satellite use of the band.[22] Based on the discussion above, Cisco believes that using an antenna elevation mask to protect satellites from outdoor unlicensed transmissions is reasonable and will protect current and future satellite systems. In the US experience, there was unanimous agreement among all parties – including the satellite incumbent- that such an approach would protect satellites. In the US to date there have been no issues with the US rules, which have been available since 2014. Cisco urges ISED to adopt the same approach as the US rule, namely to specify the elevation to be protected and allow manufacturers to meet the requirements. Equipment that meets the elevation mask requirements is available today, and by authorizing its use with higher powers, ISED will be making a significant step forward in improving unlicensed access to spectrum.

VI. Issue C: A regulatory regime for outdoor Wi-Fi deployments in the band will help ISED protect existing and future services in the band

The consultation document reviewed various approaches to regulate HPODs. The first approach might be a detailed license exempt regime specific to HPODs.[23] The consultation

[22] Consultation at 6. In addition, the proposal also references the need for the use of exclusion zones to protect existing and future satellite earth stations, and notes that one earth station identified so far could be protected with an exclusion zone of 25 kilometers. Consultation at 4, 6. The consultation states that exclusion zones might have to be adjusted going forward depending upon future satellite earth stations. In principle, Cisco has no objection to the use of exclusion zones to protect satellite earth stations, particularly in a band such as this one where there are relatively few earth stations to protect. However, Cisco notes that ISED has offered very little data about the number of earth stations that are or would be subject to exclusion zones, and whether those zones would prevent the use of 5150-5250 MHz in urban areas. In the absence of full data, Cisco believes that there may be other less-intrusive policy options that could potentially be considered.

[23] Consultation at 6-7.

document notes that extensive new text development in the regulations would be time consuming, and would likely delay the introduction of HPODs until a date subsequent to the World Radio Conference 2019. The second approach discussed is to adopt a form of a license regime. The document notes that this, too, is a significant departure from existing regulation and creates higher administrative burdens on HPOD operators. The document also states that to reduce administrative burdens, licenses might only be available to "radiocommunication service providers." Finally, the consultation document notes that ISED could simply defer action until after WRC-19 as part of its post-WRC-19 examination of Canadian spectrum and radio policies generally.

In Cisco's view, options that delay the benefits of today's unlicensed technologies to consumers and businesses are best avoided. Such approaches defer the benefits that the economy and consumers could be receiving from improved access to unlicensed technologies and specifically, Wi-Fi. For that reason, the option of developing an extensive new license exempt regime for HPODs should be discarded, as should the option of waiting until after WRC-19. ISED should act as soon as possible to improve access to spectrum at 5150-5250 MHz.

Cisco recommends that ISED embrace an approach that is similar to the US FCC's decisions with respect to outdoor utilization of the band at higher power. Specifically, we recommend a streamlined registration requirement for network operators that are deploying a large number of outdoor access points using the higher power and antenna mask. The registration could be as simple as a letter to the docket acknowledging that the network

operator is deploying more than a specified number of outdoor access points utilizing the band, and providing a point of contact should ISED need to contact the operator in the future. To the extent an allegation of satellite interference arises in the future (which we do not believe will occur), the regulator is benefited by knowing which network operators are facilitating outdoor use by deploying access points. The network operators, in turn, will know what equipment they have deployed, where they have deployed it, and can reach out to manufacturers as necessary. This is a reasonable way for ISED to respond promptly to interference allegations should they arise.

In addition, Cisco urges ISED to make whatever system it adopts available to all comers, and not to restrict the regime to radiocommunication service providers. For example, large enterprises with extensive outdoor facilities (e.g., ports, mines) should be allowed to take advantage of improved access to spectrum under the new rules. Given the importance of this spectrum to meet rising demand, and to deliver economic benefits, enterprise operators should not be excluded because they are not offering service to the public.

Other than increasing the power levels and imposing an outdoor antenna mask, ISED should not revise RSS-247 for HPODs, such as creating a completely new regulatory structure governing HPODs. We further recommend against the creation of eligibility requirements for using the band. Nor would we recommend any other conditions apply to use of the band.

VII. ISED should relax rules for indoor use of Wi-Fi to allow conducted power up to 1W

In the consultation, ISED states that the existing equipment standards in RSS-247 would continue to apply to devices designed for indoor use.[24] As a result, indoor devices would continue to operate at 200 mW. In Cisco's view, this outcome represents a missed opportunity. Cisco urges ISED to reform its rules for indoor operations to allow devices to operate up to 1W conducted power.

Given the sharp increase in demand that has occurred for Wi-Fi since 2005, the continuing forecast demand growth discussed above, the economic benefits and technological imperatives, ISED should use every opportunity to maximize the utility of 5 GHz spectrum for consumers and businesses. While Wi-Fi enables spectrum re-use by transmitting at relatively low power, the 200 mW power levels that currently apply to 5150-5250 MHz indoor use fail to deliver a good user experience. Regulatory rules that allow devices to operate at higher powers indoors (master devices at 1W conducted +6dBi gain antenna or 4W EIRP, and client devices at 250mW + 6dBi gain antenna or 1W EIRP) enable users to take full advantage of current Wi-Fi capabilities in their homes and places of business. Specifically, these higher powers help radio signals penetrate interior wall construction, and multiple interior walls. In the consumer's case, this enables better in-home reception for Wi-Fi, which is now used for streaming video, video chat, social media and much more. In the case of businesses, improved power enables more efficient networking opportunities with better coverage to support an increasing array of use

[24] Consultation at 6.

cases. It should be noted that in the case of the more advanced Wi-Fi enterprise networking equipment, power is dynamically controlled to ensure coverage, meaning that all transmitters would rarely be operating at the maximum power allowed under regulation.

Making this adjustment to indoor regulations adds to the economic and consumer benefits that will accrue from the proposed changes to outdoor regulations. In fact, as Wi-Fi continues to be much more of an indoor technology than an outdoor one, the benefits to be gained from adjusting the indoor rules are logically greater.

Finally, it is worth noting that when this adjustment to the US rules was made in 2014, there was no objection from the incumbent satellite operator. Simply put, indoor devices operate under a roof, and roofing material attenuates the signal. In effect, the roof operates as the antenna mask, protecting the satellites from RLAN energy when they are overhead.

VIII. Conclusion

Cisco recommends that ISED move to a decision in this consultation as soon as possible. In our view, deferring a decision on outdoor HPOD operation in 5150-5250 MHz denies consumers and business the benefits of currently available technology, and misses an opportunity for the Canadian economy to grow. Similarly, we respectfully request that ISED consider relaxing the rules for indoor operation in the band as well.

Respectfully submitted,

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