

**Before  
INDUSTRY CANADA  
Ottawa, Canada**

*In the Matter of*

Consultation on Allocation Changes  
and Revisions to Spectrum Utilization  
Policy and Technical Rules in the  
5 GHz Band

Notice No. DGTP-005-04

**COMMENTS OF CISCO SYSTEMS, INC.**

**CISCO SYSTEMS, INC.**

Mary Brown  
David Case

601 Pennsylvania Ave., NW  
Washington, D.C. 20004  
(202) 661-4000

**HARRIS, WILTSHIRE & GRANNIS LLP**

Scott Blake Harris  
Damon C. Ladson \*

1200 18th Street, NW  
Washington, DC 20036  
(202) 730-1300

*Counsel to Cisco Systems, Inc*

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\* Technology Policy Advisor

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Cisco Systems Inc. (Cisco) is a worldwide leader in networking solutions for the Internet and a leading manufacturer of equipment for “unlicensed” wireless services, including devices that operate in the 5 GHz band. It is pleased to provide comments in response to Industry Canada’s Consultation on 5 GHz issues, and to share its views about the most appropriate rules for using 5 GHz frequencies.<sup>1</sup>

As Industry Canada knows, Canada and the United States were instrumental in forging both a regional proposal in the Inter-American Telecommunication Commission (CITEL),<sup>2</sup> and a final decision at the 2003 World Radiocommunication Conference (WRC-03), on the allocation and use of the 5 GHz band. The WRC-03 decision provides the necessary foundation for administrations to adopt national regulations for using 5

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<sup>1</sup> See *Consultation on Allocation Changes and Revisions to Spectrum Utilization Policy and Technical Rules in the 5 GHz Band*, Radiocommunication Act, Notice No. DGTP-005-04 (February 2004) (“*Consultation*”).

<sup>2</sup> See *I Meeting of Permanent Consultative Committee II: Radiocommunications Including Broadcasting*, Inter-American Proposals Part 2, (February 3 – 7, 2003), available at [http://www.citel.oas.org/WRC/wrc2003/PZ!R-0216r2num\\_i.pdf](http://www.citel.oas.org/WRC/wrc2003/PZ!R-0216r2num_i.pdf)

GHz frequencies in a way that will foster greater deployment of low-cost, wireless broadband networks. This task was recently completed in the United States.<sup>3</sup> As Cisco noted in the United States' Federal Communications Commission's (FCC) rulemaking proceeding, because WRC-03 delegates reached general agreement on most 5 GHz issues, turning the WRC-03 results into national rules is relatively simple.<sup>4</sup>

### **DISCUSSION**

Experts across the world generally agree that ubiquitous, reasonably priced broadband services will lead to the development of new information technology services that improve productivity, enrich lives, and benefit every sector of society. Wireless technologies – including technologies for operating in the unlicensed bands – can play a critical role in bringing broadband to those who do not yet have it, and to increase its utility to those who do. Indeed, Industry Canada has been in the vanguard of those advancing wireless broadband initiatives, particularly for remote and rural areas.<sup>5</sup> Its current rules for license-exempt services are a model for other administrations.

Industry Canada is aware, then, that for low-cost wireless broadband to become widely available, the right technology must be available, sufficient spectrum must be

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<sup>3</sup> See *Revision of Parts 2 and 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, Report and Order, 18 FCC Rcd. 24484 (rel Nov. 18, 2003) (“*Report and Order*”).

<sup>4</sup> See generally *Revisions of Part 2 and 15 of the commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5GHZ Band.*, Comments of Cisco Systems Inc. ET Docket No. 03-122 (Sept. 3, 2003).

<sup>5</sup> See, e.g., *Some Examples of Wireless Broadband Solutions and Initiatives for Rural and Remote Communications in Canada International* Telecommunication Union, ITU-R 8A/9B, available at <http://www.itu.int/md/meetingdoc.asp?type=sitems&lang=e&parent=R03-8A.9B-C-0022>; *ICT4D Bridging the Digital Divide; The Canadian Experience*, ITU Telecom World 2003, 14 October, 2003, Geneva, available at [http://broadband.gc.ca/pub/media/presentations/binder/itu141003\\_en.pdf](http://broadband.gc.ca/pub/media/presentations/binder/itu141003_en.pdf) describing the steps Industry Canada is taking to provide broadband internet access to all communities in Canada – including its *Broadband for Rural and Northern Development Pilot Program* (providing funding to organizations to facilitate broadband deployment to all Canadian communities by 2005).

allocated, and the “right” regulatory environment must be established. Not surprisingly, Cisco believes that Industry Canada’s proposals for the allocation and use of additional 5 GHz spectrum for unlicensed services are thoughtful and generally will assist Canada in achieving its broadband goals. However, to provide an optimal environment for the rollout of 5 GHz broadband, some adjustments to these proposals are needed.

**I. COMMON SPECTRUM AND TECHNICAL RULES AND DEPLOYMENT FLEXIBILITY ARE ESSENTIAL FOR RAPID 5 GHz BROADBAND DEPLOYMENT**

To make broadband readily accessible to as many people as possible, administrations should implement national rules and policies that allow industry to deploy broadband using a variety of platforms. Different platforms not only are the key to a competitive infrastructure market, but operators can tailor different platforms to fit their differing cost, architecture and geographic needs.

License exempt wireless broadband technology provides a delivery platform particularly suited to low-cost broadband deployment, and perhaps uniquely suited to deployment in rural and remote areas. Wireless broadband deployment at 5 GHz is particularly attractive because unlike deployment in the 2.4 GHz range where only 83.5 MHz of spectrum is available for wireless broadband deployment<sup>6</sup>, up to 455 MHz of spectrum is available for 5 GHz broadband applications.

But to speed 5 GHz broadband deployment, and to do so efficiently for both manufacturers and users, administrations should adopt harmonized spectrum designations/allocations,<sup>7</sup> and technical and operational rules. This will allow

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<sup>6</sup> This spectrum must be shared with other unlicensed devices like cordless telephones and baby monitors as well as microwave ovens and other RF-emitting devices not used for communications.

<sup>7</sup> As Industry Canada knows, the U.S. Federal Communications Commission chose not to add new 5 GHz mobile allocations to its Table of Frequency Allocations. Instead it retained its existing “Part 15” regulatory regime, which permits devices to operate on a non-interference basis. See 47 C.F.R. §15.5.

manufactures to build common devices that can be sold without modification in a number of countries, resulting in lower costs to users.

The need for common devices is critical. When one nation adopts “unique” technical restrictions, it may have an adverse impact on that nation. Manufacturers may build unique equipment for that national market, losing economies of scale; the devices then become more expensive and demand is dampened. Alternatively, manufacturers may decide not to sell devices to customers in that market, restricting or eliminating their availability. In either case, consumers are hurt. Moreover, license exempt 2.4 GHz and 5 GHz equipment is – and ideally should be – easily transportable across borders by consumers. Thus, unique restrictions mean that consumers are likely to travel between countries with wireless devices that do not meet national regulations. The best solution is to adopt, to the extent possible, common spectrum designations, and technical and compliance rules. Common rules promote economies of scale and speedy deployment, which translates into broader access to broadband.

## **II. MOST OF INDUSTRY CANADA’S PROPOSALS WILL PROMOTE RAPID DEPLOYMENT OF 5 GHZ BROADBAND DEVICES NETWORKS**

In its Consultation, Industry Canada makes a number of proposals consistent with the results of WRC-03 that are – for practical purposes – aligned with the recent decisions taken by the U.S. Federal Communications Commission.<sup>8</sup> That is not surprising, given that Canada and the U.S. share a common broadband vision and worked closely together during the WRC process. Cisco wholeheartedly supports the following Consultation proposals:<sup>9</sup>

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<sup>8</sup> *See Report and Order* at Appendix B.

<sup>9</sup> Industry Canada also proposes to adopt the relevant new international footnotes that WRC-03 applied to various 5 GHz frequency bands. Cisco supports adoption of the international footnotes.

- ❖ An upgrade of the radiolocation service from secondary to primary allocation status in the band 5350-5650 MHz.<sup>10</sup>
- ❖ A new primary status allocation for the Earth exploration-satellite service in the band 5460-5570 MHz.<sup>11</sup>
- ❖ A new primary status allocation for the space research (active) service in the band 5350-5570 MHz.<sup>12</sup>
- ❖ A new allocation to mobile service on a primary basis in the bands 5150-5350 MHz and 5470-5725 MHz.<sup>13</sup>
- ❖ Maintaining the existing technical rules specified in Radio Standard Specification No. 210 (RSS-210) pertaining to the band 5150-5350 MHz.<sup>14</sup>
- ❖ Outdoor use of the 5250-5350 MHz band.<sup>15</sup>
- ❖ The requirement for dynamic frequency selection (DFS) to protect the radiolocation service in the bands 5250-5350 MHz and 5470-5725 MHz.<sup>16</sup>
- ❖ The requirement for transmit power control (TPC) to mitigate potential interference to the radiolocation service and to EESS and SRS operations in the 5250-5350 MHz and 5470-5725 MHz bands.<sup>17</sup>

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<sup>10</sup> See *Consultation* at 3.

<sup>11</sup> See *Id.*

<sup>12</sup> See *Id.*

<sup>13</sup> See *Id.* at 4. Cisco notes that Industry Canada is proposing a new mobile allocation to its table of frequency allocations, while the FCC did not adopt a “table allocation” for 5 GHz devices that were already operating pursuant to Part 15 of its rules. Cisco supports any regulatory regime that would provide 5 GHz wireless broadband operations some measure of protection from other unlicensed devices seeking access to 5 GHz frequencies, and thus supports this proposal

<sup>14</sup> See *Id.* at 7.

<sup>15</sup> See *Id.* at 11.

<sup>16</sup> See *Id.* at 12. Industry Canada proposes to be implement DFS in accordance with technical parameters set forth in Recommendation ITU-R M.1652.

<sup>17</sup> See *Id.* at 12-13.

If adopted, these proposals will capture essential elements of WRC-03's 5 GHz decisions that are needed to promote flexible wireless 5 GHz deployment.

### **III. THE PROPOSED E.I.R.P. ELEVATION ANGLE MASK IS NOT ECONOMICALLY FEASIBLE FOR 5 GHz WIRELESS BROADBAND DEVICES**

The Consultation document also contains a proposed requirement that 5 GHz devices comply with an e.i.r.p. elevation angle mask, when operating outdoors and above 200 mW e.i.r.p. in the 5250-5350 MHz band.<sup>18</sup> Cisco respectfully urges Industry Canada to drop this proposal. Cisco recognizes that this was intended to be “compromise” proposal allowing some outdoor use of the 5250-5350 band. Unfortunately, while the proposal was well intended, an emissions mask like that proposed would make the band effectively useless in Canada.

Cisco has analyzed the proposal to determine how the e.i.r.p. elevation angle mask could be implemented, and to determine how that would change production of the planned 5 GHz devices that will be built and marketed for countries not employing such a mask. Based on this evaluation, Cisco has concluded that the emission mask proposal is simply unworkable due to its cost. Moreover, it would severely limit the functionality of the devices. Outdoor devices would be limited to very narrow beam, short-range point-to-point systems – and be of little use to anyone.

A key to the success of 2.4 GHz wireless broadband systems has been their reasonable cost for consumers, educational institutions, governments and businesses. Cost will also be a major factor in the success or failure of 5 GHz wireless broadband systems. And the two new WRC-03 requirements that received universal support at WRC-03 – DFS and TPC – will add cost to future 5 GHz devices. Imposing the e.i.r.p.

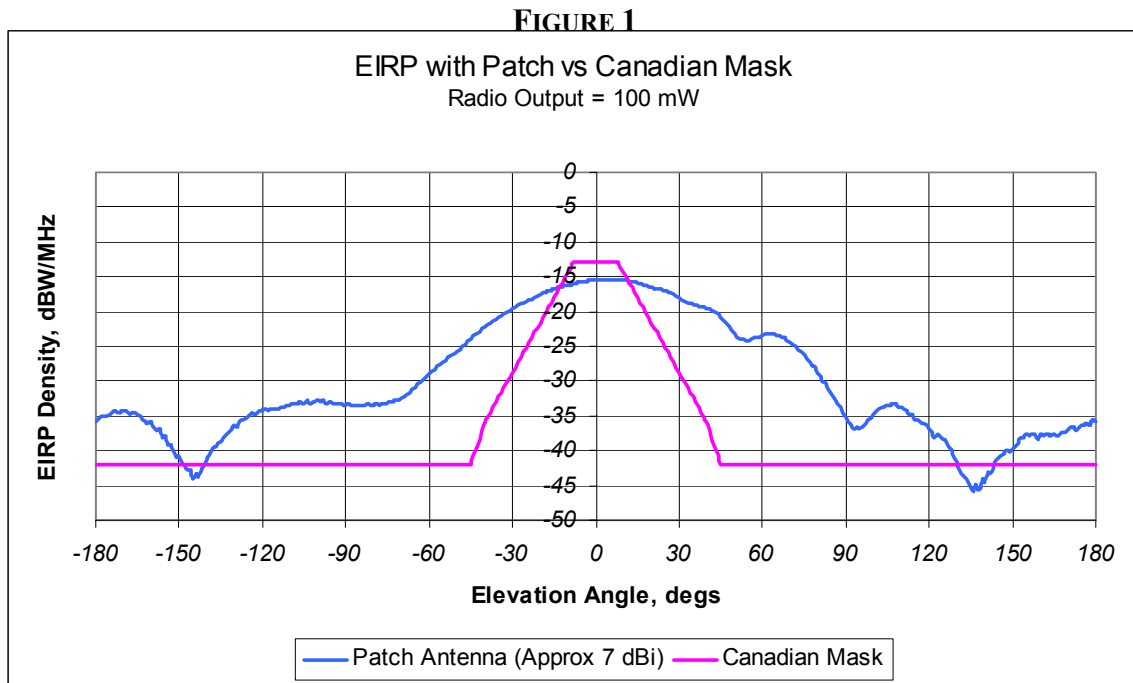
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<sup>18</sup> Id.

elevation angle mask would add too much additional cost to these devices, and would limit their functionality. Either would mean commercial failure.

Cisco's engineers have compared what would be required to build an antenna capable of meeting the proposed emissions mask to antennas typically used in Wi-Fi devices. Figures 1 and 2 below provide graphic comparisons of e.i.r.p. density versus elevation angle for two types of antennas typically used in commercially available Wi-Fi devices.

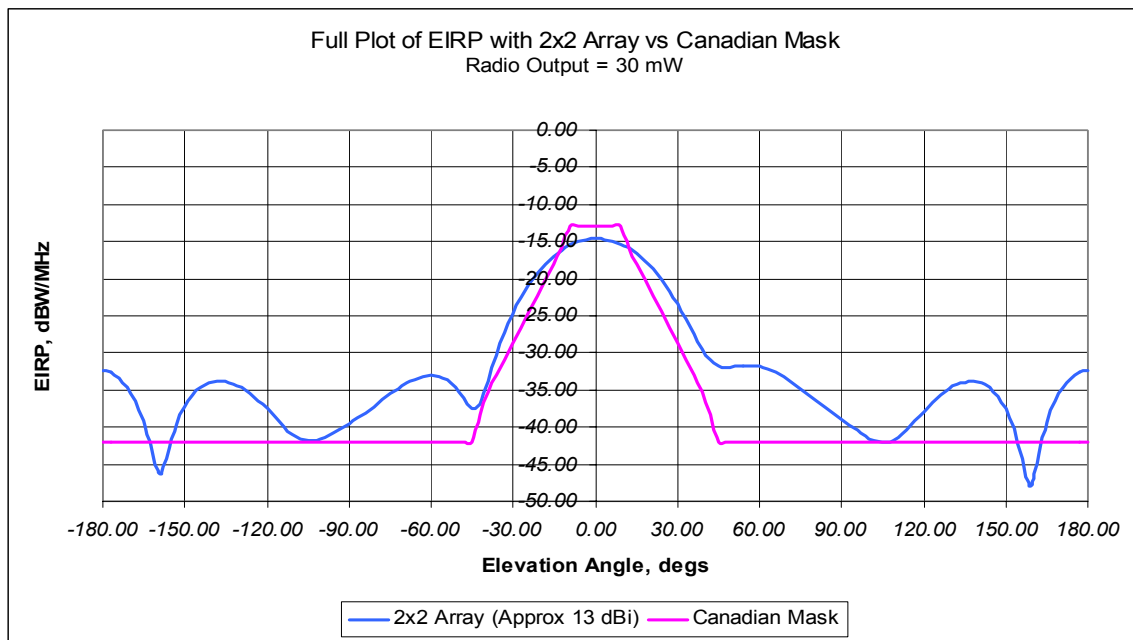
In Figure 1, a plot of e.i.r.p. density versus elevation angle for a typical 7 dBi gain patch antenna used in a 100 mW radio is compared to the same plot for the Canadian mask. The 3 dB beam width of the commercial antenna is considerably wider than is required to comply with the mask, while the antenna front-to-back ratio<sup>19</sup> is considerably lower than is required.



<sup>19</sup> The front-to-back ratio is considered to be the ratio of the gain of the main (highest gain) antenna lobe to the gain of the next highest gain antenna lobe.

In Figure 2, the same parameters are plotted for a typical 13 dBi gain 2 x 2 patch array antenna used in a 30 mW radio and are compared to the plot for the Canadian mask. Again the 3 dB beam width of the production antenna is too wide, and again the front-to-back ratio is considerably lower than is required. Moreover, the commercial antenna's side lobes far exceed the mask limits.

**Figure 2**



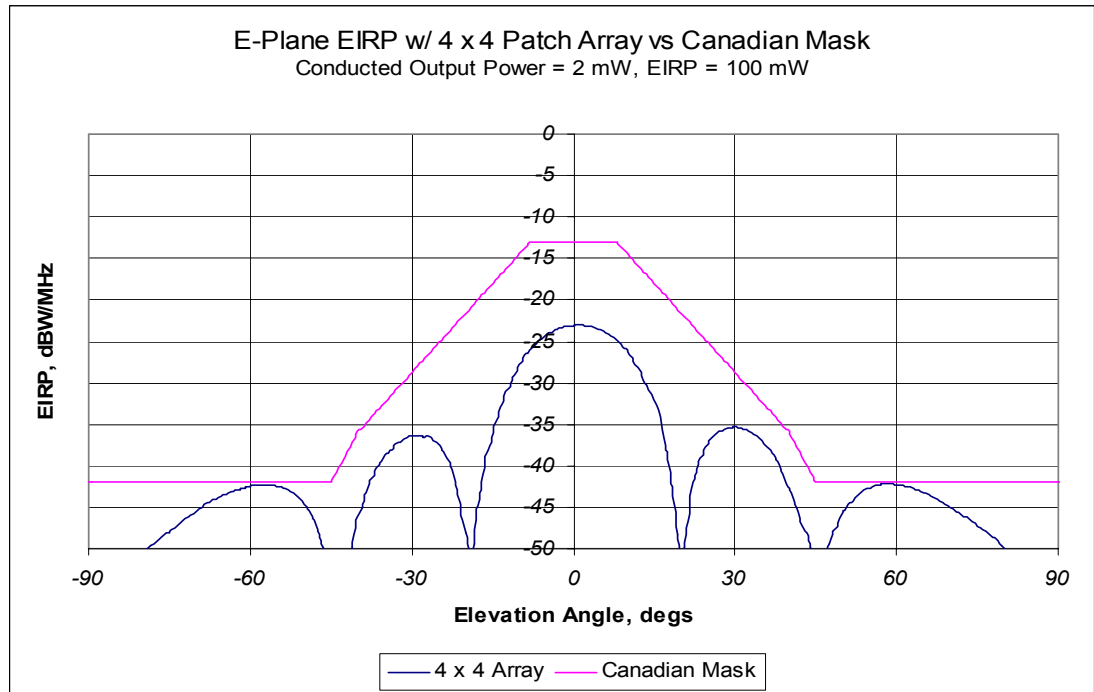
Finally, in Figure 3, the same parameters are plotted, but for a 17 dBi gain 4 x 4 patch array<sup>20</sup> antenna that would fall within the 25 degree elevation plane beam width dictated by the Canadian mask. However, this antenna would still be unacceptable under emission mask proposal unless the conducted power was reduced to 2 mW to yield an e.i.r.p. of 100 mW. Any, e.i.r.p. above 100 mW results in a system that exceeds the mask. Thus, it is not just a problem making an antenna that can meet the mask

<sup>20</sup> A 4 x 4 patch array antenna would be reasonably inexpensive (about \$15 to build; more to purchase from a vendor) and reasonably efficient and small.

requirement, it is also a problem making the entire radio *system* meet the requirements.

The system in Figure 3 would be severely limited in its application.

**Figure 3**



These graphical representations show that, even at very low power, antennas used for commercial Wi-Fi devices cannot comply with the proposed mask.<sup>21</sup> To comply with the proposed mask, manufacturers would be required to scrap current antenna designs in favor of custom antennas radically different (and more expensive) than antennas used today. As an initial matter, these new antennas would need carefully designed amplitude and phase tapers to reduce the level of the side lobes and to increase the front-to-back ratio. In addition, the 3 dB beam width would need to be narrowed significantly, and, as

<sup>21</sup> 'Usable' in the sense that the antennas can be produced in volume at a price point consistent with a low cost device.

shown in the “Figure 3” example, even a narrowed beam width does not guarantee a widely usable device.<sup>22</sup>

Cisco believes that antennas and systems that can meet the proposed emissions mask requirements simply will not be commercially viable and, thus, will never be built. Simply put, the antennas will raise the cost of production such that demand will be adversely affected, thereby limiting the market opportunity to such an extent that manufacturers will not be interested in producing small quantities of devices that would be sold into a small market. Moreover, it is likely that antennas for wireless network interface cards (NICs) just cannot be built; these antennas must be molded into a circuit mother board and the antennas needed to meet the mask requirements are narrow beam parabolic or yagi antennas that cannot etched into a board.

Meeting the proposed mask would also severely limit the functionality the devices. Essentially, an outdoor device meeting the mask requirements would be limited to very narrow beam, short-range point-to-point systems. Point-to-multi-point use essentially would be precluded because even at low power levels NICs would fail to meet the mask requirements.<sup>23</sup> This would surely have an adverse impact on those hoping to use these devices to provide broadband wireless Internet access.

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<sup>22</sup> There would also be a problem with the form factor of a mask compliant device. In a document titled *Co-Existence Between Wireless Access Systems Including RLANs and Earth Exploration Satellite Systems at 5 GHz Range* International Telecommunication Union, ITUR 8A/9B, Contribution 151, available at <http://www.itu.int/md/meetingdoc.asp?lang=e&type=sfolders&parent=R00-8A.9B-C&PageLB=25>. Canada suggests ways that manufacturers might meet the mask limits and refers to a “bifilar helical antenna” with an aperture of 2.8 wavelengths (this requires an antenna of about 6.25 inches, or about 7 inches with packaging). In the document the suggestion is made that this type of antenna combined with a “micro-machined silicon component (MEMS) tilt sensor could be used to produce a device that complies with the mask regardless of device orientation relative to the horizon. Even aside from the cost, the physical dimensions and directivity of helical antennas and extra power consumption of the sensor would render such a combination useless for normal WAS devices.

<sup>23</sup> In fact, Cisco is not aware of any current production antennas capable of complying with the mask.

The bottom line is that manufacturers cannot implement the mask because it entails completely redesigning antennas and other components, and adds far too much cost to devices that have gained acceptance because they are effective *and* inexpensive. Therefore, Cisco urges that Industry Canada drop the mask proposal.

#### **IV. THE ELEVATION ANGLE MASK IS NOT NEEDED TO PROTECT EESS**

No one disputes that protecting EESS from interference in the 5250-5350 MHz band is an important goal. However, large numbers of 5 GHz devices are already operating in that band with no interference problem. This suggests that neither an emission mask nor an indoor restriction is necessary to ensure successful EESS operations.

Potential interference to EESS from WAS networks would come not from a single WAS system, but from the aggregate output of a large number of outdoor systems actively transmitting within the EESS main beam. Though WRC-03 provides that WAS can operate both indoors and outdoors, in bands with low maximum e.i.r.p. limits – such as the 5250-5350 MHz band – most of the use will naturally occur indoors.<sup>24</sup> Thus, while there may be some important (even critical for certain network architectures) outdoor uses of the 5250-5350 MHz band, the likelihood is that without any restriction, outdoor use of the band will not create sufficient interference to EESS to be a problem.<sup>25</sup>

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<sup>24</sup> Cisco believes that the total outdoor use of Wi-Fi systems across all frequency bands will be 5 percent or less.

<sup>25</sup> In addition, EESS sensors need not receive “absolute” interference protection to carry out their function. Performance and Interference Criteria for Active Spaceborne Sensors, *available at* <http://www.itu.int/itudoc/itu-r/archives/rsg/1996-97/rwp7c/30779.html>. ITU Recommendation ITU-R SA.1166 (“*Rec. SA.1166*”) specifically provides for possibly exceeding EESS (active) interference thresholds. *Rec. SA.1166* makes allowances for interference in excess of recommended EESS interference thresholds as long as those thresholds are not exceeded for more than 1% of the images on a systematic basis or for 5% of the images on a random basis. *Rec. SA.1166* also recognizes that ITU-R studies on WAS-EESS sharing should continue and also that EESS protection “may be achieved using alternate sets of operation and technical limits.” This is consistent with *resolves 5*, Res. 229

There are also other factors that indicate the 5 GHz license-exempt services can continue to co-exist peacefully with EESS. First, “outdoor” WAS devices potentially have 355 MHz<sup>26</sup> of spectrum over which to operate. Consequently, with DFS causing devices to spread their transmissions over this large range of spectrum, even in urban areas where WAS deployment might be relatively dense, outdoor devices will not be concentrated solely in the 5250-5350 MHz band. Second, TPC will decrease the aggregate WAS “power” seen by an EESS receiver by 3 dB. Third, the aggregate level of WAS emissions will be self limiting. This is because deployment density is ultimately limited by the need to avoid intra-system interference. Fourth, WAS systems by design do not operate at 100% duty cycle and systems are not always fully loaded. All of these factors suggest that the likelihood of interference to EESS is small.

Finally, the nature of EESS operation suggests that the likelihood of harmful interference is minimal. Interference to EESS could occur when the satellite receiver is exposed to a large concentration of WAS emissions as the EESS satellite beam scans the earth. The interference “manifests” itself in some loss of data that results in “pixel dropout” in the digital image generated from that data. As the EESS satellite makes subsequent passes over the same point, it should be able to “recover” any lost data and through processing build a complete composite image. This means that in the event an EESS satellite were to experience interference as it observed a fixed point, in all likelihood the aggregate WAS emission level would be different (even zero) on subsequent satellite passes and the data would be recovered. In sum, the risk of actual

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(WRC-03) that provides administrations flexibility to protect EESS by means other than an indoor restriction or the e.i.r.p. elevation angle mask.

<sup>26</sup> Indeed they may have more. In the United States digital devices authorized pursuant to Section 15.247 of the FCC’s rules can operate all the way up to 5.850 GHz (25 MHz of additional spectrum).

harm being caused to EESS from 5 GHz systems is small, both because of the nature of the 5 GHz devices and the nature of the EESS.

## V. OTHER REGULATORY ISSUES

Test and Certification Procedures. In its Consultation, Industry Canada requests comment on appropriate test and certification procedures to ensure compliance with technical rules.<sup>27</sup> Cisco believes it is important that administrations ensure that 5 GHz RLAN devices comply with the DFS requirements defined in Annex 1 to Recommendation ITU-R M.1652. In the United States, Appendix C of the FCC's 5 GHz Report and Order contains interim measurement procedures for DFS-equipped U-NII devices.<sup>28</sup> However, a Government/Industry project team is refining those interim procedures by developing further recommendations which when completed will be recommended as final measurement procedures. When the Government/Industry group completes its work, it is expected that the U.S. FCC will replace its interim procedures. In addition, in Europe, ETSI has adopted harmonized DFS measurement procedures for devices marketed in Europe.<sup>29</sup> Cisco suggests that Industry Canada also review these procedures and consider adopting procedure harmonized with Europe and/or the United States.<sup>30</sup>

Effective Date of New Technical Requirements. Industry Canada proposes that new technical requirements be effective a year from the date of publication of its new

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<sup>27</sup> See Id. at 11.

<sup>28</sup> See *Report and Order*, 18 FCC Rcd. at Appendix C.

<sup>29</sup> See European Telecommunications Standards Institute, ETSI EN 301893, available at <http://www/etsi.org>.

<sup>30</sup> Cisco believes that Industry Canada should also ease its antenna-related rules by eliminating the integral antenna requirement that applies to devices operating in the 5150-5250 MHz band. It has made this same suggestion to the FCC, which has the proposal under consideration.

spectrum utilization policy for 5 GHz. This date will occur after the effective date recently adopted in the United States.<sup>31</sup> Canada's proposed effective date is reasonable, provided that the emission mask proposal is ultimately rejected.

### CONCLUSION

Industry Canada has been a leader in creating a regulatory framework permitting the growth of wireless broadband. Most of its proposals for the allocation and use of 5 GHz spectrum continue that tradition, and will bring great benefits to Canadian citizens and the Canadian economy. As the government has itself said: "The broadband revolution has the potential to bring Canadians and Canadian communities new opportunities in ... learning, health, business and entertainment."<sup>32</sup>

Unfortunately, the emission mask proposal stands in stark contrast to the rest of this consultation. While the proposal is well intended, it simply does not take into account the likely deployment and use of 5 GHz license-exempt devices or the realities of the commercial landscape. If the emission mask proposal is adopted, it will of necessity limit the availability of wireless broadband for Canadian consumers. And the truth is that EESS will be able to operate robustly even without adoption of the emission mask proposal – particularly in the rural areas where RLAN density is likely to be low and which make up most of the country's land mass (and presumably where EESS satellites perform their most important missions). Thus, Cisco respectfully urges that the emissions mask proposal be abandoned.

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<sup>31</sup> *Report and Order* at ¶42.

<sup>32</sup> See <http://broadband.gc.ca/pub/faqs/faqscomplete.html>.

**CISCO SYSTEMS, INC.**

Mary Brown  
David Case

601 Pennsylvania Ave., NW  
Washington, D.C. 20004  
(202) 661-4000

1 June 2004

Respectfully submitted,

**HARRIS, WILTSHIRE & GRANNIS LLP**

*Scott Blake Harris*

Scott Blake Harris  
Damon Ladson\*

1200 18th Street, NW  
Washington, DC 20036  
(202) 730-1300

*Counsel to Cisco Systems*

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\* Technology Policy Advisor