Dynamic Spectrum Alliance Limited
21 St Thomas Street
Bristol BS1 6JS
United Kingdom
http://www.dynamicspectrumalliance.org

3855 SW 153rd Drive
Beaverton, OR 97003
United States

DSA
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DSA Submission to the Telecom Regulatory Authority of India Consultation on Public Wi-Fi

Introduction

The Dynamic Spectrum Alliance (DSA) applauds the Telecom Regulatory Authority of India (TRAI) for issuing the "Consultation Paper on Proliferation of Broadband through Public Wi-Fi Networks" ('consultation paper'). [1] Based on the questions, the DSA believes the consultation paper will result in TRAI having a more thorough understanding of the factors it has identified as potentially limiting the expansion of public Wi-Fi today and the range of public policy options available that could rapidly accelerate its growth across the country.

The DSA is a global organization advocating for laws and regulations that will lead to more efficient and effective spectrum utilization. Our membership spans multinationals, small- and medium-sized enterprises, and academic, research, and other organizations from around the world, all working to create innovative solutions that will increase the amount of available spectrum to the benefit of consumers and businesses alike.[2] Our primary goals are to close the digital divide by reducing the cost of deploying last-mile wireless networks, enabling the Internet of Things, and alleviating the spectrum crunch. Accordingly, the DSA will focus its response to Question 5 of the consultation paper.

I. Overview

Today in India, over half of total Internet traffic travels over a Wi-Fi network located at the end point of a fixed network.[3] Internet traffic is projected to grow by more than a factor of four between the years 2015 and 2020, with an increased percentage of traffic traveling over mobile phones.[4] It is expected that many of these mobile phones will have built-in Wi-Fi capability. Building and maintaining robust wireless connectivity – including Wi-Fi – depends on access to license-exempt radio frequency spectrum. DSA believes it is vital that TRAI advance policies that will make available additional license-exempt spectrum both by designating bands for license-exempt use where available and through intensive spectrum sharing between and among licensed and license-exempt users where possible. The DSA believes that having an insufficient amount of license-exempt spectrum available for use presents a real barrier to proliferating public Wi-Fi across India.

Moreover, similar to licensed spectrum, there is a need for low-, mid-, and high-band license-exempt spectrum due to the varying propagation characteristics of radio waves in different spectrum bands as well as the available channel sizes. In general, low-band license-exempt spectrum is better for providing

[1] Mahanagar Door Sanchar Bhawan and Jawahar Lal Nehru Marg, "Consultation Paper on Proliferation of Broadband through Public Wi-Fi Networks", Telecom Regulatory Authority of India (TRAI), 13th July, 2016 ('Consultation paper').
[2] A full list of DSA members is available at www.dynamicspectrumalliance.org/members.html.
[3] *See* Cisco Visual Networking Index 2016, VNI Complete Forecast Highlights Tool – India. Accessed 19th August, 2016. http://www.cisco.com/c/m/en_us/solutions/service-provider/vni-forecast-highlights.html#
[4] Ibid.

wireless broadband coverage, while mid- and high-band license-exempt spectrum is better suited for delivering wireless broadband capacity. Generally, larger channel sizes are possible in mid- and high-band spectrum than low-band spectrum.

The DSA views existing static models used for assigning spectrum as inherently inefficient. The current static licensing models assign the exclusive use of spectrum to a specific user for a fixed time period in a fixed geographic area. If the assigned user does not utilise the allocated spectrum, then its potential may be lost forever. Previously the only alternative to this was licence-exempt usage, where anyone can use the spectrum on a best-efforts basis. Where feasible, this system remains more than acceptable for many users and applications. In most countries, though, there are little, if any, low- and mid- band spectrum that has not been allocated and assigned to one or more commercial licensed services or for government use.

Where licence-exempt status is not feasible, dynamic spectrum sharing would allow available spectrum to be used more efficiently than any existing static techniques. Introducing dynamic spectrum management would enable access to spectrum in a given band to be coordinated in real time (or near-real time), and the amount of spectrum adjusted depending on the service demand at any given moment, whilst taking into account geographic characteristics. Depending on the specific requirements for protecting from harmful interference the licensed services in a given frequency band, dynamic spectrum sharing can utilise a combination of technologies, including but not limited to geo-location databases, access control technologies, sensing, and data analytics to allocate the available spectrum in the most efficient manner. Maximising the efficiency of the spectrum usage increases the value of this finite resource, lowers barriers to access in established markets, and fosters the growth of new niche ones. Such dynamic thinking would allow for innovative sharing with different services across the sub-bands, ushering in considerable innovation for public Wi-Fi operators.

The DSA believes that TRAI should examine the potential for dynamic spectrum sharing in the 5 GHz band, the TV white spaces, and in high-band frequency (71-76 GHz and 81-86 GHz) licensed for Microwave Access. Additionally, TRAI should consider recommending that the entire frequency range 57-71 GHz be assigned for license-exempt use. With these steps, the DSA believes that there will be adequate low-, mid-, and high-band licence band spectrum available in India to support TRAI's objective of expanding broadband through the proliferation of public Wi-Fi in India.

II. 5 GHz Spectrum Bands

The 2.4 GHz ISM band lies between the frequencies 2400 and 2483.5 MHz. The IEEE 802.11n amendment allows for channel sizes of 20 and 40 MHz wide channels. Conceivably there can be one 20 MHz and one 40 MHz channel operating at the same time or three independent 20 MHz channels. As a practical matter, based on how Wi-Fi operates, even in moderately dense deployments of access points, the maximum channel size is 20 MHz.

The 5 GHz bands offer the potential of larger channel sizes and greater bandwidth. The IEEE 802.11ac amendment allows for channel sizes of 20, 40, 80, and 160 wide channels. A sufficiently large block of license-exempt spectrum is required to take advantage of these larger channels sizes. Additionally, at moderate power levels, radio waves can penetrate a wall – which is useful for providing Wi-Fi within an

enterprise or business, and useful for providing Wi-Fi coverage indoors and outdoors from an outdoor access point.

Based on the consultation paper, it is DSA's understanding that the under the country's current rules, only two segments of the 5 GHz band are available for unlicensed Wi-Fi use, and these segments are only available indoors and at low power.[5] The DSA assumes that unlicensed access for the 'low power equipment' operating in 5825-5875 MHz band at up to 4 W EIRP is for point-to-point communications.

- 5150-5350 MHz band can be used indoors for 'low power equipment', with a maximum EIRP of 200 mW. No unlicensed outdoor use permitted.
- 5725-5875 MHz band can be used indoors for 'wireless access system' including radio local area network, with a maximum EIRP of 200 mW. No unlicensed outdoor use permitted
- 5825-5875 MHz band is designated for lower power equipment for both indoor and outdoor use, with a maximum EIRP of 4 Watts.

The DSA suggests that TRAI considers making additional 5 GHz spectrum available for license-exempt Radio Local Area Network (RLAN) applications, allow indoor and outdoor use across all 5 GHz bands used by RLAN applications, and increase the maximum conducted and radiated power for RLAN applications. In addition, DSA recommends that TRAI extend the 5GHz band by opening the lower part of 6GHz for -exem licence pt use. Specifically, the DSA recommends that TRAI:

- Permit licence exempt operations in the 5470-5725 MHz and 5850-5925 MHz bands. Both of these bands are allocated for the mobile service in the International Table of Spectrum Allocations for Region 3.
- Extend the 5 GHz band by allocating 5925-6425 for licence-exempt use. Access to this spectrum would lead to three additional 160 MHz channels, and six additional 80 MHz channels. Providing sufficient bandwidth to supply broadband access in high density locations throughout India.
- Permit indoor and outdoor use of the above bands for RLANs as well as the frequency ranges 5150-5350 MHz and 5725-5850 MHz. Limiting Wi-Fi to indoor use only, will discourage growth in Public Wi-Fi expansion. Public Wi-Fi users will expect their Wi-Fi enabled devices to be able to operate anywhere and at all times.
- Increase the maximum conducted power to 1 W EIRP for all 5 GHz bands. Increasing the power will increase the utility of these bands for Public Wi-Fi utilizing higher bandwidth 5 GHz access points as it will increase the local coverage area when operating outdoors, improve signal strength through a wall when operating indoors, and in general lead to a greater range of Wi-Fi applications.

The DSA recognizes that license-exempt sharing of some 5 GHz bands will require the use of mitigation technologies such as Dynamic Frequency Selection in order to protect licensed operations.

In Europe, there is license-exempt use in the spectrum band 5150-5350 MHz for indoor use only. Last month, United Kingdom regulator Ofcom completed a consultation on 'Improving spectrum access for consumers in the 5 GHz band'. The DSA submitted comments.

[5] See Consultation paper at 2.25

In the United States, the Federal Communications Commission (FCC) amended its rules in 2014 to allow outdoor use of the 5150-5250 MHz band as well as increasing the maximum conducted power allowed to 1 W. The FCC put in place mitigation measures to ensure that ground-to-space satellite operation in the adjacent band would not be impacted by harmful interference from the aggregated Wi-Fi signals. No harmful interference has been reported to date. At present in the United States, licence exempt Wi-Fi devices can operate at up to 1 W conducted power, both indoors and outdoors in the frequency ranges 5150-5250 MHz and 5725-5850 MHz. Wi-Fi device can operate in the frequency ranges 5250-5350 MHz and 5470-5725 MHz, both indoors and outdoors, at a maximum power of 250 mW, and must use DFS to protect incumbent U.S. federal government users of these bands. Earlier this year, the FCC released a Public Notice, inquiring whether Wi-Fi can share the 5850-5925 MHz frequency range with Dedicated Short Range Communications.

III. Television White Spaces

The TV White Spaces (TVWS) is the unassigned and unused spectrum in the VHF and UHF bands which are allocated to the broadcast television services on a primary basis. Moreover, the bands' propagation characteristics enable radio signals to travel further and penetrate walls and irregular terrain, making them uniquely well-suited for non-line-of-sight broadband communication and other innovative applications on a secondary basis. Technology now allows TVWS devices to operate without causing harmful interference to incumbent services. As the TV bands are global, India's Public Wi-Fi operators will be able to benefit from the global economies of scale for infrastructure and user equipment.

Even after the country completes its 700 MHz auction there will be a considerable amount of underused spectrum available in the remaining UHF band. Depending on the architecture, power fixed TVWS radios can be used in Public Wi-Fi networks point-to-multipoint and / or as backhaul. When operating point-to-multipoint, the TVWS link can connect the local Internet point-of-presence to multiple end points, each which terminates in a 2.4 GHz or 5 GHz WLAN. It can also be used to offload data carried over licenced spectrum. There are multiple commercial providers of fixed TVWS radios. In the near future it is expected that low power TVWS radios will become commercially available for personal / portable devices. The initial form factor most likely will be a dongle that plugs into a device's USB port. Here the TVWS enabled device would allow for Public Wi-Fi networks with a greater local range that Wi-Fi networks operating at 2.4 GHz or 5 GHz. For these reasons, the DSA suggests that TRAI recommend the country establish a licence-exempt framework for use of the TVWS spectrum that will foster economic growth, complement licenced uses, and enable innovation.

Equally importantly, technological developments now allow new products and services to make use of this valuable spectrum while protecting incumbent users. For example, devices can rely on databases to provide a list of available channels based on a device's location. In such situations, databases calculate channel availability based on information regarding protected operations (e.g., location, frequency, and transmitter power) as well as characteristics of the wireless device itself (e.g., location, transmit power capabilities, and out-of-band emissions characteristics). Commercial TVWS database Administrators have been certified in the United Kingdom and in the United States.

The United Kingdom, the United States, Singapore, and Canada have rules in place for commercial use of the TVWS. The regulators in several additional countries have initiated public consultation to assist the

authorities in understanding the public costs and benefits of allowing licence-exempt devices to access the TVWS on a secondary basis.

IV. Extend the 60 GHz Spectrum Band

The DSA strongly supports TRAI's earlier recommendation to designate the 57-64 GHz ('60 GHz') band for unlicenced operations. The oxygen absorption lines within the band limit the effective signal range and allows for greater frequency reuse. This makes the spectrum well suited for multi-gigabit wireless personal areas network (WPAN) and wireless local area networks (WLAN) that can operate effectively at distances of up to 10 meters.

The IEEE developed and approved amendments to existing standards for licenced-exempt devices operating in Wireless Local Area Networks (802.11ad) and Personal Area Networks (802.15) in the 60 GHz band. The channels size is 2.16 GHz wide. The Wi-Fi Alliance[6] has create a certification program to ensure that devices conforming to the 802.11ad standard are interoperable. Those devices that are shown to be interoperable are called Wi-Gig certified. Being readied for the widespread commercialization are tri-band access point, with radios operating in the 2.4 GHz, 5 GHz, and 60 GHz bands. It is easy to imagine Public Wi-Fi operators in India operating these access points once they become available. And to the degree that the 60 GHz band is licenced-exempt in a critical mass of countries around the world, these tri-band access points and user equipment will benefit from global economies of scale.

The DSA believes that TRAI should consider recommending extending the 60 GHz licenced-exempt band to 71 GHz, effectively creating a 14 GHz block that can accommodate six, Wi-Gig channels in use at the same time. Again, keeping economies of scale in mind, the technical rules for this extended band should generally track the rules established for the frequencies between 57 and 64 GHz.

In addition, TRAI should explore allowing licence-exempt use of the 71-76 GHz band and 81-86 GHz bands, so long as they do not interfere with incumbent generally licenced operations. The oxygen absorption in these bands is favorable for outdoor backhaul applications.

DSA believes applying database technology based on that developed for licence-exempt use of the TV white spaces will allow licence-exempt Wi-Fi devices to share the band with Microwave Access Carriers in these high-frequency spectrum bands.

V. SUMMARY

[6] Wi-Fi Alliance® is a global non-profit industry association – our members are the worldwide network of companies that brings you Wi-Fi®. The members of our collaboration forum come from across the Wi-Fi ecosystem and share a common vision of connecting everyone and everything, everywhere. Since 2000, the Wi-Fi CERTIFIED™ seal of approval designates products with proven interoperability, industry-standard security protections, and the latest technology.

The DSA is supportive of TRAI's effort to increase broadband coverage and capacity through the proliferation of Public Wi-Fi networks. The DSA suggests TRAI recommend increasing the amount of licence-exempt spectrum available through dynamic spectrum sharing in segments of the 5 GHz band, the TVWS, high-band spectrum (71-76 GHz and 81-86 GHz), as well as assigning the lower part of 6 GHz and the entire 57-71 GHz range for licence-exempt use. The DSA believes that making a sufficient amount of licence exempt spectrum available across India is a prerequisite for such Wi-Fi proliferation to succeed.

Respectfully submitted,

H. Sama Nwana
Executive Director
Dynamic Spectrum Alliance