INTRODUCTION

Microsoft commends the Ministry of Communication and Information Technology (MCIT) on its vision to make Myanmar a mobile-first, digitally connected nation. The 2013 Telecommunications Law that repealed the Myanmar Telegraph Act of 1885 and the Myanmar Wireless Telegraph Act of 1934 has set the stage for the rapid growth of the Nation's telecommunications market by liberalizing the information and communications technology (ICT) sector. The People of Myanmar have benefitted from the increased competition for mobile telephony services between the incumbent and the two new market entrants.

The Telecommunications Law includes only the broadest of outlines with respect to spectrum management. MCIT is given the responsibility to manage the frequency spectrum under the international telecommunications conventions. An independent regulator was created. Among its responsibilities is to assign the frequency bands under the national frequency allocation plan. The Ministry has moved forward in developing a series of rules to implement the Telecommunications Law.

It is remarkable that over the course of less than two years, the penetration of mobile telephony in Myanmar has increased dramatically to where it now reaches an estimated 66 percent of the population[1]. Our understanding is that the majority of mobile service is now third-generation (3G) wireless service capable of Internet access, with the balance being second-generation (2G) wireless service. As a result, Internet user penetration grew from just over 1 percent in 2013 according to data from the International Telecommunication Union (ITU) to 12.6 percent in November 2015.[2] MCIT has correctly identified the need to increase overall Internet access as well as increase the speed of the available Internet access to enable the provision of fourth generation (4G) wireless services capable of supporting mobile broadband services.

Numerous studies have shown the benefits mobile broadband connectivity have in spurring economic growth, enabling more efficient provision of government services, and improving the quality of life of its residents through digital inclusion. In order for the Government of Myanmar to meet its broadband objectives over the next five years it must put in place a transparent and non-discriminatory spectrum management framework that promotes efficient use of the spectrum, fosters innovation, and leverages regional harmonization. Microsoft believes that Myanmar's spectrum management framework needs to include spectrum sharing through Dynamic Spectrum Access and allow use of the television white spaces. In this spirit, and specifically in response to Question 18 (License Exempt) and Question 19 (Broadcasting), Microsoft submits its comments to MCIT's draft "Spectrum Roadmap: Meet the Needs Over the Next 5 Years".

POLICIES FOR UBIQUITOUS, AFFORDABLE & ROBUST MOBILE BROADBAND CONNECTIVITY

Microsoft advocates globally for spectrum management policies that support ubiquitous, affordable, and robust mobile broadband connectivity. The company is not, and has no intention of becoming a mobile broadband provider. We are, though, increasingly dependent on mobile broadband providers worldwide to deliver our mobile services to our customers' mobile devices

[1] From Internet World Stats released on November 15, 2015
[2] ibid

no matter where they are located, including Myanmar. We need there to be broadband connectivity available wherever and whenever needed. And even if mobile broadband connectivity is available, unless it is affordable to a large proportion of the community, broadband uptake will be lower than it could be. Finally, the broadband connectivity needs to be sufficiently robust to support high-capacity and low-latency cloud-based applications – *everywhere*.

Microsoft also advocates globally for spectrum management policies that lead to more efficient use of spectrum. Experience has shown that over time the growth of mobile broadband services will inevitably lead to capacity pressures if no spectrum management policies are put in place to make more efficient use of existing radio spectrum resources.

DYNAMIC SPECTRUM ACCESS (DSA)

One promising wireless technology is what is known as Dynamic Spectrum Access (DSA). DSA uses location-aware devices and online databases to deliver low-cost broadband access and other forms of connectivity to consumers. This approach is rooted in the idea that devices with greater knowledge of their surroundings can opportunistically use available radio spectrum. While there are several spectral bands that lend themselves to DSA, the spectrum band of most interest for providing last-mile broadband connectivity is the broadcast television (TV) bands.

TELEVISION WHITE SPACES (TVWS)

There are TV broadcast channels that are unassigned or unused in nearly every location in the world. These empty channels -- blocks of spectrum – are what is known as the "white spaces". DSA is being applied to license-exempt devices operating in TV-band White Spaces (TVWS) to deliver what United States Federal Communications Commission coined as "Super Wi-Fi." Much like today's license-exempt technologies – most notably Wi-Fi – Super Wi-Fi will be provided over radio spectrum that is shared among different users and Internet service providers. This under-utilized spectrum is proving to be a key part of the future of not just universal broadband access but of the solution for the explosion of devices connecting the Internet. As with other license-exempt technologies, TVWS devices cannot cause harmful interference to licensed services while having to accept (and not claim protection from) interference.

The two attributes of TV band spectrum that make the TVWS attractive as an important new tool for communications network designers seeking to provide last mile broadband access in less densely populated areas are that for a given transmission power level radio waves in the TV bands: (1) travel further through the atmosphere than radio waves at higher frequencies, increasing the coverage area and thus lower infrastructure costs, and (2) sustain less signal loss through common building materials, trees, and foliage than radio waves at higher frequencies, leading to stronger received signal. In addition, TVWS can operate non-line of sight, which allows signals to be received around some obstructions. TVWS technology has the same spectral efficiency as LTE technology.

It is important to emphasize that license-exempt use of the TVWS is consistent with the ITU's Radio Regulations and is left to each Administration to implement using best practices.

Currently, Singapore[3,4], United Kingdom, United States and Canada each have rules in place that allow for commercial license-exempt devices to utilize the TVWS as long as they do not cause harmful interference to broadcasters and other licensees of the VHF and UHF bands. In addition, there are over two dozens of countries that are either in pre-regulation stage developing TVWS regulatory frameworks, or conducting trials and commercial pilots on TVWS networks, such as Finland, South Africa, the Philippines, New Zealand, Malawi, Bhutan, Botswana, Brazil, China, Cote D'Ivoire, Ghana, Hong Kong, India, Indonesia, Japan, Kenya, Morocco, Namibia, Nigeria, South Korea, Tanzania, Taiwan, Uruguay, and Vietnam.

Over the past decade Microsoft has conducted 16 TVWS technology trials and pilot projects with local partners across 5 continents, in both developed and developing economies. These projects include providing broadband connectivity to primary and secondary schools, health care facilities, and government offices in communities without broadband access. The common theme is that these communities all recognize that broadband connectivity is a key enabler and a priority for socio-economic development.

COMMON IMPLEMENTATION OF A TVWS NETWORK

TVWS networks are accessed using smart, radio-enabled devices that report their location to an Internet database. The database tells the license-exempt device which TV white spaces channels, and at what power level, it is permitted to operate on in its current location. The database has a list of all protected TV stations and frequencies across the country, so the devices can avoid causing interference to TV broadcasts and any other licensees. This technology is truly dynamic – as different TV channels become available, TVWS devices can opportunistically switch from one group of channels to another. This win-win translates to greater network capacity, allowing a greater number of users in a given area while, at the same time, protecting television reception from interference. All of this engineering will be invisible to the users, who will simply experience more ubiquitous broadband connectivity.

TVWS network begins with a connection from the closest Internet point of presence to a central point in the selected community, often over a microwave link. The TVWS base station(s), located at that central point, provide point-to-multipoint connectivity to several sites within the community. TVWS receivers located on the customers' premises are typically connected to a commercial 2.4 GHz and/ or 5 GHz Wi-Fi local area network. Most mobile devices sold today include integral Wi-Fi radios, thus allowing such enabled devices to connect to the broadband Internet over the heterogeneous network that leverages the plentiful TVWS spectrum found in rural areas.

Microsoft's experience is that there are some common challenges in providing affordable broadband access to rural communities in developed and developing countries, where the costs of extending a traditional cellular infrastructure are prohibitively high and tree cover (and foliage) limits the penetration of satellite services. Additionally, for those pilot projects in communities where electricity is not available or is not reliable, the TVWS base stations and customer premise

[3] https://www.ida.gov.sg/~/media/Files/PCDG/Consultations/20130617_whitespace/ExplanatoryMemo.pdf
[4] https://www.ida.gov.sg/~/media/Files/PCDG/Licensees/StandardsQoS/TechRefSpec/Draft_TS_WSD_30March2015.pdf

equipment are powered by solar cells. The solar power also provides electricity for consumers to charge their mobile devices.

Our expectation is that when spectrum for fourth generation (4G) wireless services is made available for auction and licensed for commercial use, mobile operators will concentrate their initial efforts on Myanmar's urban areas. With nearly two-thirds of Myanmar's population living in rural areas, use of the TVWS spectrum in combination with spectrum in other bands, such as the 5.8 GHz microwave band, offer the potential of providing affordable broadband access to rural areas.

Microsoft believes that in order for the TVWS to be available to extend communications networks in Myanmar and provide affordable last mile broadband access to its people living in rural areas, MCIT needs to authorize its use in its spectrum management rules. Existing TVWS regulatory frameworks that have been developed by leading regulators in countries such as US, Singapore, UK, and Canada can be used as basis and reference for Myanmar to develop its own TVWS regulatory rules. The global Dynamic Spectrum Alliance (DSA, www.dynamicspectrumalliance.org) also offers a "model regulation" for regulators interested in developing TVWS regulatory frameworks.

Microsoft appreciates the opportunity to submit comments on MCIT's draft spectrum management framework and looks forward to further discussions with the Ministry. If you require additional information on Microsoft's TVWS activities, or assistance in further exploring TVWS technologies and solutions, please contact:

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