SUMMARY

Microsoft appreciates the opportunity to comment on the New Zealand Ministry of Business, Innovation, and Employment, Radio Spectrum Management's (RSM) Television White Space Devices Certification and Licensing Rules Draft for Consultation. Microsoft supports the adoption of an interim framework that enables the testing of white spaces technologies. As TVWS technologies have been proved in multiple pilot projects around the globe, we encourage RSM to move expeditiously to adopt a permanent framework for operation of unlicensed (license-exempt) devices in the television white spaces (TVWS). Microsoft believes that use of unlicensed fixed and personal portable TVWS technologies can complement and extend the reach of New Zealand's Ultra-Fast Broadband Initiative and Rural Broadband Initiative.

There are several commercial vendors of fixed TVWS devices that can provide point-to-point and point-to-multipoint systems with download speeds in excess of 10 Megabits per sec (Mbps) over distances spanning several kilometers. These fixed TVWS devices utilize proprietary technologies. In addition to providing broadband access to homes, schools, libraries, and health providers in remote areas, fixed TVWS devices can be part of a network that provides a wireless canopy over an urban public park or a campus such as in Microsoft's commercial pilots with local partners in Ghana and Tanzania.

New Zealanders subscribing to a broadband Internet service delivered over fiber will want to access high-speed nomadic broadband access across multiple devices from a single fixed access point throughout their home or business. Radio chips for fixed and mobile TVWS devices that meet the new IEEE 802.11af (Wi-Fi) standard that would fall under 'coverage licenses' are expected to become commercially available beginning in the 2015-2016 time frame. The products that have been announced are tri-band access points that will have radios operating in the TVWS, 2.4 GHz, and the 5 GHz spectrum bands -- suitable for last mile connectivity and hot spot coverage.

Although the technical analysis and licensing regime proposed by RSM in this interim licensing scheme take a very conservative approach and excludes the use of geolocation databases to determine available TVWS channels, Microsoft believes the interim approach moves the process forward and will provide RSM with greater visibility into the operation of TVWS devices and further confirmation that such devices can operate effectively without causing harmful interference to the incumbent primary service, Digital Terrestrial Television (DTT).

Microsoft offers some ideas such as a "shot clock" and "RSM appeals process" to try to keep the licensing process across the multiple Territorial Local Authorities moving forward. We also suggest that for fixed deployments in rural areas with hilly terrain, after review by an Approved Radio Engineer (ARE), RSM should allow the TVWS transmitter's height above average terrain to be in excess of that allowed in the Federal Communication Commission's (FCC) rules. RSM may also want to take into consideration that the FCC at its September 30, 2014 Open Meeting will adopt as yet-to-be public proposed updated rules for unlicensed devices operating in the 600 MHz band.

Introduction

<u>Infrastructure Investments for High Speed Broadband Access Throughout New Zealand</u>

The New Zealand Ultra-Fast Broadband Initiative is a public-private partnership to roll out fibre-to-the-premise connections for Internet service in towns and cities with populations over 10,000. In all, when the Initiative is completed at the end of 2019, 75 percent of New Zealanders will have access to

Ultra Fast Broadband (UFB), defined as broadband capable of at least 100 Megabits per second (Mbps) download and 50 Mbps upload.

Under the complementary Rural Broadband Initiative (RBI), by 2016, 86 percent of rural homes and businesses (outside UFB areas) will have access to broadband with peak speeds of at least 5Mbps download. This will be achieved by upgrading and adding towers to expand fixed wireless service as well as building more fiber cabinets in less densely populated areas to improve copper-based (DSL) broadband services.

Priority users such as schools, libraries, and hospitals are to be connected with fibre capable of peak speeds of at least 100Mbps through the UFB or RBI. Remote schools will receive point-to-point wireless connections capable of peak speeds of at least 10Mbps.

New Zealanders Increasingly accessing the broadband Internet over mobile and nomadic devices

Among New Zealanders, the use of mobile and nomadic devices to access the Internet is skyrocketing. New Zealanders are increasingly accessing the broadband Internet wirelessly both 'on the go' (mobile use) and in range of a fixed broadband connection at home, work, café, outdoors, etc. (nomadic use). According to World Internet Project New Zealand report "Internet Trends in New Zealand 2007-2013", sixty nine percent of survey respondents accessed the Internet wirelessly in 2013 over smart phones and tablets, up from eight percent in 2007.[1] Moreover, "Almost four out of five (79%) internet users in New Zealand have accessed the internet through a laptop in the last year, slightly (but significantly) more than the proportion having accessed the internet through a desktop computer (74%)"[2]. New Zealanders will want to have the same user experience on their mobile and nomadic devices as they can receive on their fast fixed broadband connections to their homes and workplaces.

These trends are mirrored in the broader landscape. Each year, Internet Protocol (IP)-based networking equipment manufacturer Cisco Systems, Inc. (Cisco) releases a white paper that examines major global mobile data traffic projections and growth trends. In its most recent paper, Cisco notes that in 2013, global mobile data traffic grew 81 percent from the previous year, with mobile video traffic exceeding 50 percent[3]. Looking ahead, Cisco forecasts that global mobile data traffic will increase nearly 11-fold between 2013 and 2018 and that over two-thirds of the world's mobile data traffic will be video by 2018[4]. There is no reason to believe that the trend will be any different in New Zealand. Consumers will want to access video over mobile and nomadic connections to the Internet across multiple devices. The expected skyrocketing increase in the use of wireless networks to access the Internet will increase the demand for both licensed and unlicensed spectrum, and thus driving the need for active spectrum management on the part of RSM.

ROLE OF TELEVISION WHITE SPACES IN MEETING INCREASED DEMAND

The Digital Dividend and Dynamic Spectrum Access

[1] Gibson, A., Miller, M., Smith, P., Bell, A. Crothers, C (2014). *Internet Trends in New Zealand 2007-2013*. Auckland, New Zealand: Institute of Culture, Discourse & Communication. Auckland University of Technology.
[2] Gibson, A., Miller, M., Smith, P., Bell, A. Crothers, C (2014). *The Internet in New Zealand 2013*. Auckland, New Zealand: Institute of Culture, Discourse & Communication, AUT University.
[3] Cisco Visual Networking Index (VNI) Global Mobile Data Traffic Forecast Update 2014
[4] Ibid

RSM has interest in exploring dynamic spectrum access (DSA) as one spectrum management tool that may improve the spectrum efficiency of the reorganized broadcast television band. The 'Radio Spectrum Five Year Outlook 2012-2016' describes DSA as "involves gaining access to frequencies at a certain time or in a certain geographic location on a relatively temporary basis, even where the frequencies have already been assigned to another user (who is not using it at the particular time or location). These unused frequencies are often referred to as "white spaces"[5]. The report goes on to mention that there is ongoing work within the Ministry exploring opportunities for white space use. One example of this effort is the 2013 report "White Space Spectrum Availability in New Zealand", which provides an overview of the white space spectrum available in the Ultra High Frequency (UHF) digital TV band (510 to 694 MHz) and attempts to determine the quantity of white spaces spectrum available throughout the country[6].

Benefits of Access to Unlicensed Spectrum

Access to unlicensed spectrum allows licensed wireless and wireline broadband providers to increase the reach of their networks and improve network management in congested urban areas through techniques such as cellular offloading. "Globally, 45 percent of total mobile data traffic was offloaded onto the fixed network through Wi-Fi[7] or femtocell in 2013... Without offload, mobile data traffic would have grown 98 percent rather than 81 percent in 2013".[8] In a 2012 publication[9], Cisco cites that "Two-thirds of all smartphone activities are typically "nomadic," such as email, web browsing, gaming, using productivity tools, and making video calls", and identifies unlicensed devices such as Wi-Fi as "ideal for these pursuits".

An additional benefit is that innovators creating new products and services operating in unlicensed spectrum bands do not need to seek permission from spectrum licensees such as mobile broadband network operators. In the United States, for example, all that it is required is that the devices conform to Part 15 of the Federal Communications Commission's rules.[10] Other jurisdictions are exploring the possibility of allowing devices access to the TVWS frequencies without a license, but subject to device type approval procedures to ensure interference protection.

Radio waves operating in different spectrum bands have varying atmospheric propagation characteristics and interact with materials differently. Therefore, unlicensed spectrum in different bands are looked at for different applications based on its respective properties. For example, unlicensed Wi-Fi devices operating in the 5 GHz band using the 802.1ac standard can deliver lots of data quickly, but can realistically only be used for line-of-sight communications over limited distances due to the spectrum's characteristics.

Sub-1 Gigahertz (GHz) spectrum such as in the broadcast television bands has lower atmospheric attenuation resulting in radio waves being able to travel greater distances in free space

[5] Page 14, New Zealand Ministry of Business, Innovation, & Employment, "Radio Spectrum Five Year Outlook 2012-2016"
[6] Lopata, F., *White Space Spectrum Availability in New Zealand*. Ministry of Business, Innovation, & Employment, 2013
[7] Trademark of the Wi Fi Alliance
[8] Cisco Visual Networking Index (VNI) Global Mobile Data Traffic Forecast Update 2014
[9] Cisco IBSG Service Provider FastFacts – "A New Chapter for Mobile: How Wi-Fi Will Change the Mobile Industry as We Know It" (2012)
[10] Code of Federal Regulations, Title 47, Part 15

without requiring equipment to repeat the original signal. Additionally, these radio waves are able to penetrate many structural materials considerably better than those operating in higher frequency spectrum, and allows for non-line of sight applications.

The availability of substantial new sub- 1 Gigahertz (GHz) spectrum in the television white spaces (TVWS) on an unlicensed basis may provide an affordable wireless solution to extending the reach of broadband networks serving rural consumers and priority users, enable high speed indoor and outdoor wireless local area networks, and network the millions of devices that will compose the coming Internet of Things. TVWS devices that will use the 802.11af Wi-Fi standard may not have as much data capacity as in other bands, but exhibit a much greater range of operations.

MICROSOFT'S EXPERIENCE WITH TVWS

Microsoft views TVWS devices as one tool in the toolkit of licensed and unlicensed spectrum bands that can be combined in different use cases to provide affordable mobile and nomadic broadband connectivity. One key factor is that the broadcast television band is by-and-large a global spectrum band. This creates the possibility of low cost, mass produced chip sets, devices, and equipment, which helps with affordability.

Below we present a few examples of TVWS technology demonstrations, technology trials, and commercial pilots the company has participated in with local partners in countries around the world.

Mawingu Project – Kenya

Mawingu translates into cloud in Swahili. The project is collaboration between Kenya's telecom regulator, Ministry of Information and Communications, Microsoft, and local partners. The commercial pilot is about delivering low-cost wireless broadband access to previously unserved locations near Nanyuki. The network relies on a combination of "license-exempt" wireless technologies including Wi-Fi, TVWS, and point-to-point microwave.

The network covers a diversity of end points across a broad area. It connects healthcare clinics, community centers, town hall, government offices, four primary and two secondary schools, the community library, and other facilities. This point-to-multipoint network provides broadband connectivity to rural locations up to 13 km from base stations. Even across this range we are able to deliver between 3 and 5 Mbps to students who have never had broadband access before. The data rate increases for shorter distances.

The deployment also pioneered the use of solar-powered base stations together with TVWS to deliver high speed Internet access to areas currently lacking even basic electricity. It is an ongoing project as the government and local partners are interested in expanding the coverage footprint.

Limpopo TVWS Project in South Africa

Several countries, including South Africa, have published their respective National Broadband Plan. The South African National Broadband plan aims to connect all schools, public health and other government facilities by the year 2020.

Microsoft is participating in the Limpopo TV White Space project. Limpopo is a province located in northeast South Africa. The project looked to connect Limpopo University with nearby primary schools to provide them with broadband access.

The University has a fiber network that connects to the Internet backbone. TVWS radios were placed on top of the university library. Normal Internet traffic was converted into a format that can be broadcast over the TV white spaces. There was also a TVWS radio at each of 5 nearby primary schools that were as far away as 10 km. Within each school there was a Wi Fi local area network connected to the TVWS radio. The network continues to be in use.

Tanzania

In Dar es Salaam, Microsoft is partnering with the Tanzania Commission on Science and Technology and a local Internet Service Provider to provide more robust broadband access to faculty and staff at four universities. Unlike in South Africa and Kenya, there is no need for long range TVWS links in Dar es Salaam as fiber access to the Internet lands nearby. The project, which has just gotten underway, extends the fiber from the main Internet Point of Presence to a centralized base station location on each campus via 24 GHz unlicensed microwave transmitter. TVWS radios are deployed as higher speed shorter links to the surrounding customer premise equipment locations. Each of these locations, which is within several hundred meters of the base station, will connect to a Wi Fi distributed antenna system to provide broadband access throughout the campus buildings and open spaces. Download speed will be up to 10 Megabits per second across campus.

Ofcom Trials - Glasgow

At the May 2014 Dynamic Spectrum Alliance conference in Accra, Ghana, Taiwain-based chip manufacturer Mediatek announced its intention to develop chips for a tri-band access point operating in the TVWS, 2.4 GHz, and 5 GHz unlicensed spectrum bands. The TVWS radio would conform to the new 802.11af standards for personal portable devices[11].

Mediatek mocked up its TVWS 802.11af radio chip and provided them to Canadian radio manufacturer 6Harmonics to incorporate into a portable device as part of Microsoft's contribution to Ofcom's TVWS trials conducted over the summer in the UK. The 6Harmonics 802.11af radios were tested in Glasgow. Ofcom collected data to better understand the performance of a personal portable TVWS device in real world testing.

Namibia 'Citizen Connect' TVWS Pilot Project

In August 2014, the not-for-profit MyDigitalBridge Foundation, in partnership with Microsoft and Adaptrum, with support from the Millennium Challenge Corporation (MCC) and Millennium Challenge Account (MCA)-Namibia, successfully trialed the Namibian TV White Spaces (TVWS) pilot project. The intention is to provide a blueprint of broadband internet connectivity countrywide supporting digital inclusion. Called 'Citizen Connect', the pilot consists of a network deployed over a 62km x 152km (9,424 km²) area, making it the biggest TVWS project of its kind in terms of area coverage.

The trial at the University of Namibia's Jose Eduardo dos Santos Campus in Ongwadiva, Namibia, demonstrated the following to the Namibian Parliamentary Standing Committee: The connection of three regional offices, 28 schools and seven education circuit offices, all with a link distance of 8km to 10km (with two links at 12km). Typical speeds range from 5Mbps to 10Mbps and provided users access

[11] http://www.dynamicspectrumalliance.org/newsletter2/index.html

to a wide range of voice, video, and data applications. The demonstration included high-resolution video conferencing from three locations, each connected to the Internet through the TVWS technology.

COMMENTS ON THE CONSULTATION

Microsoft's experience is that unlicensed TVWS devices conforming to the FCC's rules can operate without causing harmful interference to licensed services. With that said, we appreciate RSM's approach in its interim licensing arrangement as an opportunity for it to gain experience and build confidence in the utility of TVWS technologies for different use cases throughout New Zealand. Much of the responsibility during this interim licensing period appears to fall on the shoulders of the country's cadre of AREs.

The interim licensing arrangement is timely in that commercially produced fixed TVWS equipment is now available in increasing volumes and commercially produced mobile TVWS equipment used for coverage licenses is expected to be available with two years. The interim licensing arrangement will provide New Zealand companies interested in providing commercial services that utilizes TVWS spaces with time for planning, capital expenditure, and implementation.

In regards to the technical rules, Microsoft suggests that for 'fixed licenses' in rural areas with hilly terrain that the RSM does not limit the Height-Above-Average-Terrain found in the US FCC rules. The ARE can determine what the overall (antenna plus terrain) height can be supported that will not cause harmful interference to DTT service.

Additionally, with an eye to a future New Zealand database to determine TVWS channel availability, RSM might consider supporting related research at local universities that would include collecting actual measurements of DTT signals to refine any further propagation modeling, particularly in more densely populated areas where there are lots of building and other structures.

With respect to the licensing process, Microsoft suggests that RSM develops and provides each TLA with a template for licensing TVWS devices and gives TLAs a shot clock (of a to be determined duration) for which to process an application for license, or it is deemed granted. Prospective licensees that are turned down by a TLA for a license should have the ability to appeal to RSM. RSM should have the ability to take up such appeals with the specific TLA if it assesses that circumstances warrant such action.