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Model White Spaces Rules: Background and Context

I. License-Exempt Spectrum: History and Background

In the past, exclusive licenses for specific frequency bands and specific purposes dominated government spectrum policy. In the last decade, however, governments around the world have embraced the concept of "license-exempt" (also known as "unlicensed") spectrum as another way to bring citizens innovative new wireless technologies. License-exempt spectrum refers to frequency bands, such as those bands used for Wi-Fi technologies, for which regulators do not grant exclusive licenses, but instead protect against interference and achieve important operational safeguards through equipment certification and clear and enforceable technical rules.

The result of this shift has been dramatic. License-exempt spectrum has been, and continues to be, a powerful catalyst for innovation and investment. Today, there are over ten billion devices connected to the Internet, and connections leveraging license-exempt spectrum access carry the majority of Internet traffic.

Now many countries are taking another next step in the evolution of spectrum policy, through the license-exempt use of the "TV White Spaces." As certain spectrum resources are more intensely used, countries adopting this innovation create significant new opportunities to leverage the underutilized portions of their spectrum resources. Typically, bands assigned for television broadcast include unused (or interleaved) frequencies between TV channels. These unused frequencies are called "TV White Spaces." At the frequencies below 1 GHz, such as those allocated to television broadcasting, radio waves travel farther and penetrate walls and other obstructions more easily at a given power level than those at frequencies already available for license-exempt operations in many jurisdictions.[1] These physical characteristics make the TV White Spaces frequencies particularly useful for many new and existing applications, in addition to their value for TV broadcast services. In particular, broadband Internet access delivered over television white spaces may be able to serve areas that have historically been either difficult or expensive to reach.

As a result of these benefits, countries around the world have adopted or are working to adopt license-exempt TV White Spaces regulations. In the United States, the Federal Communications Commission ("FCC") finalized rules to make that spectrum available in 2010. Canada has initiated a similar regulatory proceeding, and Singapore recently adopted rules enabling license-exempt access to TV White Spaces. These rules permit license-exempt devices to operate on TV channels that are not assigned for use in

[1] Many jurisdictions have enabled license-exempt use in the 2400-2483 MHz band. Many jurisdictions also allow license-exempt use in various parts of the 5150-5925 MHz bands, although precise allocations and operating rules vary.

their vicinity, subject to specific technical requirements designed to prevent interference to TV broadcasting and other authorized users of the TV bands. In the United Kingdom, Ofcom has published its TV White Spaces rules and is conducting a pilot with a number of manufacturers and database operators. The Independent Communications Authority of South Africa (ICASA) is also exploring the possibility of enabling access to TV white spaces. Relatedly, a Task Group under the European Telecommunications Standards Institute has developed a harmonized European standard for white space devices operating in the 470-790 MHz bands.

II. Benefits of TV White Spaces Access

The best measure of the promise of White Spaces technologies is the history of Wi-Fi. Today, countries that developed globally harmonized license-exempt spectrum rules give their citizens access to Wi-Fi-powered personal computers, printers, videogame consoles, streaming devices, security cameras, medical devices, MP3 players, digital cameras, smartphones, and tablets. Worldwide, approximately 439 million households use Wi-Fi networks—a number that is expected to grow to nearly 800 million by 2016—and there are also millions of publicly available Wi-Fi hotspots. Nearly one billion new Wi-Fi devices are sold every year, and that number is expected to continue to grow. These developments were made possible because of the availability of smart, globally-harmonized spectrum rules in countries around the world.

The favorable propagation characteristics of the TV White Spaces promise to make White Spaces devices even more powerful than their Wi-Fi ancestors. White Spaces technologies will greatly expand the utility and help reduce the cost of using license-exempt devices to be used on broadband networks. It is also likely to make deployment of last-mile connections in hard-to-serve areas more affordable. These benefits, in turn, have significant economic and development benefits. Even though many of the world's citizens lack reliable Internet access, in 2010, the Internet already contributed an average of 1.9% or $366 billion in GDP in 30 emerging markets.[2] With greater access to the Internet and to affordable devices, this number is certain to grow.

White spaces access can be deployed quickly and takes advantage of otherwise unused spectrum. Because enabling spectrum access for white spaces devices does not require relocating incumbents and because the rules protect those incumbents, a license-exempt framework for access to TV white spaces can be adopted and put into use without disruption to incumbent operations.

The opportunistic or dynamic use concept central to license-exempt White Spaces use ensures that rules can accommodate changing circumstances. Dynamic use is the

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[2] Olivia Nottebohm, James Manyika, Jacques Bughin, Michael Chui, Abdur-Rahim Syed, McKinsey and Company, *Online and Upcoming: The Internet's Impact on Aspiring Countries* (2012), *available at* http://www.mckinsey.com/client_service/high_tech/latest_thinking/impact_of_the_internet_on_aspiring_countries.

idea that radio technologies should identify and use different frequencies within a defined band, based on what frequency is available for interference-free operation at a given time in a given geographic location. Although the particular unused TV channels vary from location to location, White Spaces devices have the flexibility and agility to locate and operate on the unused channels, no matter where the devices are located in a country that permits such access. This means that previously unused spectrum becomes a valuable resource. It also means that both the technology and the rules can operate before, during and after the digital television transition – regulators merely have to provide industry with information regarding occupied channels, switchover timeline, and new channel assignments and locations, and devices will be able to avoid broadcast operations and other licensed uses.

Finally, a license-exempt approach fosters innovation. Because license-exempt access to spectrum is free from the delays associated with the licensing process, and the use of the spectrum itself is not subject to licensing fees or auction participation, manufacturers can rapidly develop equipment to fill a unique need and enter the marketplace quickly.[3]

III. Standards and Ecosystem Development

A number of industry standards have emerged to meet the needs of the growing white space ecosystem. For example, the IEEE has developed two standards, 802.11af and 802.22, which are both designed for devices operating in the TV white spaces. As noted above, ETSI is also developing a European standard for white spaces devices. Moreover, a number of commercial deployments have been launched. Trials, pilots, and commercial deployments leveraging TV white space technologies have now been launched on five continents (Africa, Asia, Europe, North America, and South America).[4] With support from governments, commercial deployments are serving rural areas, cities, and university campuses, improving access to broadband, as well delivering government, educational, and health services. And the technologies can be deployed rapidly in response to demand: this flexibility was demonstrated recently in the Philippines, where the Philippine Government deployed TV white space radios and connectivity in aid of earthquake and typhoon recovery in Bohol and Tacloban, respectively.[5]

IV. Purpose and Overview of Model Rules

The Model White Spaces Rules that follow are designed to be a template on which to base rules for license-exempt use of TV White Spaces. They are based on the

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[3] Kenneth R. Carter, Ahmed Lahjouji & Neal McNeil, FCC, *Unlicensed and Unshackled: A Joint OSP-OET White Paper on Unlicensed Devices and Their Regulatory Issues*, OSP Working Paper Series at 5 (May 2003).

[4] *See, e.g.,* numerous deployments featured on the Dynamic Spectrum Alliance website, http://www.dynamicspectrumalliance.org/pilots.html.

[5] *See, e.g.*, Pia Ranada, *TV White Space Connects Bohol Fisherfolk to the Net*, RAPPLER (Apr. 5, 2014), *available at* http://www.rappler.com/nation/54742-tv-white-space-fisherfolk-bohol (last visited Jun. 25, 2014).

existing U.S. and proposed U.K. regulations, to ensure the benefits of globally harmonized rules and access to globally standard technologies.

To be sure, the process of providing license-exempt spectrum access to white space devices will vary across different jurisdictions. Accordingly, the model rules also incorporate some flexibility to diverse legal environments and regulatory regimes. For example, in some cases, regulators can enable white space devices by a simple amendment to existing rules, while in other cases these changes may require legislative changes. However, the underlying technical approaches identified in the model rules for enabling white space device operation can be applied in the vast majority of jurisdictions.

One critical concern is whether regulators can permit license-exempt access to the TV white space spectrum under the International Telecommunications Union's (ITU) Radio Regulations. The definitive answer is "yes." The ITU World Radiocommunication Conference of 2012 concluded that the current international regulatory framework can accommodate software defined radio and cognitive radio systems, hence dynamic spectrum access, without being changed. According to Francois Rancy, Director of the ITU's Radiocommunications Bureau, "The development of systems implementing this concept, such as TV white spaces, is therefore essentially in the hands of national regulators in each country."

Nonetheless, ITU Member States regulators could benefit from collaborative approaches with other Member States. Several studies currently underway in ITU-R Working Parties (WPs), namely 1B, 5A, 5D, and 6A will serve at the basis for discussions about TV white spaces and dynamic spectrum access at WRC-15. ITU-R WP5A has recently finalized a technical report on cognitive radio systems. Moreover, the ITU Development (ITU-D) sector is taking on a greater role in assessing the social and economic benefits of spectrum sharing approaches, including dynamic spectrum access. In particular, this year's World Telecommunications Development Conference (WTDC) provided a formal mandate – Resolution 9 – for further study on dynamic spectrum access within the upcoming ITU-D study cycle. The next study cycle of ITU-D will thus offer further opportunities for ITU Member States to share their experiences on implementing regulations and to demonstrate the impact of TV white spaces in their developmental efforts.

In summary, the Model Rules include provisions that provide a technical framework to enable license-exempt access to valuable, underutilized spectrum while protecting incumbent licensees. Under the Model Rules:

- The rules are designed to enable additional access to spectrum *while protecting incumbents from harmful interference.* A primary goal of the rules is to ensure that incumbent operations are not disrupted.

- License-exempt white space devices can use one of two separate methods to prevent harmful interference to incumbents: geolocation or spectrum sensing.

- The geolocation method requires white space devices to determine their physical location and to avoid incumbent licensees in their vicinity by

contacting a database that contains information about incumbents and the frequencies on which they operate. This method is designed with a fail-safe: white space devices may operate only after receiving permission from a database, and may be shut down if there is a risk of harmful interference.

- The regulator may designate one public entity or multiple private entities to administer databases. The rules also describe database administrator responsibilities.

- White space devices relying on a database must communicate with that database in a secure manner. A white space device must cease operations if a database indicates that the frequencies in use by the device are no longer available. Incorporation of a database enables greater control over devices, thereby providing additional assurance that devices will not interference with incumbent operations.

- Regardless of the mechanism that a white space device uses to avoid causing harmful interference, all devices must comply with operational rules, such as transmit power and emissions limits, to protect incumbents.

The Dynamic Spectrum Alliance welcomes the opportunities to engage with regulators on these important issues. For further information, please do not hesitate to contact H Nwana, Executive Director of the Dynamic Spectrum Alliance, at hnwana@dynamicspectrumalliance.org or info@dynamicspectrumalliance.org.