

## Telecommunications Regulatory Affairs Advisory Committee

### Development of TV White Space Technology

#### Purpose

This paper briefs Members on the development of TV White Space (“TVWS”) technology in the United States, the United Kingdom, Singapore and New Zealand, and the preliminary assessment of the Office of the Communications Authority (“OFCA”) on the availability of TVWS spectrum for low power telecommunications applications in Hong Kong.

#### Background

##### *TVWS*

2. The sub-band 470 – 806 MHz in the Ultra High Frequency (“UHF”) band (i.e. Channel 21 – 62) is allocated primarily for terrestrial TV broadcasting service on a worldwide basis. In traditional radio system planning, co-channel TV broadcasting stations and hence their coverage areas are geographically separated so as to avoid radio interference. As a result, some TV channels at certain locations are not used at all times. These TV channels are generally referred to as “TVWS” or “TVWS spectrum”.

3. Radio spectrum is a scarce resource. With the continued growth in demand for spectrum for telecommunications services, some countries are/have been exploring ways to use the TVWS for low power telecommunications applications, such as wireless broadband Internet access and machine-to-machine (“M2M”) <sup>1</sup> applications (e.g. smart

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<sup>1</sup> M2M communications, also called Machine Type Communications, refer to the communications between machines/devices where data can be exchanged in an automatic manner with little or no human intervention.

metering). Figure 1 provides the basic concept on the feasibility of deploying TVWS.

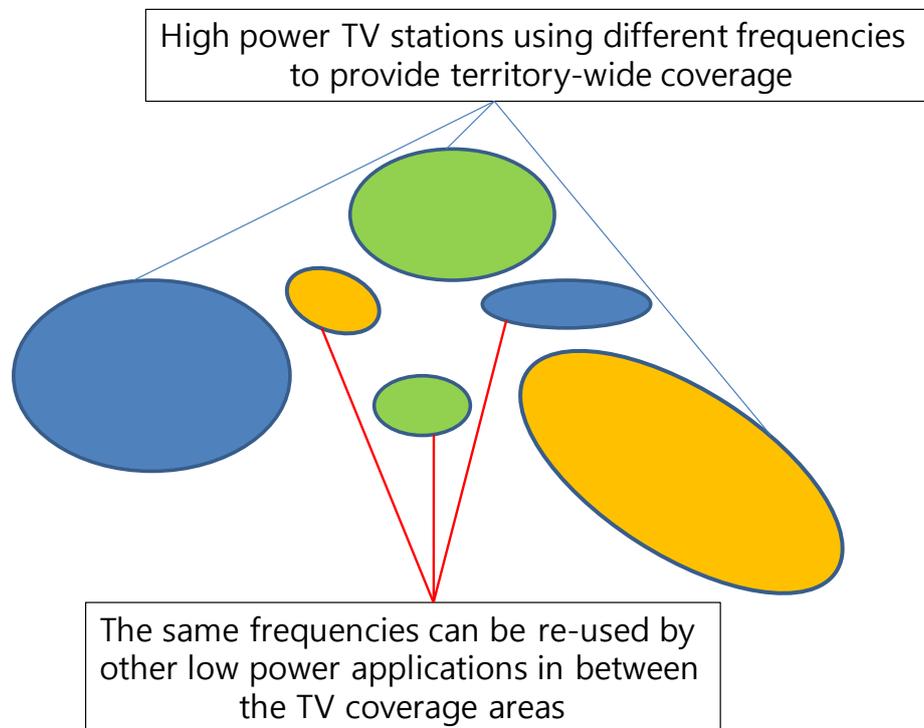


Figure 1 - Co-existence of low power applications and TV services

### ***Typical TVWS System Configuration***

4. TVWS technologies are now available for enabling co-existence of low power TVWS applications and the existing TV services in a harmonised manner. A typical TVWS system configuration, as depicted in Figure 2, consists of an on-line white space (“WS”) database with built-in intelligence capable of determining service areas of all existing TV stations and hence the availability of TV channels for share use by TVWS devices at different locations. In a typical operation cycle, a master TVWS device, e.g. a base station of a communications network, will query a WS database from time to time to obtain the available TV channels for use at a particular location where the use of these TV channels would not cause interference to the TV services. In this regard, system administrators may change the on-line WS database as

necessary to cater for any change in the use of TV channels<sup>2</sup> and their availability for the particular locations. Slave devices, such as user equipment and customer premises equipment, will listen to the master device and communicate with the master device using the TV channel as specified by the master device. Through dynamic management and allocation of TV channels, TVWS devices would not cause harmful interference to the existing TV services whilst allowing sharing of TV channels for TVWS devices.

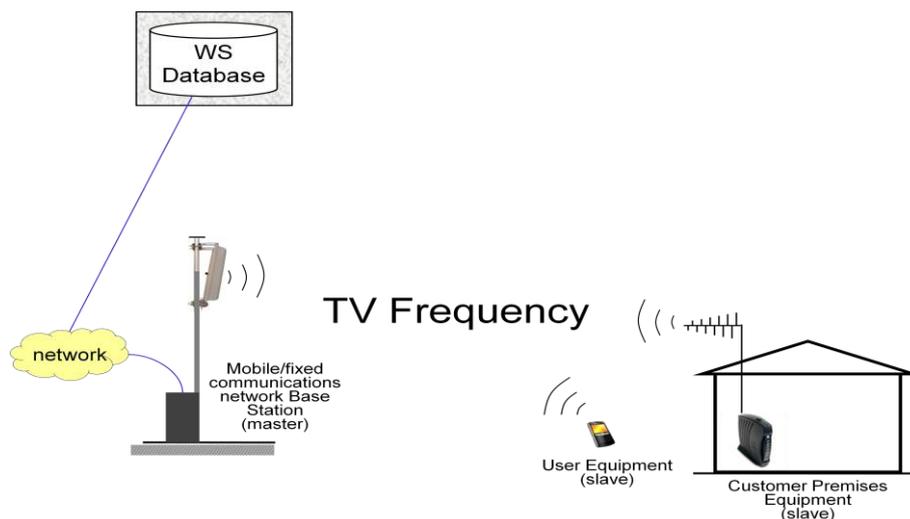


Figure 2 - A typical TVWS system configuration

## Potential Low Power TVWS Applications

5. Some potential low power TVWS applications, such as rural broadband, hot-spot coverage and M2M communications, and their potential benefits are summarised below–

### (a) Rural Broadband

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<sup>2</sup> The technical characteristics of a TV channel such as transmitting power and radiation pattern may be changed for on-going optimisation of network coverage. There may also be unexpected radio interference caused by TVWS devices for shared use of a particular TV channel due to the difference in computer prediction and real-live signal reception. Moreover, Programme Making Special Events equipment, such as professional wireless microphones, that also share the TV band may be used at a particular location and time for an event. As such, master TVWS devices need to query a WS database periodically in order to obtain the updated list of available TV channels so as not to cause interference to any existing services.

Owing to the favourable radio propagation characteristics for radio frequencies below 1 GHz, TVWS provides a communications environment for affordable wireless broadband services to rural and under-privileged communities in developing countries, particularly those sparsely populated countries with large geographical size. Trials in some countries have demonstrated the potential of TVWS technology to bridge digital divide<sup>3</sup> and provide affordable access to the Internet to serve billions of people that are yet to be connected.

(b) Hot-spot Coverage

TVWS could be used to provide fixed or mobile communications in hot-spots. This is similar to Wi-Fi hot-spots for use in public areas.

(c) M2M Communications

TVWS could be used to provide low data rate connections between sensors and devices used for the purposes of control, telemetry or remote monitoring. This can help resolve connectivity challenges to enable the evolving Internet of Things (“IoT”)<sup>4</sup> or M2M communications. As such communications would demand tens of billions of telecommunications connections by wireless means, the long-range, low-power and low-cost characteristics of TVWS devices may be very suitable for meeting the challenges and demand of IoT/M2M in this regard.

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<sup>3</sup> The term “digital divide” refers to an economic inequality between groups, broadly construed, in terms of access to, use of or knowledge of information and communications technologies.

<sup>4</sup> IoT refers to a scenario in which devices and things have their unique identifiers and the ability to communicate with others over the Internet or a similar wide-area network.

## Development in United States, United Kingdom, Singapore and New Zealand

### *Regulatory Framework for TVWS*

6. In the United States, the Federal Communications Commission (“FCC”) has adopted a licence-exempted regulatory framework and a certification scheme for TVWS devices since 2010. The first commercial TVWS application was launched in April 2013.

7. In the past few years, the United Kingdom has carried out several consultations and trials on TVWS applications. In 2011, the Office of Communications (“Ofcom”) of the United Kingdom issued a statement which concluded that TVWS devices could be used without licence provided that they complied with some specified technical requirements. In 2013, Ofcom put forward a framework of WS technology and specified the technical details for implementing the technology.

8. Singapore has also been active in conducting TVWS trials since 2009. While some pilot projects were being conducted by the industry, the Infocomm Development Authority (“IDA”) of Singapore conducted a consultation on the proposed framework for TVWS in 2013. A licence-exempted regulatory framework has been adopted by IDA in June 2014.

9. The Radio Spectrum Management (“RSM”) of New Zealand conducted a consultation on an interim licensing arrangement for preliminary usage and trials of TVWS devices in the TV band in August 2014. RSM will consider the long-term licensing regime that will best suit its situation once international frameworks and regulatory regimes are developed.

10. More information about the TVWS development in these countries is given at **Annex**.

### *Availability of TVWS Equipment*

11. Some TVWS equipment vendors have developed wireless broadband solution utilising TVWS which have been approved by the FCC for unlicensed use in the United States. The TVWS broadband radio solution developed by certain equipment vendor can offer data rate over 10 Mbps and support non-line-of-sight communications.

## **Hong Kong TVWS Environment**

### *Utilisation of TV Channel*

12. Owing to the hilly terrain of Hong Kong, all 42 TV channels (8 MHz bandwidth per channel) in the 470 – 806 MHz band have been assigned for the territory provision of analogue terrestrial TV services, digital terrestrial TV services and mobile TV services. It should be noted that the Mainland is also sharing the same TV band for terrestrial TV broadcasting. As Hong Kong and Guangdong are geographically adjacent to each other, TV signals from Guangdong transmitting stations may spill into Hong Kong and vice versa. To ensure the TV services in Hong Kong and Guangdong can co-exist, both sides need to coordinate with each other regularly to resolve any interference issues. For any possible introduction of new services in the 470 – 806 MHz including low power TVWS applications in Hong Kong, we will also need to complete frequency coordination with the Mainland authority.

### *Availability of TVWS in Hong Kong*

#### OFCA's Assessment

13. OFCA has recently carried out a preliminary assessment on the potential availability of TVWS in outdoor areas of Hong Kong with a software tool for radio network planning. The assessment takes into account all TV channels being used in Hong Kong (i.e. Channel 21 – 62) and also those TV channels being used in the neighbouring areas in the Guangdong Province, including analogue and digital terrestrial TV and mobile TV transmission. In the assessment, a TV channel is considered

locally unoccupied and available for TVWS if the corresponding signal power receivable at that particular location is less than or equal to a pre-set threshold level of -114 dBm as specified by the FCC. However, if the lower/upper adjacent channel(s) is/are intended for TV reception in the same area, such TV channel(s) will be considered as unavailable to TVWS in that area in order to prevent radio interference to normal TV reception.

14. The result of OFCA's assessment reveals that only a small number of TV channels in the 470 – 806 MHz band might be available for TVWS in certain outdoor areas of Hong Kong, mainly parts of the New Territories and outlying islands. OFCA's assessment results are consistent with the fact that TV channels have been heavily utilised in Hong Kong and the Guangdong Province and that there are high level spillover TV signals from the Guangdong Province.

#### *Limited Indoor TVWS Applications*

15. While there is little potential for the use of TVWS at outdoor areas, TVWS may be used for indoor low power applications, such as in shopping malls and underground Mass Transit Railway stations, as building structures or confined areas could provide signal screening, thereby helping to prevent any TVWS applications inside buildings or confined areas from affecting the normal TV reception at open space. However, the benefits would be very limited when compared with the potential costs entailed in setting up and maintaining a WS database, resulting in little commercial incentives to make use of the meagre TVWS in Hong Kong for low power applications.

### **Way Forward**

16. TVWS technology is still at the early stage of development as TVWS consumer devices have yet to appear in the mass market. Only a small number of countries have developed the TVWS regulatory framework which is tailor-made to their specific local environment. OFCA will keep monitoring the development of TVWS consumer devices and overseas TVWS deployments.

**Views Sought**

17. Members are invited to take note of the contents of this paper. Any views or comments from Members would be welcome.

**Office of the Communications Authority  
November 2014**

**Annex**

**Development of TVWS in United States, United Kingdom,  
Singapore and New Zealand**

**United States**

The United States is the pioneer in developing the TVWS technology. In 2010, FCC adopted a licence-exempted regulatory framework for TVWS devices<sup>5</sup>, with the management of TVWS devices through on-line databases. FCC has granted approval to a number of companies to operate their database systems to provide service to certified unlicensed devices that operate in the TV band.

2. All TVWS devices require certification from FCC. The maximum equivalent isotropically radiated power for fixed TVWS device is 4 W and that for portable TVWS device is 100 mW. Details of the technical parameters of TVWS devices can be found from Subpart H (Television Band Devices) of Part 15 (Radio Frequency Devices) of Title 47 of the Code of Federal Regulations (47 CFR).

3. The first commercial application of TVWS in the United States is a rural broadband service which has been launched in April 2013 in the area of Northern California called El Dorado County, or Gold Country. Cal.net, an ISP, is partnering with Carlson Wireless Technologies, a network equipment provider, to bring wireless broadband service to the said area with the speed of around 2 to 4 Mbps.

**United Kingdom**

4. The United Kingdom is active in conducting trials and consultations on TVWS where Ofcom has been evaluating the applications of TVWS for a number of years. Some TVWS trials have

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<sup>5</sup> The details of the regulatory framework can be found from [http://hraunfoss.fcc.gov/edocs\\_public/attachmatch/FCC-10-174A1.pdf](http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-10-174A1.pdf).

been conducted in Cambridge areas using database systems from Spectrum Bridge and Microsoft.

5. Following a series of consultations, Ofcom issued a statement entitled “Implementing Geolocation: Summary of consultation responses and next steps”<sup>6</sup> which set out the approach to implement the geolocation method to allow licence-exempted wireless devices to access TVWS spectrum in September 2011. The statement concluded that licence-exempted devices could be authorised to use TVWS so long as they radiated in specific frequencies and at specific powers in accordance with TVWS databases that met Ofcom’s requirements. Under these conditions, it believed that such TVWS devices would not cause harmful interference to the existing licensed services.

6. Ofcom has issued a consultation paper entitled “TV white spaces: approach to coexistence”<sup>7</sup> in September 2013. This paper sets out the proposed framework of WS technology in the United Kingdom. More specifically, the paper presents proposals for the parameters and algorithms that will determine the available frequencies and powers (TVWS availability) for use by TVWS devices in the TVWS framework. These proposals aim to ensure a low probability of harmful interference to other services using the UHF TV band or adjacent bands.

7. Ofcom has been conducting a pilot which aims to test interactions between devices and databases so as to provide an opportunity for the industry to conduct trials, and to gain further information on the coexistence issues. A number of companies are taking part in the pilot, either as databases, devices or service providers, providing input and expertise on coexistence testing, offering trial locations, and volunteering as pilot users.

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<sup>6</sup> The document can be downloaded from  
<http://stakeholders.ofcom.org.uk/binaries/consultations/geolocation/statement/statement.pdf>.

<sup>7</sup> The consultation paper can be downloaded from  
<http://stakeholders.ofcom.org.uk/binaries/consultations/white-space-coexistence/summary/white-spaces.pdf>. An addendum to the consultation paper issued in October 2013 can be downloaded from  
<http://stakeholders.ofcom.org.uk/binaries/consultations/white-space-coexistence/summary/addendum.pdf>.

## Singapore

8. Since 2009, IDA of Singapore has conducted a number of TVWS trials to study the benefits of the technology and concluded that TVWS can increase the availability of broadband services and improve overall spectrum efficiency. Subsequently, an industry consortium known as the Singapore White Space Pilot Group (“SWSPG”), with support from IDA, launched a series of TVWS pilot projects in various parts of Singapore. These pilot projects utilised a geolocation database which explore how WS technology can supplement and enhance the existing broadband infrastructure, overcome challenging terrains, and enable innovative consumer and business applications.

9. In June 2013, IDA issued a consultation paper on “Proposed Regulatory Framework for TV White Space Operations in the VHF/UHF Bands”<sup>8</sup> to seek the views of the industry on the proposed licence-exempted regulatory framework with a view to facilitating the deployment of TVWS technology. In June 2014, the IDA issued a decision paper entitled “Regulatory framework for TV white space operations in the VHF/UHF bands”,<sup>9</sup> which came into effect on 1 November 2014.

10. Under Singapore’s framework, the operation of TVWS devices is on a licence-exempted basis, subject to certain technical specifications and prescribed operational parameters. In addition, TVWS equipment is also subject to certification and registration. In order to prevent interference, spectrum not used for supporting television broadcasting in Singapore is made available for TVWS applications. IDA also makes clear that when analogue television is eventually switched off and the 700 MHz band (i.e. commonly referred to 698 – 806 MHz band) is ready to be allocated for International Mobile Telecommunications (“IMT”) services in Singapore, the original channels in the 700 MHz band for use by TVWS devices will be vacated for IMT services. All WS databases need to be licensed by IDA, but there is no

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<sup>8</sup> The consultation paper is available at:  
[http://www.ida.gov.sg/~media/Files/PCDG/Consultations/20130617\\_whitespace/PublicConsult\\_ws.pdf](http://www.ida.gov.sg/~media/Files/PCDG/Consultations/20130617_whitespace/PublicConsult_ws.pdf).

<sup>9</sup> The decision paper is available at:  
[http://www.ida.gov.sg/~media/Files/PCDG/Consultations/20130617\\_whitespace/ExplanatoryMemo.pdf](http://www.ida.gov.sg/~media/Files/PCDG/Consultations/20130617_whitespace/ExplanatoryMemo.pdf).

limit on the number of WS database providers.

### **New Zealand**

11. In 2012, the Ministry of Business, Innovation & Employment (“MBIE”) of New Zealand issued a study report on “White Space spectrum availability in New Zealand”<sup>10</sup>. The study confirmed that there is white space spectrum available, particularly in rural areas of New Zealand. New Zealand will consider the long-term licensing regime of TVWS that will best suit its situation once international frameworks and regulatory regimes are developed.

12. In order to allow preliminary usage and trials of TVWS, Radio Spectrum Management (“RSM”) of MBIE issued a consultation paper on “Television White Space device certification and licensing rules”<sup>11</sup> in August 2014 to seek industry’s views on an interim licensing arrangement of WSDs. A TVWS licence is proposed under the interim licensing arrangement. TVWS devices accepted by FCC or Ofcom could be used under the interim TVWS licence. The geolocation databases that are deployed in some other jurisdictions are not implemented at this stage. Taking into consideration the submissions received from industry in September 2014, RSM would consider fine-tuning the interim licensing and certification rules.

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<sup>10</sup> The study report is available at:  
<http://www.rsm.govt.nz/cms/pdf-library/policy-and-planning/current-projects/Report%20Whitespace%20availability%20in%20NZ.pdf>.

<sup>11</sup> The consultation paper is available at:  
<http://www.rsm.govt.nz/cms/pdf-library/policy-and-planning/television-white-space-licencing-rules/tv-white-space-certification-and-licensing-rules>.