

## **Frequency Bands for Broadband Wireless Access**

### **Purpose**

At the 27<sup>th</sup> RSAC meeting held in March 2004, various frequency bands available for allocation for Worldwide Interoperability for Microwave Access (“WiMax”)<sup>1</sup> were discussed (see RSAC Paper No. 1/2004). In RSAC Paper No. 1/2004, it was considered that the 3.4 – 3.6 GHz band (“3.5 GHz band”) is a candidate band for WiMax. Subsequently, at the 28<sup>th</sup> RSAC meeting held in September 2004, the proposal in RSAC Paper No. 8/2004 of allocating the 3.5 GHz band to Broadband Fixed Wireless Access (“BFWA”) services was discussed. Since then, there have been developments in Broadband Wireless Access (“BWA”) in respect of its deployment in overseas countries, the approval of the WiMax standard by IEEE<sup>2</sup> as well as the equipment certification by WiMax Forum<sup>3</sup>. In particular, OFTA has noticed that there are already frequency allocations made by the spectrum authorities in South Korea, Japan, the United States and Singapore in the 2.3 – 2.4 GHz band (“2.3 GHz band”) and the 2.5 – 2.69 GHz band (“2.5 GHz band”) for deployment of WiMax.

2. This paper updates Members on the above developments and discusses the planning of the 2.3 GHz and 2.5 GHz bands for deployment of BWA in Hong Kong.

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<sup>1</sup> WiMax is a standard-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and digital subscriber line (“DSL”). WiMax will provide fixed, nomadic, portable, and eventually, mobile broadband connectivity without the need for direct line-of-sight to a base station.

<sup>2</sup> IEEE, the Institute of Electrical and Electronics Engineers, is a world-leading professional association for advancement of technology. One of its missions is to develop telecommunications standards.

<sup>3</sup> The WiMax Forum is an organization of leading operators and communications component and equipment companies. The WiMax Forum’s charter is to promote and certify the compatibility and interoperability of BWA equipment that conforms to IEEE 802.16 and ETSI HiperMan standards.

## **Status of Development of Standards for WiMax**

### ***IEEE***

3. IEEE 802.16 is the standard for WiMax. Initially, IEEE focused on development of fixed broadband wireless access. However, there are now several extensions of the IEEE 802.16 standard which add data capability to the initial standard.

4. IEEE 802.16a standard focuses on fixed BWA. IEEE 802.16-2004 enhances the IEEE 802.16 standard by providing support for indoor customer premises equipment (“CPE”). The IEEE 802.16e standard is an extension to the approved IEEE 802.16-2004 standard to enable full mobility of users.

5. In December 2001, IEEE approved the initial 802.16 standard for wireless metropolitan areas network (“MAN”) for the 10-66 GHz frequency range. The 802.16a extension for sub-11 GHz was approved in January 2003. The 802.16-2004 standard was ratified by the IEEE in June 2004. The 802.16e was approved in December 2005 and is now known as “IEEE 802.16e-2005”.

### ***ETSI<sup>4</sup> and ITU<sup>5</sup>***

6. In Europe, ETSI has been working on a similar IEEE 802.16 standard within the BRAN (broadband radio access network) project. ETSI has developed the HiperACCESS standard for frequencies above 11 GHz and the HiperMAN standard for frequencies below 11 GHz. HiperMAN has evolved over a protracted standardising process to be a subset of IEEE 802.16 and is supported by WiMax, thereby allowing interoperability across US and the Europe. The ITU is ratifying the IEEE 802.16 standard for worldwide use (together with HiperMAN/HiperACCESS) through the development of a specific recommendation identifying broadband wireless access standards.

### ***South Korea***

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<sup>4</sup> ETSI, the European Telecommunications Standards Institute, is the official body responsible for standardization of information and communications technologies including telecommunications within Europe.

<sup>5</sup> International Telecommunication Union

7. With the support of the Korean Government, Wireless Broadband (“WiBro”) is developed by the Korea’s telecommunications industry. WiBro is a wireless telecommunications standard similar to IEEE 802.16e. The Koreans sought to develop WiBro as a regional and potentially international alternative to 3.5G/4G systems. The WiBro standard is yet to be incorporated into the set of WiMax or IEEE standards, but an agreement was made in November 2004 between (Intel and LG Electronics) to ensure interoperability between WiBro and WiMax.

## **Status of Frequency Allocation for and Deployment of WiMax**

### ***South Korea***

8. In South Korea, the Ministry of Information and Communication has licensed three telecommunications companies (SK Telecom Co, KT Corp and Hanaro Telecom Inc) to provide mobile broadband Internet services. These three companies are allowed to offer commercial services using WiBro in the 2.3 GHz band. The services would allow broadband Internet access through mobile phones or other handheld devices such as laptop, personal data assistant (“PDA”) at vehicle speed of up to 60 km/h and can offer users of a downlink data rate and an uplink data rate of up to 3 Mbps and 1 Mbps respectively for 10 MHz channel bandwidth. KT Corp and SK Telecom have targeted to offer commercial services in April and June 2006, respectively. Hanaro has however decided to surrender the licence.

### ***United States***

9. In the United States, there are a number of BWA deployments using proprietary systems (including Airspan Networks, Aperto, Alvarion VL OFDM and Dragonwave) in the 2.5 GHz band. For example, Towerstream<sup>6</sup> is serving major cities in the USA such as Los Angeles, New York, Chicago, Boston, Providence (Rhone Island) and San Francisco. Sprint and Speakeasy<sup>7</sup> are serving Seattle. However, Sprint has announced that they will begin trials of pre-certificated WiMax systems. Towerstream will also introduce WiMAX systems to follow their highly successful pre-WiMax network servicing

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<sup>6</sup> Towerstream is a fixed-wireless broadband provider in the US.

<sup>7</sup> Speakeasy is a nationwide provider of broadband voice and data services in the US.

businesses, educational facilities and government entities.

### ***China***

10. In China, the Ministry of Information Industry has licensed the use of 3.5 GHz spectrum for fixed BWA in over 100 cities. However, it is not yet widely deployed. Dalian and Chengdu are implementing the pre-WiMAX networks that will be upgradeable when certification testing begins.

### ***Singapore***

11. The Infocomm Development Authority of Singapore auctioned 25 lots of BWA spectrum rights in the 2.3 GHz and 2.5 GHz bands on 24 May 2005. The lots were eventually issued to six successful bidders. Successful bidders can start deploying their BWA networks from 1 July 2005, and have to offer services within 18 months if they obtain the 2.5 GHz spectrum and/or within 36 months if they obtain the 2.3 GHz spectrum. The spectrum may be used for full mobility services (speed > 10 km/h) from 1 January 2006.

### ***Japan***

12. In Japan, the Ministry of Internal Affairs and Communications has also proposed the allocation of 2.5 GHz band for mobile BWA that supports continuous IP connection e.g. WiMax (IEEE 802.16e) and Next-generation Personal Handyphone System, etc.

### ***Other Countries***

13. In Chile, Entel announced that they will start offering WiMax in 2006. In other countries, there are also trial deployments, but commercial deployments are still awaited availability of spectrum.

### ***ITU Allocation for WiMax***

14. There are some technical difficulties concerning the use of 3.5 GHz band for mobile WiMax with the IEEE 802.16e standard. In fact, the radio propagation characteristics in this band may not be the most suitable one for mobile applications. Handset antenna design is also difficult, given that the

existing 3.5 GHz antenna is still of the size of a man's palm. WiMax Forum is keen to gain support from the ITU for allocating spectrum in the 2.5 GHz band, which can better support mobile applications. WiMax Forum has submitted a paper to the ITU-T Working Party 8F meeting held in Bangkok from 25 January to 1 February 2006 on the sharing of 2.5 GHz band between IMT-2000 and BWA systems.

### **Status of Equipment Certification by WiMax Forum**

15. On 19 January 2006, the WiMax Forum announced that the base station solutions from Aperto, Redline and SEQUANS, and the CPE equipment from Wavesat have passed the protocol conformance and interoperability tests and designated as "WiMax Forum Certified". These products are developed according to WiMax Forum-defined certification profile for 3.5 GHz based on IEEE 802.16-2004 and ETSI HiperMAN standards. Also WiMax chipsets from Intel, Fujitsu and Wavesat are available. Thus, "WiMax certified" fixed BWA products for 3.5 GHz band are now available. It is therefore feasible to deploy WiMax for fixed application in the 3.5 GHz band.

16. As the IEEE 802.16e standard has just been approved in December 2005, there is long way to go before mobile WiMax systems and handsets can be commercialized.

### **Frequency Bands for BWA in Hong Kong**

#### ***Frequency Planning for the 2.3 GHz Band***

17. In paragraph 7 of RSAC Paper No. 1/2004 and paragraph 14 of the second consultation paper on the licensing framework for the deployment of BWA, OFTA has mentioned that this band is currently allocated to electronic news gathering ("ENG") and outside broadcasting ("OB") links and fixed links in Hong Kong. There is about 73 MHz of spectrum being vacant in this band. As the Mainland China has planned this band for 3G expansion, OFTA has given the view that this band is a possible candidate for BWA, but the release of this band for deployment of BWA will be subject to further review.

18. In the light of the frequency allocation for this band in the overseas countries, OFTA has started taking the necessary steps to vacate 19 MHz more frequency spectrum in this band by the end of 2006. OFTA is also considering the feasibility of vacating the whole 2.3 GHz band and is discussing with the remaining existing users in the band with a view to migrating their frequencies to other bands.

### ***Frequency Planning for 2.5 GHz Band***

19. According to the latest ITU allocation, this band is identified as additional spectrum which may be used by countries wishing to implement 3G mobile services. In paragraph 9 of RSAC Paper No. 1/2004, OFTA has mentioned that the band is currently allocated to ENG/OB links and fixed links in Hong Kong and that the band has been reserved for 3G expansion in Hong Kong. As discussed in the 26<sup>th</sup> meeting of the RSAC held on 25 September 2003, these ENG/OB links will be migrated to the 2200 - 2290 MHz band and according to the current progress, the band will be cleared by November 2006.

### **Candidate Bands for BWA in Hong Kong**

20. In view of the developments in BWA and the frequency allocation for BWA in the overseas countries, in addition to 3.5 GHz as proposed in RSAC Paper No. 1/2004, it appears that 2.3 GHz and 2.5 GHz bands are also candidate bands for deployment of mobile and/or fixed BWA.

21. In OFTA's second consultation on BWA, a joint submission by 13 operators (including the two satellite operators) raised their concern on potential interference caused by BWA equipment to downlinking services currently using C-band satellites. AsiaSat, in its own separate submission, pointed out that the deployment of 3.5 GHz band for BWA operation might potentially affect FSS reception in three different ways:

- (a) in-band interference of FSS receivers by the BWA operating in 3.4 - 3.6 GHz band;
- (b) out-of-band BWA emissions interfering with FSS operating in adjacent frequency bands (3.6 – 4.2 GHz band); and
- (c) saturation of FSS receiver front-ends which affects FSS operation in the 3.4 - 4.2 GHz band.

AsiaSat was concerned that introduction of BWA in the 3.5 GHz band would impose significant constraints for C-band FSS operation in Hong Kong and that the FSS operation in both the standard and extended C-bands will be affected. In its view, C-band FSS operation is of particular significance in Hong Kong because of the climatic conditions affecting reliable use of the Ku bands.

22. In response to the operators' concern on potential radio interference caused by BWA on FSS operation, OFTA has conducted theoretical analysis to address the three scenarios of radio interference. Field tests have also been conducted to verify the result of the analysis. The preliminary findings show that BWA and FSS operation cannot co-exist in the 3.5 GHz band due to in-band interference from BWA, while FSS receiver saturation and out-of-band BWA emission could be controlled via a number of mitigation measures and a more stringent set of emission limits respectively. Details of the analysis, field tests and mitigation measures are given in the RSAC Paper No. 2/2006 which will be discussed at the RSAC to be held on 17 February 2006.

23. In addition to the above mentioned analysis and field test and subject to views of the Members and industry, OFTA would also set up a joint test after the RSAC meeting. OFTA would invite interested RSAC members and other interested parties from the industry to join the test with a view to clarifying with the industry the potential impact of radio interference caused by BWA in the 3.5 GHz band on FSS in the standard and extended C-bands and the effectiveness of the mitigation measures.

24. Although the potential of interference to FSS from BWA in the 3.5 GHz band needs to be verified by the theoretical analysis and field test, having noted the latest development in spectrum allocation for BWA systems overseas, in particular, in the 2.3 GHz and the 2.5 GHz bands, OFTA considers that, at this stage, the choice of frequency bands for BWA in Hong Kong should not be confined to the 3.5 GHz band. OFTA proposes to maintain an open mind in the allocation of other bands for BWA in order to ensure that suitable spectrum is made available to accommodate BWA in the most spectrum efficient manner.

25. As pointed out in paragraph 14, the WiMax Forum has already submitted a paper to the ITU-T Working Party 8F on the sharing of 2.5 GHz band between IMT-2000 and BWA systems. OFTA notes that the intention of

the Wimax Forum is to ensure that the full range of WiMax services including mobility services could be realized by implementing the BWA systems at a lower frequency band. Although the result on the proposed sharing of IMT-2000 and BWA systems in the 2.5 GHz band is yet to be determined, the proposal is in line with our technology-neutral policy which would allow the market to adopt an open telecommunications standard for BWA in the 2.5 GHz band.

### **Advice Sought**

26. Members are invited to give views on the frequency planning in the 2.3 and 2.5 GHz bands, in particular, on the following issues:

- (a) potential interference caused by BWA systems to FSS in the 3.5 GHz band and the associated need to consider alternative BWA bands; and
- (b) having regard to the technology-neutral policy and subject to the outcome of the decision of the ITU, whether the 2.5 GHz band would become a candidate band for both BWA and 3G services.

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