通訊事務管理局辦公室
OFFICE OF THE COMMUNICATIONS AUTHORITY

Radio Spectrum and Technical Standards Advisory Committee

SSAC Paper 9/2016 for Information: Spectrum Supply for IMT Services

Office of the Communications Authority
10 November 2016

Purpose

- Members are invited to note the current use of spectrum for public mobile services and the latest development including the identification of spectrum for International Mobile Telecommunications ("IMT") currently advocated by the International Telecommunication Union ("ITU"), regional standardisation bodies and some economies

Quick Review on IMT Spectrum Availability below 6 GHz in Hong Kong

Spectrum Harmonisation for Public Mobile Services

- Since the World Radiocommunication Conference ("WRC")-92, ITU identified altogether 10 frequency bands below 6 GHz for IMT
- Individual regions / administrations developed specific band plans for IMT following the allocation of ITU, taking into account also their specific constraints / requirements
- The Third Generation Partnership Project ("3GPP", a standards development body for IMT technical specifications) issued specifications for about 50 frequency bands ("3GPP bands") to facilitate equipment support by vendors

Assigned 3GPP Bands in Hong Kong

- Six 3GPP bands have been assigned for 2G/3G/4G and cdma2000 services in Hong Kong
  - These bands have a total bandwidth of 582 MHz

3GPP band	Uplink (BS Rx) (MHz)	Downlink (BS Tx) (MHz)	Utilisation Status in Hong Kong
1	1920.3 – 1979.7	2110.3 – 2169.7	3G service
3	1710.5 – 1784.9	1805.5 – 1879.9	GSM and LTE services
5	825 – 832.5	870 – 877.5	cdma2000 service
	832.5 – 837.5	877.5 – 882.5	3G service
7	2500 – 2570	2620 – 2690	LTE service
8	885 – 915	930 – 960	GSM, 3G and LTE services
40	2300 – 2390		TD-LTE and fixed wireless access services

Vacant 3GPP Bands in Hong Kong

- The following bands are currently vacant
  - ➢ 34.6 MHz bandwidth are readily available in Hong Kong subject to operators' demand and interest

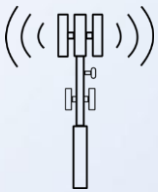
3GPP band	Frequency Band	Bandwidth	Remark
33	1900 – 1904.9 MHz	4.9 MHz	Spectrum released from the withdrawal of licence exemption for PHS apparatus since 10 May 2016
33 34	1904.9 – 1919.9 MHz 2019.7 – 2024.7 MHz	20 MHz	Unpaired 3G bands not used by the mobile operators now, and have been put back to reserve upon expiry of the assignments to the operators on 21 October 2016. These bands have been included in Spectrum Release Plan
34	2010 – 2019.7 MHz	9.7 MHz	Released for auction in early 2011 but was not acquired by any bidder. This band has been included in Spectrum Release Plan

Use of 3GPP Band 42? (1 of 2)

- **3GPP band 42 (3.4 – 3.6 GHz)**
  - In 2004 – 06, former OFTA conducted a compatibility test of broadband wireless access (BWA) [1] at 3.4 – 3.6 GHz, which confirmed that interference would be caused to fixed satellite services operating in 3.4 – 4.2 GHz
  - Public mobile services of IMT involve high density deployment of radio base stations over the territory, that would likely cause harmful interference to satellite services

There are now some **1,600** SMATV systems and **900,000** outlets in Hong Kong

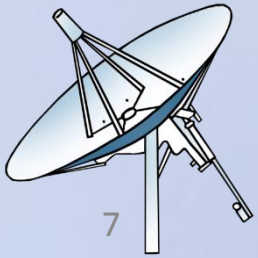
Signals from a terrestrial base station as receivable on ground is very large compared with that from satellites



Mobile Base Station

Signals from an IMT base station (say 3.4 GHz) can jeopardise the normal operation of a SMATV/TVRO receiver in its entire operating band of 3.4 – 4.2 GHz

Equipment used in SMATV/TVRO systems is designed to receive very weak signals from satellites over an excessively wide frequency range



SMATV / TVRO System

[1] RSAC Paper 5/2006, available at http://tel_archives.ofca.gov.hk/en/ad-comm/rsac/paper/rsac5-2006.pdf

Use of 3GPP Band 42? (2 of 2)

- **3GPP band 42 (3.4 – 3.6 GHz)**
  - The finding of a recent ITU-R report[2] on the relevant matter as published in 2015 is in line with that of the above OFTA tests
  - 3GPP Band 42 is not usable for IMT due to harmful interference to existing services

[2] ITU-R Report S.2368-0, "Sharing studies between International Mobile Telecommunication-Advanced systems and geostationary satellite networks in the fixed-satellite service in the 3400-4200 MHz and 4500-4800 MHz frequency bands in the WRC study cycle leading to WRC-15", June 2015

Use of APT 700 MHz Band?

- APT 700 MHz band is **3GPP band 28**, which is **703 – 748 MHz / 758 – 803 MHz**
- This band, being used for TV broadcast in Hong Kong, is not available for IMT now
- It is a working target of the Government to switch off the analogue TV service at the end of 2020. A review of the target date will be conducted in 2017-18

Use of L-Band?

- The L-band (**1427 – 1518 MHz**) is identified in WRC-15 for IMT globally. It corresponds to 3GPP **band 11** and **band 21**
- Availability of the L-band for IMT was discussed during SSAC meeting in Feb 2016[3]
- Whether this band may be allocated to public mobile services is subject to further study, including the availability of global harmonised IMT band plans and their associated equipment support

[3] SSAC Paper 1/2016, available at http://www.ofca.gov.hk/filemanager/ofca/en/content_751/SSAC_Paper_1_2016.pdf

IMT Spectrum Availability above 6 GHz

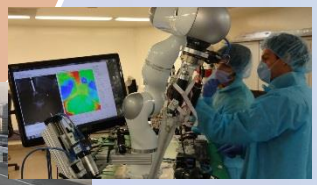
Demands for 5G

Enhanced mobile broadband

- It is typically provided in hotspots, with high user-experienced data rate and low mobility

Ultra-reliable and low latency communications

- These applications has stringent requirements on latency, availability and throughput, etc. Example include emergency, autonomous vehicles, remote medical surgery, etc.



Massive machine type communications

- It refers to a large no. of connected devices typically transmitting low volume of non-delay-sensitive data, e.g. wearables, smart cities, smart homes, etc.

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IMT Spectrum above 6 GHz (1 of 2)

- While existing mobile spectrum at lower frequency bands may be deployed for 5G, ITU-R identified 11 candidate frequency bands above 6 GHz (lie within 24.25 – 86 GHz) for 5G for consideration at WRC-19
- In Hong Kong, two candidate frequency bands (i.e. 24.25 - 27.5 GHz and 37 - 40.5 GHz) are being used partially for fixed links but the utilisation rates are not high (at least 76% channels are vacant)
  - Deployment for 5G in these bands is subject to spectrum re-farming
- The remaining nine candidate frequency bands are vacant
  - Subject to the decision of WRC-19, these bands are readily available for 5G

IMT Spectrum above 6 GHz (2 of 2)

- **Candidate 5G Bands for discussion at WRC-19**

Frequency Bands	Available Bandwidth
24.25 – 27.5 GHz	3.25 GHz
31.8 – 33.4 GHz	1.6 GHz
37 – 40.5 GHz	6.5 GHz
40.5 – 42.5 GHz	
42.5 – 43.5 GHz	
45.5 – 47 GHz	4.7 GHz
47 – 47.2 GHz	
47.2 – 50.2 GHz	
50.4 – 52.6 GHz	2.2 GHz
66 – 76 GHz	10 GHz
81 – 86 GHz	5 GHz

Frequency bands having allocations to the mobile service on a primary basis

Frequency bands which require additional allocations to the mobile service on a primary basis

5G Development in Other Economies

Mainland China

- Ministry of Industry and Information Technology of the People's Republic of China ("MIIT") has initiated 5G trials with participants from Huawei, ZTE, Datang Telecom, Ericsson, Nokia/Shanghai Bell, Intel and Samsung

Economy	Phase	Scope	Frequency band
China	1st phase: Technology R&D trial to be completed by 2018	Key technology trial (1st step), completed in Sep 2016	Low Band: 3.4 - 3.6 GHz High Band: Not specified
		Technical solution trial (2nd step), to be completed by Sep 2017	
		System trial (3rd step), to be completed by Oct 2018	
	2nd phase: Product R&D trial to be completed by 2020	Not specified	

United States

- In July 2016, FCC opened up spectrum to facilitate 5G development

Frequency Band	Bandwidth	Usage
27.5 – 28.35 GHz	0.85 GHz	Licensed use
37 – 38.6 GHz	1.6 GHz	Licensed use 37 – 37.6 GHz (0.6 GHz bandwidth) is shared among different commercial users and federal users
38.6 – 40 GHz	1.4 GHz	Licensed use
64 – 71 GHz	7 GHz	Unlicensed use

- Additional bands being contemplated by FCC for 5G include –

24.25 – 24.45 GHz	24.75 – 25.25 GHz	31.8 – 33.4 GHz	42 – 42.5 GHz
47.2 – 50.2 GHz	50.4 – 52.6 GHz	71 – 76 GHz	81 – 86 GHz

Source: FCC Notice 16-89 released in July 2016

Trials by Other Economies

Economy	Action	Frequency band
Europe	In Jul 2016, Vodafone and Huawei conducted 5G field trials	71 - 86 GHz
	In Feb 2016, Deutsche Telecom showcased Huawei's 5G equipment	73 GHz band
Japan	In Feb 2016, NTT Docomo and Ericsson conducted 5G outdoor trial	15 GHz band
	NTT Docomo plans to provide 5G services at the venues of the 2020 Tokyo Olympic Games	Not specified
South Korea	In Mar 2016, SK Telecom and Samsung conducted 5G outdoor trial	28 GHz band
	South Korea plans to provide 5G pilot services during the 2018 Pyeongchang Winter Olympic Games	28 GHz band
Singapore	In Jul 2016, Singtel and Ericsson conducted pre-5G trial	5 GHz unlicensed band
	In Aug 2016, Singtel and Ericsson showcased 5G technology using Ericsson's 5G radio prototypes	Not specified

Summary

- ITU has identified a number of harmonised bands below 6 GHz for IMT in the previous WRCs and most of them have been allocated for public mobile services in Hong Kong
- Notwithstanding that WRC-19 will discuss 5G band harmonisation focusing on the higher frequency bands above 6 GHz, some economies are still actively exploring the use of frequency bands below 6 GHz band for 5G
- Some economies are conducting 5G trials using different frequency bands above and below 6 GHz bands
- Different regional 5G advocating groups have started to meet and discuss with a view to agreeing on the harmonised bands for 5G to be adopted in WRC-19
- The respective 5G candidate bands for discussion in WRC-19 are largely vacant in Hong Kong

END