Statement of the Communications Authority

Change in the Allocation of the 3.4 – 3.7 GHz Band from Fixed Satellite Service to Mobile Service

28 March 2018

PURPOSE

This Statement promulgates the decisions of the Communications Authority ("CA") to change the allocation of radio spectrum in the 3.4 – 3.7 GHz band from fixed satellite service ("FSS") (space-to-Earth) to mobile service ("MS") for the provision of public mobile services with effect from 1 April 2020.

EXECUTIVE SUMMARY

S1. Taking into account views and comments received by the CA during the public consultation conducted from July to September 2017; industry feedback; and recommendations of a consultancy study on the co-existence of FSS and public mobile services operating in different parts of the 3.4 – 4.2 GHz band (commonly known as the "C-Band"), the CA decided that the primary[1] allocation of the 3.4 – 3.7 GHz band will be changed from FSS to MS with effect from 1 April 2020, thereby giving an advance notice of about two years to the affected licensees. While 200 MHz of spectrum in the 3.4 – 3.6 GHz band will be assigned for the provision of public mobile services, 100 MHz of spectrum in the 3.6 – 3.7 GHz band will be partitioned as a guard band to minimise radio interference to FSS operating in the 3.7 – 4.2 GHz band.

S2. Given the fact that existing earth stations for telemetry, tracking and control ("TT&C") of satellites in orbit ("TT&C Stations") operate in the 3.4 –

[1] Different services are classified as "primary" or "secondary". Stations of a "secondary" service shall not cause harmful interference to or claim protection from stations of "primary" services operating in the same frequency band.

3.7 GHz band and noting that they are important for the operation of licensed satellites currently in orbit, TT&C Stations which are duly licensed by the CA will be allowed to operate in the 3.4 – 3.7 GHz band and will be protected from radio interference of public mobile services. To this effect, restriction zones (in Tai Po and Stanley) where these TT&C Stations are located will be delineated to constrain the deployment of mobile base stations of public mobile services operating in the 3.4 – 3.6 GHz band.

S3. Licensed systems of external fixed telecommunications network services ("EFTNS") and Satellite Master Antenna Television ("SMATV"), as well as self-provided external telecommunications systems ("SPETS") operating in the 3.7 – 4.2 GHz band should implement necessary mitigating measures[2] so that they will be able to reasonably withstand radio interference caused by mobile base stations operating in the 3.4 – 3.6 GHz band. In case any of these systems, after upgrade, are subject to harmful interference from the subsequently-installed mobile base stations, the mobile network operators ("MNOs") concerned should adjust or relocate their mobile base stations to obviate the interference. On the other hand, any subsequent radio station(s) of EFTNS, SPETS and SMATV should only be installed at locations where their operation will not be adversely affected by any mobile base stations already operating in the vicinity.

INTRODUCTION

2. To support the continued development of public mobile services and to facilitate the commercial launch of the fifth generation mobile ("5G") services in the timeframe of 2020, there is a need for Hong Kong to make available additional radio spectrum for the operation of public mobile services. On 21 March 2017, the CA promulgated its work plan[3] for making available additional spectrum to meet the demand of public mobile services, including 5G services, towards 2020 and beyond. Among the frequency bands included in the work plan, the 3.4 – 3.6 GHz band offers wide area coverage and high data speed, rendering it suitable for the provision of public mobile services.

[2] The mitigating measures are elaborated in paragraphs 21 – 23 below.

[3] A related press release on the CA's work plan is available at: https://www.coms-auth.hk/en/media_focus/press_releases/index_id_1423.html.

The 3.4 – 3.6 GHz band has also been actively developed for 5G services by a number of major economies such as Europe, the United Kingdom, Australia and the Mainland.

3. In Hong Kong, the 3.4 – 4.2 GHz band is currently used for various satellite applications for external telecommunications including non cable-based EFTNS, operation of SPETS, reception of satellite television programmes via SMATV systems and television receive-only ("TVRO") systems, FSS downlink capacity leasing service, as well as TT&C and monitoring of satellites.

4. The CA indicated in its work plan that the 3.4 – 3.7 GHz band (i.e. the lower part of the C-Band) might be re-allocated from FSS to MS. Since the intended re-allocation may have implications for the public and certain sectors of the industry, a public consultation was conducted from July to September 2017 to solicit views and comments of the telecommunications industry and other affected persons on the CA's proposal and the timetable to change the allocation of the 3.4 – 3.7 GHz band from FSS to MS.

5. In the consultation paper published on 27 July 2017 ("Consultation Paper")[4], the CA proposed that 200 MHz of spectrum in the 3.4 - 3.6 GHz band be made available for the provision of public mobile services; while 100 MHz of spectrum in the 3.6 - 3.7 GHz band be reserved as a guard band. In other words, public mobile services and FSS will operate in different parts within the C-Band.

6. To ensure that the existing SMATV systems which are accessible by households operating in the 3.7 – 4.2 GHz band will not be subject to interference from public mobile services which will operate in the 3.4 – 3.6 GHz band, the Office of the Communications Authority ("OFCA") assisted the CA in commissioning a consultancy study ("Consultancy Study") in August 2017 for recommendations on technical mitigating measures and operational precautions for SMATV systems and mobile base stations. The Consultancy

[4] The Consultation Paper is available at: https://www.coms-auth.hk/filemanager/en/content_711/cp20170727_e.pdf.

Study was completed in January 2018. The Consultancy Study report[5], which identifies a number of feasible mitigating measures, is published together with this Statement for public information.

7. Having duly considered views and comments received in the public consultation; industry feedback collected at the Radio Spectrum and Technical Standards Advisory Committee ("SSAC")[6]; and the recommendations of the Consultancy Study, the CA sets out in this Statement its decisions on the change in frequency allocation of the 3.4 – 3.7 GHz band from FSS to MS.

LEGISLATIVE AND POLICY FRAMEWORK

8. Under section 32G(1) of the Telecommunications Ordinance (Cap. 106) ("TO"), the CA shall promote the efficient allocation and use of the radio spectrum as a public resource of Hong Kong. In accordance with sections 32H(3) and 32H(4) of the TO, the CA may vary or withdraw frequencies or bands of frequencies, or vary the purposes for which and the conditions under which the frequencies or bands of frequencies are to be used, provided that a reasonable notice of the intended variation or withdrawal to the licensees which have been assigned the relevant frequencies or bands of frequencies is given.

9. As set out in the Radio Spectrum Policy Framework ("RSPF")[7] promulgated by the Government in 2007, there is no legitimate expectation that there will be any right of renewal of any licence or spectrum assignment upon expiry of a licence or spectrum assignment under the TO. The decision on

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[5] The Consultancy Study report entitled "*Consultancy Report on Assessments on and Recommendations to Enable the Electromagnetic Compatibility between Public Mobile Services and Fixed Satellite Service Operating in the C-Band* " is available at: https://www.ofca.gov.hk/filemanager/ofca/common/reports/consultancy/cr_201803_28_en.pdf.

[6] SSAC advises the Director-General of Communications on, inter alia, the planning of the use of radio frequency spectrum and the needs, establishment and maintenance of technical standards. The SSAC comprises representatives from telecommunications and broadcasting licensees; amateur radio societies; local certification bodies; Consumer Council; Hong Kong Productivity Council; The Hong Kong Institution of Engineers; The Institution of Engineering and Technology Hong Kong; local industry associations; relevant government departments and a member appointed on an ad personam basis.

[7] The Radio Spectrum Policy Framework is available at: http://www.cedb.gov.hk/ccib/eng/legco/pdf/spectrum.pdf

whether a new spectrum assignment, with the same or varied radio frequencies, should be given to the spectrum assignee would be made and notified to the spectrum assignee within a reasonable time before the expiry of its spectrum assignment, after taking into account the spectrum policy objectives and all other relevant factors, including but not limited to any other public interest considerations.

10. In January 2008, the former Telecommunications Authority ("TA") issued a statement (the "TA Statement")[8], specifying that insofar as it is practicable in the circumstances, a minimum notice period would be given for variation or withdrawal of spectrum assignments upon or before their expiry. The minimum notice periods vary from one to three years depending on the types of assignments. The former TA (now the CA) is entitled to depart or deviate from the stated minimum notice periods where the circumstances so warrant.

PUBLIC CONSULTATION

11. The Consultation Paper published on 27 July 2017 put forward the proposal for changing the frequency allocation of the 3.4 – 3.7 GHz band from FSS to MS. The public consultation lasted for six weeks and ended on 7 September 2017. At the close of the consultation, a total of 20 submissions were received from four MNOs, four satellite operators, two EFTNS operators, a SMATV operator, an equipment supplier, a wireless technology company, a Legislative Council Member and six industry organisations[9].

12. Major views and comments of the respondents pertaining to the proposed change in the allocation of the 3.4 – 3.7 GHz band from FSS to MS, as well as the responses of the CA, are summarised at **Annex A**.

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[8] The TA Statement is available at: http://tel_archives.ofca.gov.hk/en/tas/spectrum/ta20080131.pdf

[9] Submissions on the Consultation Paper are available at: https://www.coms-auth.hk/en/policies_regulations/consultations/completed/index_id_420.html.

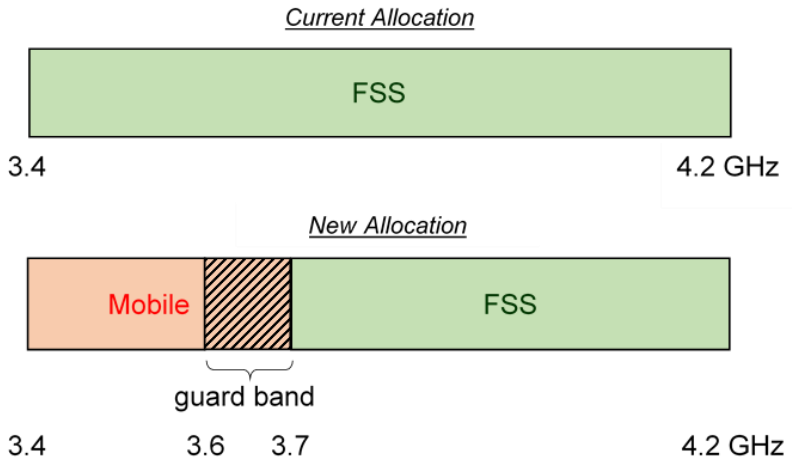
THE DECISIONS OF THE CA ON THE RE-ALLOCATION OF THE 3.4 – 3.7 GHz BAND

Change in Frequency Allocation

13. It is the decision of the CA to change the primary allocation of the 3.4 – 3.7 GHz band from FSS to MS. 200 MHz of spectrum in the 3.4 – 3.6 GHz band will be assigned for the provision of public mobile services while 100 MHz of spectrum in the 3.6 – 3.7 GHz band will be partitioned as a guard band. The current primary allocation to FSS in the 3.7 – 4.2 GHz band will not be affected by the re-allocation. Accordingly, FSS will continue to be a primary service in the 3.7 – 4.2 GHz band.

14. The CA considers that the aforesaid change in the allocation of the 3.4 – 3.7 GHz band strikes a reasonable balance between the interests of the mobile and the satellite industries. An additional 200 MHz of spectrum will be made available for the provision of public mobile services, which is equivalent to around 36% of the 552 MHz of spectrum currently deployed for public mobile services. At the same time, the 3.7 – 4.2 GHz band will remain a primary frequency band for use by the satellite industry. The band plans showing the change in frequency allocation are set out in Figure 1 below.

Figure 1: Current and new allocations of the C-Band (i.e. 3.4 – 4.2 GHz band) in Hong Kong



15. Please refer to section 2 of **Annex A** for the CA's responses to the views and comments received in the public consultation on the change of

frequency allocation of the 3.4 – 3.7 GHz band.

Protection Principle and Mitigating Measures for Existing Systems and Services Operating in the C-Band

16. The change in frequency allocation of the 3.4 – 3.7 GHz band from FSS to MS may affect, to differing extents, existing radio users operating in the C-Band. There is thus a need to introduce a guard band in the 3.6 – 3.7 GHz band for the co-existence of MS and FSS operating in separate parts of the C-Band, especially in urban areas.

17. After the change in frequency allocation is effected, FSS downlink capacity in the 3.4 – 3.7 GHz band will no longer be available for use in Hong Kong. EFTNS and SPETS licensees may need to lease FSS downlink capacity and operate solely in the 3.7 – 4.2 GHz band in order to maintain the existing services. With regard to the SMATV and TVRO systems, there is a possibility that they may be overloaded/desensitised by relatively strong radio signals of mobile base stations which are operating in the 3.4 – 3.6 GHz band. Therefore, there is a need to upgrade these SMATV/TVRO systems for necessary protection (see paragraphs 21 – 23 below for details). Likewise, similar mitigating measures should also be implemented at EFTNS/SPETS earth stations.

18. In case the deployment of any mobile base station operating in the 3.4 – 3.6 GHz band causes harmful interference to an existing system of SMATV/EFTNS/SPETS in the vicinity that is operating in the 3.7 – 4.2 GHz band notwithstanding the proper implementation of appropriate mitigating measures, the MNOs concerned (i.e. MNOs operating the relevant mobile base station(s)) should be accountable for offering protection to the existing systems. However, TVRO systems, being exempted from licensing requirements under the TO, will not be entitled to protection from any harmful interference from prospective public mobile services.

19. The CA is of the view that a principle for protecting existing radio stations from harmful interference caused by subsequently established radio stations ("Protection Principle") should be introduced, so that existing SMATV/EFTNS/SPETS systems operating in the 3.7 – 4.2 GHz band which have implemented appropriate mitigating measures ("Upgraded Systems") will

be protected from any harmful interference from public mobile services which will subsequently operate in the 3.4 – 3.6 GHz band. In case there is harmful interference caused to any of these Upgraded Systems, the MNOs whose services cause problems of interference will be held accountable for any necessary remedial actions. Likewise, any subsequently-established radio station(s) of EFTNS, SPETS and SMATV should cater for the local radio environment before its installation at a particular location. In other words, an entity responsible for such a subsequently-established radio station should not request nor seek any protection from interference caused by an existing mobile base station which is already operating in the vicinity.

20. Please refer to section 3 of **Annex A** for the CA's responses to the views and comments received from the public consultation in relation to the above protection principle and mitigating measures to be implemented for existing systems and services other than TT&C, as well as precautions to be taken in respect of the prospective public mobile services.

Consultancy Study and Baseline Requirements for Protection of SMATV/EFTNS/SPETS

21. Enhancements of typical SMATV systems were analysed in the Consultancy Study with a view to improving their immunity to interference. The findings indicate that by retrofitting an appropriate band-pass filter into SMATV systems operating in the 3.7 – 4.2 GHz band, they should be able to co-exist with MS systems operating in the 3.4 – 3.6 GHz band. Specifically, such a band-pass filter should have a passband of 3.7 – 4.2 GHz and achieve a suppression of at least 55dB for the out-of-band signals (i.e. public mobile signals) in the 3.4 – 3.6 GHz band.

22. However, the above mitigation measures alone may not be sufficiently resilient in dealing with some special circumstances. For instance, if a mobile base station installed on a rooftop is located higher than a SMATV antenna, and their respective antennas are facing each other in close proximity, significant interference to the SMATV system might occur. Given that Hong Kong is geographically located in the northern hemisphere and that geostationary satellites are orbiting over the equator, SMATV antennas in Hong Kong are naturally pointing south at various azimuths and elevation angles. With this in mind, the Consultancy Study report recommends taking specific

mitigation measures against this by the adjustment of the direction of the mobile base station antenna or relocation of the mobile base station to another building, preferably in the eastern or western direction in respect of the SMATV antenna concerned. On the whole, mobile network coverage will not be compromised even with such mitigation measures, as the required separation between the upgraded SMATV system and the mobile base station is in the order of 65 metres under the worst-case scenario.

23. A set of baseline requirements defining the necessary mitigating measures in detail is set out in an information note[10] issued by OFCA. SMATV/EFTNS/SPETS systems receiving signals in the 3.7 – 4.2 GHz band with the necessary mitigating measures implemented will be protected from any significant interference from public mobile services which will operate in the 3.4 – 3.6 GHz band. It should be noted that the implementation of the baseline requirements as detailed in the information note is mandatory for those SMATV systems[11] which operate in the 3.7 – 4.2 GHz band and wish to be protected from any significant interference from public mobile services which will operate in the 3.4 – 3.6 GHz band. EFTNS/SPETS systems should make reference to the said baseline requirements.

24. The CA is mindful of the costs required for upgrading some 1 600 existing SMATV systems (i.e. those covered by existing SMATV licences, i.e. on or before 28 March 2018) with some 890 000 user outlets in Hong Kong. Since the SMATV systems affected are serving the general public, there is a need to deal with the funding aspect of the upgrading work of these SMATV systems. This issue will be addressed in the forthcoming public consultation by the CA regarding the assignment arrangements for spectrum in the 3.4 – 3.6 GHz band.

Protection for TT&C Stations

25. TT&C Stations are set up for daily operation of particular satellites (which includes manoeuvring the satellites in orbit and monitoring the

[10] Available on CA website at: https://www.coms-auth.hk/filemanager/statement/en/upload/440/i0012e.pdf.

[11] For systems of SMATV/EFTNS/SPETS with more than one satellite path, any path(s) with the necessary mitigating measures implemented is entitled to protection from interference caused by late-coming public mobile services.

operational status of the satellites) and they are important for the operation of a satellite network. In Hong Kong, some channels in the C-Band are deployed for TT&C functions, with a few being within the 3.4 – 3.7 GHz band. Given the fact that the transceivers of TT&C channels are equipped and pre-configured on board the satellites concerned, there is no prospect of changing the frequencies of these TT&C channels after satellite launching. As such, TT&C channels should be protected in respect of the re-allocation of the 3.4 – 3.7 GHz band to MS.

26. The existing TT&C Stations in Hong Kong are located at the Tai Po Industrial Estate and in Stanley, far from densely-populated areas. To reduce impact on TT&C Stations arising from the re-allocation, local satellite operators who have the necessary technical expertise and resources should implement appropriate mitigating measures. As an additional safeguard for existing TT&C Stations, the CA has decided to impose restriction zones constraining the deployment of mobile base stations of public mobile services operating in the 3.4 – 3.6 GHz band. Details of the restriction zones are set out at **Annex B**. Currently, local satellite operators also monitor satellite signals in the 3.4 – 3.7 GHz band at the TT&C Stations. In principle, the use of the 3.4 – 3.7 GHz band for TT&C functions and monitoring functions at the TT&C Stations would be allowed only at the aforesaid existing locations although, following frequency re-allocation, local satellite operators will not be entitled to claim protection for the continuance of any such monitoring functions at the TT&C Stations. An application for using the 3.4 – 3.7 GHz band at a new TT&C Station to be located at a position that would neither incur any change of the restriction zones nor impose additional constraints on deployment of mobile base stations may nevertheless be considered.

27. Apart from the protection offered by the restriction zones, the Tai Po TT&C Station has a TT&C channel of some 1 MHz bandwidth in operation at the lower edge of the 3.4 – 3.6 GHz band, which requires even greater protection to avoid co-channel interference. As such, in the case of installation of any mobile base station using a frequency carrier at the band edge of 3.4 GHz, co-channel interference to the aforesaid TT&C channel will be inevitable. In this respect, the MNO concerned should take steps to ensure that there is no harmful or significant interference to that existing TT&C channel.

28. Please refer to section 4 of **Annex A** for CA's responses to the views

and comments received in the public consultation in relation to the protection for TT&C Stations.

Timeframe and Advance Notice Period for Change in Frequency Allocation of the 3.4 – 3.7 GHz Band

29. For re-farming any frequency band, advance notification of a reasonable period should be given to all the affected licensees. The same applies for the 3.4 – 3.7 GHz band. According to the TA Statement, an advance notice period of three years should, insofar as it is practicable, be given to licensees whose spectrum as affected by the proposed re-allocation are being used for connection between networks and customers.

30. The timeframe of the Mainland in deploying 5G services is expected to be by 2020. If the Mainland deploys 5G services in the 3.4 – 3.6 GHz band and Hong Kong maintains the status quo, i.e. continue to use the 3.4 – 3.6 GHz for FSS, wide-spread interference to existing FSS users near the Mainland-Hong Kong boundary would occur. Hence, there are justifications and operational needs for the CA to give an advance notice period of about two years to the affected licensees so as to effect the frequency re-allocation to tally with the anticipated timeframe of the Mainland in deploying 5G services.

31. Accordingly, and having duly considered the views and comments received in the public consultation, the CA has decided to effect the re-allocation of the 3.4 – 3.7 GHz band from FSS to MS with effect from 1 April 2020 ("Effective Day"), with an advance notice of about two years to be given to the affected licensees.

32. Please refer to section 5 of **Annex A** for the CA's responses to the views and comments received in the public consultation in relation to timeframe of the re-allocation and the associated advance notice period to be given to the affected licensees.

Table of Frequency Allocations in the 3.4 – 4.2 GHz Band

33. Figure 2 below depicts the relevant changes to the allocation of the 3.4 – 3.7 GHz band in Hong Kong's table of frequency allocations to come into effect on the Effective Day.

***Figure 2*: The current and new tables of frequency allocations of the 3.4 – 4.2 GHz band in Hong Kong**

Current Frequency Allocation

MHz 3400 – 4200	
HONG KONG ALLOCATION	BAND PLAN AND EXISTING UTILISATION
3400 – 3700 FIXED-SATELLITE[12] (space-to-Earth)	3400 – 3700 (a) Fixed-satellite
3700 – 4200 FIXED FIXED-SATELLITE (space-to-Earth)	3700 – 4200 (a) Fixed-satellite

New Frequency Allocation from the Effective Day

MHz 3400 – 4200	
HONG KONG ALLOCATION	BAND PLAN AND EXISTING UTILISATION
3400 – 3700 MOBILE [1]	3400 – 3600 (a) Mobile Service 3600 – 3700 (a) Guard Band [2]
3700 – 4200 FIXED FIXED-SATELLITE (space-to-Earth)	3700 – 4200 (a) Fixed-satellite

TT&C Stations are earth stations performing telemetry, tracking and control functions. "Protected TT&C Stations" refer to those situated at specific locations in Tai Po Industrial Estate and Stanley as designated by the CA.

[1] Additional allocation: The 3400 – 3700 MHz band is also allocated to fixed-satellite (space-to-Earth) on a primary basis for use of the band for TT&C functions at the Protected TT&C Stations, which are protected from interference of public mobile services.

[2] Use of the 3400 – 3700 MHz band for FSS would only be allowed at licensed TT&C Stations.

[12] Services with the names printed in capitals under the column of HONG KONG ALLOCATION (for example, FIXED-SATELLITE) are "primary" services.

WAY FORWARD

34. After the re-allocation, existing systems of SMATV/EFTNS/SPETS operating in the 3.7 – 4.2 GHz band which have implemented the necessary mitigating measures should be protected from significant interference caused by public mobile services subsequently operating in the 3.4 – 3.6 GHz band. To further ensure the co-existence of both FSS and MS operating in different parts of the C-Band, any subsequent installation of radio stations of public mobile services or FSS should duly consider the actual electromagnetic compatibility environment at the location of its installation. OFCA will follow up with interference cases in respect of relevant stations that have fulfilled the requirements under the Protection Principle.

35. After promulgating the decisions in this Statement, the CA will shortly launch a public consultation on the assignment arrangements of spectrum in the 3.4 – 3.6 GHz band for the provision of public mobile services.

Communications Authority
28 March 2018

Annex A

Summary of Submissions to the Consultation Paper and the Responses of the Communications Authority

Section 1: Introduction

1.1 The Communications Authority ("CA") conducted a public consultation[1] to seek views and comments of the telecommunications industry and affected persons on the proposed change in the current frequency allocation of the 3.4 – 3.7 GHz band from fixed satellite service ("FSS") (space-to-Earth) to mobile service ("MS") in the timeframe of 2020, for the provision of public mobile services.

1.2 At the close of the public consultation on 7 September 2017, 20 submissions were received. They are listed below under different categories and in alphabetical order –

Mobile Network Operators ("MNOs")

- China Mobile Hong Kong Company Limited ("CMHK")
- Hong Kong Telecommunications (HKT) Limited ("HKT")
- Hutchison Telephone Company Limited ("Hutchison")
- SmarTone Mobile Communications Limited ("SmarTone")

Satellite Operators

- ABS Global Ltd ("ABS")
- APT Satellite Company Limited ("APT")
- AsiaSat Satellite Telecommunications Company Limited ("AsiaSat")
- MEASAT Satellite System Sdn. Bhd. ("MEASAT")

External Fixed Telecommunications Network Services ("EFTNS") Operators

- China Satellite Communications (Hong Kong) Corporation Limited

[1] The consultation paper was issued on 27 July 2017 and is available at: https://www.coms-auth.hk/filemanager/en/content_711/cp20170727_e.pdf.

("China Satellite")
- Telstra International Group ("Telstra")

Satellite Master Antenna Television ("SMATV") Operator

- Pacific Satellite International Limited ("PSI")

Equipment Supplier

- Ericsson Limited ("Ericsson")

Wireless Technology Company

- Ruckus Wireless, Inc. ("Ruckus")

Legislative Council Member

- Hon Charles Mok

Industry Organisations

- Asia-Pacific Satellite Communications Council ("APSCC")
- CASBAA Ltd. ("CASBAA")
- EMEA Satellite Operators Association ("ESOA")
- Global VSAT Forum ("GVF")
- GSM Association and the Global Mobile Suppliers Association ("GSMA&GSA")
- Hong Kong General Chamber of Commerce ("HKGCC")

1.3 Having duly considered the views and comments received in the public consultation; feedback from the industry via the Radio Spectrum and Technical Standards Advisory Committee[2]; and the recommendations of a

[2] Radio Spectrum and Technical Standards Advisory Committee ("SSAC") advises the Director-General of Communications, who acts for the CA, on planning of radio spectrum and setting of technical standards. The SSAC comprises representatives from telecommunications and broadcasting licensees; amateur radio societies; local certification bodies; Consumer Council; Hong Kong Productivity Council; The Hong Kong Institution of Engineers; The Institution of Engineering and Technology Hong Kong; local industry associations; relevant government departments and a member appointed on an ad personam basis.

consultancy study on the co-existence of FSS and public mobile services in adjacent bands ("Consultancy Study"), the CA sets out in this Annex its responses to the views and comments received. For the avoidance of doubt, the CA has taken into account and given thorough consideration to all of the submissions which are relevant to the change in the frequency allocation of the 3.4 – 3.7 GHz band, even if not all of the issues raised are specifically mentioned or addressed herein.

1.4 This Annex sets out the major views and comments contained in the received submissions and the responses of the CA. Please refer to the statement to which this Annex is attached for the decision made by the CA after the public consultation on the matter.

1.5 The views, comments and responses set out in this Annex are without prejudice to the exercise of the powers by the CA under the Telecommunications Ordinance (Cap. 106) ("TO") or any other relevant legislation.

Section 2: Change in Frequency Allocation

2.1 Under the CA's proposal as set out in the public consultation paper ("Consultation Paper"), the current allocation to FSS in the 3.4 – 3.7 GHz band will be withdrawn and re-allocated to MS. 200 MHz of spectrum in the 3.4 – 3.6 GHz band will be assigned to the provision of public mobile services while 100 MHz of spectrum in the 3.6 – 3.7 GHz band will be partitioned as a guard band (hereunder referred to as the "Re-Allocation"). There will be no new frequency assignment in the guard band, save for its use at existing earth stations which are performing telemetry, tracking and control ("TT&C") functions.

<u>Question 1</u>: What are your views on the above proposed Re-Allocation?

<u>Views and Comments of the Respondents</u>

2.2 The respondents' views on this question are basically divided into three camps -

(a) nine respondents (CMHK, Ericsson, GSMA&GSA, HKGCC, HKT, Hon Charles Mok, Hutchison, SmarTone and Ruckus) support the proposed Re-Allocation;

(b) nine respondents (ABS, APSCC, APT, AsiaSat, CASBAA, China Satellite, ESOA, GVF and MEASAT) object; and

(c) the remaining two respondents (PSI and Telstra) raise concerns on the proposed Re-Allocation without showing explicit support or objection.

2.3 Five respondents (ABS, APT, CASBAA, ESOA, and MEASAT) object to the Re-Allocation and question why more spectrum is needed for public mobile services and why allocation is made in the 3.4 – 4.2 GHz band (commonly known as the "C-Band"). They argue that the satellite industry needs to use the entire C-Band spectrum; that the proposed change of allocation is made without a forecast of the local MS spectrum requirement in the sub-6 GHz band; and that the sub-6GHz band is underutilised as reflected from the fact that there is 35 MHz of idle spectrum for public mobile services. China

Satellite indicates that there are many satellite services in the C-Band and objects to the proposed Re-Allocation. ABS further suggests that the CA should mandate MNOs to refarm all second generation ("2G") and third generation ("3G") mobile services to the fourth generation ("4G") for more efficient use of spectrum.

2.4 Most of the respondents from the satellite industry express their concerns in the difficulty to move up existing satellite utilisation in the 3.4 – 3.7 GHz band to upper C-Band or other bands, and the potential significant loss of satellite services due to the Re-Allocation. Some of them opine that the prospective frequency allocation to MS should first consider the significant impacts, including economic loss to FSS, and that there should be no impairment of existing systems or services. They express doubt as to the legitimate grounds for the Re-Allocation and consider that the proposed Re-Allocation is made without commercial compensation in a fair manner. They also criticise that the public consultation has left a feeling of uncertainty about and lack of confidence in, the future of FSS bands in Hong Kong. APT, CASBAA, ESOA and MEASAT argue that under the Space Station Carrier Licence ("SSCL") associated with Outer Space Licences ("OSL") granted to domestic satellite operators, their use of spectrum (including C-band) should not be jeopardised within the licence period.

2.5 ABS, CASBAA, ESOA do not agree with the need to review the use of the C-Band in Hong Kong, despite the identification of that frequency band by the International Telecommunication Union ("ITU") for International Mobile Telecommunication ("IMT") years ago; the rapid development in the 3.4 – 3.6 GHz band in the Mainland; and the cross-boundary interference that may occur post 2020 as mentioned in the Consultation Paper. They comment that Hong Kong is not obligated to be aligned with the ITU frequency allocation or the Mainland allocation. AsiaSat, CASBAA, ESOA, and MEASAT further comment that the majority of countries in ITU Region 3 did not support the respective mobile allocation at the expense of FSS at the World Radiocommunication Conference ("WRC") held in 2007.

2.6 APSCC, CASBAA, ESOA, and GVF together with ABS also briefly address the important role of satellite technologies in the fifth generation of mobile services ("5G"), and suggest forbidding MS access to bands that are already in use or likely to be used by satellites.

2.7 AsiaSat, CASBAA, and ESOA note the heavy use of the 3.4 – 3.7 GHz band. The latter two respondents find the low utilisation of FSS downlink capacity in the 3.4 – 3.7 GHz band as stated in the paragraph 19 of the Consultation Paper specious. On reception of satellite television programmes, CASBAA and ESOA add that Nepali, Arabic and Italian broadcast channels are only provided in the 3.4 – 3.7 GHz band in Hong Kong.

2.8 Although respondents from the satellite industry raise concerns about the proposed Re-Allocation, the proposal is welcomed by the mobile industry and some other respondents. Nine respondents (CMHK, Ericsson, GSMA&GSA, HKGCC, HKT, Hon Charles Mok, Hutchison, SmarTone, and Ruckus) welcome the proposed Re-Allocation and share the view that the CA should make available additional spectrum to facilitate the 5G development and delivery of quality public mobile services, and achieve parity in mobile service standards with other economies. HKGCC and HKT further advocate that MNOs have a legitimate and primary right to use the 3.4 – 3.6 GHz band in accordance with the identification of the relevant band to MS in WRC-2007.

2.9 GSMA&GSA comment that the C-Band will be one of the first frequency bands to carry 5G traffic, making it a critically important band for MNOs who seek to offer the next generation public mobile services to consumers and businesses. Consequently, the provision of C-Band for 5G mobile services gives the Hong Kong economy a boost. HKT comments that closer cooperation between Hong Kong and the Mainland authorities in harmonising the 3.4 – 3.6 GHz band for MS helps avoid cross-boundary interference.

2.10 Seven respondents (Ericsson, GSMA&GSA, HKGCC, HKT, Hon Charles Mok, Hutchison, and SmarTone) indicate their strong demand for additional mobile spectrum to support 5G services. With a view to making additional spectrum available to public mobile services, Ericsson suggests the CA to allocate the entire C-Band to MS.

2.11 Hutchison further comments that the spectrum amount currently assigned to each MNO in Hong Kong is inadequate. Hence, assignment of additional and sufficient spectrum to MNOs is essential for them to provide superb network speed so as to deliver first-class services in terms of quality and

enriched user experience to customers. HKT shares the same view and considers that there will soon be (if there is not already) a spectrum shortage in Hong Kong.

2.12 Hon Charles Mok emphasises that additional new spectrum for MS is a key requirement for Hong Kong to stay competitive and underpins the importance of 5G for the development of Hong Kong as a Smart City. He considers that more spectrum for MS is necessary for Hong Kong to catch up and stay in pace with advanced mobile applications. He suggests that the CA should take into account the public's expectation on quality mobile services when reviewing the frequency allocation of the 3.4 – 3.7 GHz band.

2.13 In relation to the 35 MHz of leftover spectrum in the sub-6GHz band, HKT indicates that the said spectrum stays idle due to the lack of supply of suitable handsets and network equipment operating in the band, apart from the limited bandwidth and fragmentation of the relevant spectrum which makes the use by MNOs in Hong Kong and justification of their network investment difficult. HKGCC holds a similar view that the said 35 MHz of spectrum, which is split into two blocks, is not useful for cost-effective infrastructure development.

2.14 On the use of the C-Band by SMATV, HKT emphasises that given the ample choices of viewing content over free-to-air, pay television channels, as well as the Internet, the SMATV market has diminished significantly. HKT supports the Re-Allocation and further proposes that the CA should consider the most valuable use of the spectrum.

2.15 Ruckus considers the Re-Allocation appropriate for outdoor (macro cell), while the 3.6 – 3.7 GHz band is suitable for building (low power) coverage and can facilitate the application of wireless technology. It also suggests permissive indoor use of the 3.6 – 3.7 GHz band as a mitigating measure.

Responses of the CA

2.16 The CA notes the views of respondents and their concerns in the proposed Re-Allocation. The mobile penetration rate in Hong Kong reached 248% in December 2017, one of the highest in the world, with an average

monthly mobile data usage per capita exceeding 4.0 GBytes. From 2011 to 2017, the average monthly mobile data usage per capita has grown from 582 MBytes to 4112 MBytes, representing a compound annual growth rate of 39%. It is expected that this growth trend will continue and hence more spectrum is needed to meet the growth in demand. In fact, the use of the 3.4 – 3.6 GHz band for public mobile services (including 5G services) has gained momentum in the United States ("US"), the United Kingdom, Europe, Australia and the Mainland, among others, in recent years. For example, the European Union has earmarked this band as a strategic band for the launch of 5G in Europe in 2020. This band is therefore important to bring about the 5G launch in Hong Kong for us to be in line with the major economies.

2.17 Although there is 35 MHz of spectrum left unassigned in the sub-3GHz frequency bands for public mobile services, all of the 552 MHz of spectrum in this low frequency range, where supply of mobile equipment is available and is subject to competing demands, has been assigned for the provision of public mobile services. In view of the ever growing data usage in Hong Kong, additional spectrum supply is necessary to address, among other things, the demand of spectrum which will be brought about by the various categories of 5G services including but not limited to mobile broadband, Internet of Things, ultra-reliable and low latency communications, and the desire for a better user experience in terms of data service availability with wide coverage and in crowded areas such as in train compartments and large shopping malls.

2.18 Following the technology neutral principle, it is up to the MNOs to refarm spectrum currently used for 2G/3G networks to 4G networks. Even with all the existing mobile spectrum refarmed for the provision of 4G services, the aforesaid strong demand for spectrum for public mobile (including 5G) services will not be met without additional spectrum allocation. The 3.4 – 3.6 GHz band is one of the frequency bands identified by ITU for IMT services and is widely adopted for public mobile services (especially in recent years after WRC-2015) in other economies since this frequency band is capable of offering satisfactory signal coverage and high data transmission capacity. The identification of the 3.4 – 3.6 GHz band for use by MS including 5G services in Hong Kong is in line with the latest overseas development.

2.19 The allegations that the CA has neglected the potential impacts,

including economic loss, brought about by the Re-Allocation and the lack of legitimate grounds are unsound. The CA has duly taken into account the possible impacts on FSS and their need for the C-Band when considering the future allocation of the C-Band. In this connection, status quo will be maintained for the upper part of the C-Band (i.e. the 3.7 – 4.2 GHz band) where there is much higher utilisation for satellite services. Furthermore, a guard band in the range of 3.6 – 3.7 GHz is introduced as one of the mitigating measures to safeguard FSS operations in the upper C-Band. In tandem, a technical consultancy study has been conducted to examine feasible mitigating measures for protecting SMATV systems in the upper C-Band due to the use of public mobile services in the 3.4 – 3.6 GHz band.

2.20 With regard to the licensing period of SSCL and the associated OSL, as well as the advance notice period in association with the change of frequency allocation in the 3.4 – 3.7 GHz band, given the obligation of the CA to promote the efficient use of radio spectrum, the CA may vary or withdraw allocations and assignments of frequency bands if reasonable notices of the intended variation or withdrawal have been given to the respective licensees in accordance with section 32H of the TO. As stated in a statement of the Telecommunications Authority issued in 2008, the actual notice period may depart or deviate from the stated minimum notice periods (ranging from one to three years) where the circumstances so warrant. In this connection, there is no statutory requirement for the CA in respect of compensation to the affected spectrum users upon any variation or withdrawal of frequency allocation/assignment. Furthermore, the withdrawal of the 3.4 – 3.7 GHz band from the operational frequency range of FSS operators in Hong Kong, while continuing to protect the TT&C functions in this band, does not affect the use of that frequency band in the space by satellites of SSCL holders, which typically covers a regional foot print of a much wider area not limited to within Hong Kong.

2.21 While Hong Kong and the Mainland both follow the ITU global frequency allocations, the CA performs independent functions on local spectrum management. As far as frequency coordination between Hong Kong and the Mainland is concerned, the natural terrain in the New Territories is inadequate to act as physical barriers to block out radio signals from the Mainland which may cause potential radio interference to Hong Kong. Aligning the frequency allocations in the relevant frequency band of Hong

Kong and the Mainland not only helps address the need for interference mitigation, but also copes with the local spectrum demand for public mobile services in Hong Kong. More importantly, the Re-Allocation contributes to addressing the needs of society for public mobile services towards 2020 and beyond.

2.22 The CA notes that in the early years, many countries in Region 3 did not support mobile allocation in the C-Band at the expense of FSS. However, the situation has changed in recent years. Some Region 3 countries, including the Mainland, Japan and Korea, have already developed or are actively planning for the provision of public mobile services in the C-Band. As a matter of fact, the 3.3 – 3.6 GHz band is going to be deployed for the provision of 5G services in the Mainland in 2020 or even earlier.

2.23 The CA notes the potential role of satellite applications in the development of 5G services, which covers some other higher frequency bands. The CA considers that the Re-Allocation can strike a balance by allowing both public mobile services and FSS a fair access to the C-Band spectrum to serve the industry and the general public. Without implementing the Re-Allocation, there will be insufficient spectrum, in particular the sub-6GHz spectrum, for building leading-edge telecommunications infrastructure and underpinning Hong Kong's competitiveness. Inbound international roaming for visitors will also be adversely affected if the spectrum of 3.4 – 3.6 GHz band, which will be commonly used in many economies for the provision of 5G services, is not made available in Hong Kong.

2.24 In relation to the analysis of C-Band utilisation in Hong Kong, as stated in paragraphs 18 – 23 of the Consultation Paper, it is based on the updated records of the Office of the Communications Authority ("OFCA"). The figures (e.g. 21 690 MHz of aggregated transponder bandwidth, 11% of downlink capacity within 3.4 – 3.7 GHz, and 3% of this downlink capacity amount provided for EFTNS / self-provided external telecommunications systems ("SPETS") in Hong Kong) stated in paragraphs 18 – 19 of the Consultation Paper focuses on the downlink capacities available in the 3.4 – 3.7 GHz band relative to that of the total available amount in the C-Band, X-Band, Ku-Band and Ka-Band[3], and the corresponding proportion being provided for

[3] Please refer to paragraph 18 of the Consultation Paper for the exact frequency ranges of X-Band, Ku-Band and Ka-Band.

EFTNS / SPETS. It has taken into account the available and usable transponder bandwidths offered by all Hong Kong satellites concerned, rather than just the physical bandwidths of the bands concerned.

2.25 The CA has duly considered the impact to SMATV systems, as stated in paragraphs 23 and 31 of the Consultation Paper. The estimated percentages of programme channels and systems which will potentially be being affected are 12% (9 out of 75) and 11% (173 out of 1 600) respectively. Hong Kong adopts an "open sky" policy for the reception of satellite TV programmes by SMATV and television receive-only ("TVRO") systems, i.e. any unencrypted television programmes may be received off-the-air and, save for revocation by the copyright owner concerned, the right to receive and view the said programmes is deemed to have been granted under the Copyright Ordinance (Cap. 528). The CA has no jurisdiction on the choice of the foreign satellite broadcasters in using frequency channels to deliver their programme contents via satellites including the use of encryption technology.

2.26 The CA notes the suggestion of moving FSS to bands higher than the 3.4 – 4.2 GHz band. Considering that the 3.7 – 4.2 GHz band is more heavily used in Hong Kong and the significant impact which will be brought by the vacation of FSS from the entire 3.4 – 4.2 GHz band, the suggestion would not be considered at the present stage. The CA will continue to take heed of the worldwide development trend in this regard.

2.27 On Ruckus's suggested indoor use of the 3.6 – 3.7 GHz band, the CA is of the view that using the 3.6 – 3.7 GHz band for indoor deployment of public mobile services might also affect FSS in the vicinity, especially those operating in the same band. This proposal may not be feasible in practice.

Section 3: Protecting Principle for Existing SMATV/EFTNS/SPETS Systems and Mitigating Measures

3.1 Assuming that the 3.4 – 3.7 GHz band is re-allocated to MS, a protection principle was proposed by the CA in the Consultation Paper to ensure the co-existence of FSS and public mobile services in the C-Band. In case a mobile base station of public mobile services operating in the 3.4 – 3.6 GHz band causes interference to an existing system of SMATV/EFTNS/SPETS in the vicinity operating in the 3.7 – 4.2 GHz band with the necessary mitigating measures implemented, the MNOs concerned should be held accountable for offering protection to these systems. TVRO systems will not be entitled to protection from any harmful interference from the prospective public mobile services since they are exempted from licensing requirements under the TO. Some mitigating measures for systems and services operating in the 3.4 – 4.2 GHz band after the proposed Re-Allocation have already been set out in the Consultation Paper.

Question 2: ***Do you agree with the principle of protecting existing SMATV/EFTNS/SPETS systems operating in the adjacent band of 3.7 – 4.2 GHz with the implementation of the mitigating measures?***

Views and Comments of the Respondents

3.2 There are 17 respondents who commented on the protection principle. Among these respondents, 12 of them (ABS, APSCC, APT, AsiaSat, CASBAA, CMHK, Ericsson, ESOA, GVF, HKGCC, PSI and SmarTone) agree with the proposed protection principle for existing SMATV/EFTNS/SPETS systems with the necessary mitigating measures implemented and one respondent (HKT) raises objection. Other respondents express different concerns on the protection principle.

3.3 Notwithstanding the reasons given by the CA on the ineligibility of TVRO systems for being protected under the Re-Allocation, eight respondents (ABS, APSCC, APT, AsiaSat, CASBAA, ESOA, GVF, and MEASAT) advocate that TVRO should be protected. ABS claims that it is inappropriate not to protect TVRO on grounds that it is unlicensed. While APSCC and GVF

suggest that the protection should be extended to cover future systems, AsiaSat raises the need to protect TVRO and earth stations performing TT&C functions ("TT&C Stations").

3.4 Hutchison is of the view that the protection principle should be applicable to EFTNS and SPETS only, but not SMATV or TVRO, because owners and users of SMATV and TVRO are not licensees and MNOs should not be accountable for their rectification work. HKT points out that only existing TT&C Stations need to be protected. It further supplements that it is unreasonable and impractical for public mobile services to take steps to avoid interfering with FSS or be held accountable for the protection to existing SMATV/EFTNS/SPETS systems that are scattered across the territory.

3.5 CASBAA does not agree with the CA's use of the term "legacy systems" for describing FSS.

Responses of the CA

3.6 The CA notes the views made by the 17 respondents on Question 2 and that there is only one respondent who objects to the protection principle for SMATV/EFTNS/SPETS. The respondents' concerns on TVRO and future systems are also noted. The protection considerations for TT&C Stations will be covered in Section 4 of this Annex.

3.7 Unlike SMATV/EFTNS/SPETS for which their deployments are approved under licences issued by the CA, TVRO systems are licence-exempted in Hong Kong. The CA does not have any information on the number, locations, users or technical parameters of TVRO systems being used in Hong Kong. A TVRO system is a simple and low-cost receiver for use at a single premise and may be used anywhere in Hong Kong in an uncoordinated manner. The fact that there is a lack of information on the number of such systems which exist across the territory renders it infeasible to accord protection to each and every TVRO system. On the other hand, there are many TVRO systems in Hong Kong operating in the Ku-Band for direct-to-home reception. These Ku-Band TVRO systems generally have a small antenna dish of about one foot in diameter and will not be affected by the proposed Re-Allocation.

3.8 The proposed protection applies to present licensed systems of SMATV/EFTNS/SPETS, so long as they have implemented the necessary mitigating measures. If harmful interference to any of these FSS systems (existing and operating as at the date of this Statement) arises, the MNO(s) concerned, as providers of a subsequently-established service, will be held accountable. Future FSS systems that are established after the Re-Allocation will not be entitled to any protection from nearby mobile base stations of public mobile services already in service in order not to disrupt the operation of the latter. In sum, it is paramount that any future installation of FSS or MS services shall take into account the local radio environment when they are built on site.

3.9 While HKT comments that it is unreasonable and impractical for public mobile services to avoid interfering with FSS, it should be noted that MNOs will be the recipients of the re-allocated resources. Furthermore, under the Re-Allocation, as incumbent users, SMATV/EFTNS/SPETS systems are already required to put in place necessary mitigating measures before they can claim protection from the public mobile services.

3.10 The CA uses the term "legacy systems" simply to mean FSS systems that are currently in existence and operating as at the date of this Statement, as differentiated from future FSS systems established thereafter.

<u>Question 3</u>: For implementation of the proposed Re-Allocation, please suggest or give your views about any mitigating measures to be implemented for the existing systems and services as well as any precautions to be taken for the operation of the new mobile base stations to be operating in the 3.4 – 3.6 GHz band.

<u>Views and Comments of the Respondents</u>

3.11 Among the several mitigating measures suggested by the CA in the Consultation Paper, many respondents comment on the use of the 100 MHz of spectrum at 3.6 – 3.7 GHz as a guard band. PSI and Telstra support, and seven other respondents (Ericsson, GSMA&GSA, HKGCC, HKT, Hutchison, Ruckus, and SmarTone) wonder whether 100 MHz is justified and suggest to minimise it. Ericsson and HKT suggest having more studies or trials to minimise the guard band and release more spectrum for MS. HKT further

comments that as the 100 MHz of guard band is substantial, the possibility of interference should be minimal, if any, and no further mitigating measures by MNOs would be necessary. On the other hand, two respondents (MEASAT and PSI) consider that the unmanaged transmitter output power of IMT (i.e. MS) would affect satellite broadcasting services even with a guard band of 100 MHz in between.

3.12 The liability for the implementation of mitigating measures also draws the respondents' attention. SmarTone considers that all necessary mitigating measures should be implemented in TT&C Stations before imposing the restriction zones, and in SMATV systems before requiring rectification by MNOs. Necessary mitigating measures for TVRO systems should be implemented by TVRO users. Four other respondents (ABS, CASBAA, ESOA, and GVF) share the view that the protection should be at the expense of MNOs as late comers. A similar view is expressed by PSI that the CA and recipients of the re-allocated resources should provide financial resources for all mitigating work. AsiaSat considers the incompatibility between IMT and FSS in the C-Band noteworthy, and that it is not reasonable for any cost to be borne by satellite users, save for new providers deploying systems after the Re-Allocation. If such cost is not borne by such new providers, it should be covered by OFCA. In this connection, HKT opines that as the CA will be the one who decides on the Re-Allocation, MNOs should not be held responsible. Rather, the CA should fund the mitigating measures with the spectrum utilisation fees ("SUF") received. Three respondents (CASBAA, ESOA and MEASAT) query how the cost of mitigating measures will be borne by new providers.

3.13 To ensure seamless service in satellite television programme reception by SMATV systems, HKGCC suggests that SMATV licensees should be responsible for providing technical support to SMATV systems for subscribers, and other services operating in the adjacent bands to the public mobile services should accommodate such mobile services as far as possible. Ericsson proposes the CA making known the mitigating measures required and the implementation details to MNOs prior to auction.

3.14 Some respondents comment on the technologies for better sharing of the band between FSS and IMT. GSMA&GSA points out that advanced networks are not comparable to the network architectures of the past, and

today's sharing parameter must reflect that situation. Ruckus adds that receiver performance should be improved for better sharing possibility. AsiaSat considers that unwanted emissions (spurious and out-of-band emissions) of IMT equipment could not be mitigated by the use of filters at the satellite receiver end and control on such emissions would rely on the emission mask specifications of IMT equipment. Similarly, APT highlights that evidence should be provided by the CA, MNOs or manufacturers to demonstrate the out-of-band performance of mobile terminals, especially for the roaming terminals.

3.15 For smooth transition during band vacation and implementation of feasible mitigating measures, HKGCC, Hon Charles Mok and Hutchison suggest that the Government should proactively engage the relevant licensees at an early stage. Discussion on feasible mitigating measures/implementation, feasibility of restriction zones, shielding structure, etc. should be facilitated.

3.16 For the impact of public mobile services on SMATV/EFTNS/SPETS, CMHK considers it difficult to make the assessment in the absence of deployment information of these systems. Three other respondents (CASBAA, ESOA, and MEASAT) are concerned about how interference issues would be mediated.

3.17 Feasible mitigating measures are crucial to the successful band sharing between IMT and FSS. Five respondents (APT, AsiaSat, CASBAA, ESOA, and MEASAT) express reservations as to the feasibility of the mitigating measures proposed in the Consultation Paper. MEASAT considers these measures simplistic while APT doubts the feasibility of these mitigating measures due to the lack of studies on spectrum utilisation in the 3.7 – 4.2 GHz band, financial burden on licensees and lack of information regarding the out-of-band performance of future mobile terminals.

3.18 Some respondents (APSCC, AsiaSat, Ericsson, HKGCC, and MEASAT) suggest specific mitigating measures, including antenna installation, tighter limitations on unwanted emissions of IMT equipment, front-end filter, guard band, prior consultation with domestic FSS and/or mobile operators on protection criteria and field tests, site survey, impact analysis on new mobile base stations, active monitoring and establishment of interference-resolving process, etc. GSMA&GSA and Ericsson suggest some publications on sharing studies and mitigating measures for reference. Telstra proposes OFCA to

consider additional mitigating measures, including setting appropriate interference thresholds for public mobile services, technologies such as 5G beam-forming antennas, coordination services with various stakeholders such as careful technical planning of the location, and transmitting power limits for new 5G mobile base stations in the vicinity of satellite facilities.

3.19 CASBAA and ESOA opine that given the small percent of Hong Kong satellite terminals with respect to the entire satellite network spanning over many territories, reconfiguration of transponder downlink capacity leasing may not be realistic. The same consideration applies to the case of re-tuning satellite transmitting frequencies for broadcast to SMATV and TVRO. AsiaSat enquires how OFCA would control and ensure that outdoor IMT signal levels would not unduly interfere with FSS reception.

Responses of the CA

3.20 The introduction of a guard band of 100 MHz at the 3.6 – 3.7 GHz band will reduce the impact of public mobile services on FSS after the Re-Allocation and facilitate the implementation of interference mitigating measures. It is noteworthy that protection of a satellite downlink signal, which is in general very weak, would demand significant suppression of the unwanted but relatively strong mobile signal receivable at the satellite dish. Additional filter would be needed to suppress the unwanted signal and a frequency separation of 100 MHz is needed to ensure that the filtering effect is up to the suppression requirement. The need for a guard band of 100 MHz is ascertained by the consultants who conducted the Consultancy Study[4] earlier, which indicates that significant suppression of mobile signal could only be achieved with such frequency separation, thus allowing extensive deployment of public mobile services.

3.21 The Consultancy Study has assessed the impacts of using 50 MHz and 100 MHz as guard bands. Laboratory measurements demonstrated that with a 100 MHz guard band, an appropriate band-pass filter retrofitted into a SMATV system can suppress the receivable unwanted mobile signals by a

[4] The Consultancy Study report entitled "*Consultancy Report on Assessments on and Recommendations to Enable the Electromagnetic Compatibility between Public Mobile Services and Fixed Satellite Service Operating in the C-Band* " is available at: https://www.ofca.gov.hk/filemanager/ofca/common/reports/consultancy/cr_201804_01_en.pdf.

magnitude of up to 60 dB. If the bandwidth of the guard band is reduced to 50 MHz, the achievable suppression is 27 dB only. To offer the same level of protection to SMATV systems when a 50 MHz guard band is used, the transmitting powers of mobile base stations need to be reduced proportionately by 33 dB, thereby leading to a significant decrease in the coverage area of a mobile base station and hence a corresponding increase in the number of mobile base stations required for attaining ubiquitous coverage. With these findings, the consultant has re-affirmed that a 100 MHz guard band is optimal in striking a balance between protecting SMATV systems on the one hand and not impeding the roll-out of public mobile services on the other.

3.22 As stated in paragraph 32 of the Consultation Paper, given that SMATV/EFTNS/SPETS installations are scattered in Hong Kong in an uncoordinated manner, there may be a need to impose constraints on the deployment of radio base stations of public mobile services, such as operation in a restricted radiated power, to ensure their co-existence.

3.23 The CA notes the potential interference between FSS and IMT sharing the C-Band. As recommended in the Consultancy Study, EFTNS/SPETS should also make reference to the necessary mitigating measures and arrange implementation prior to the Re-Allocation.

3.24 As to which party should be held accountable for the mitigating work, the spectrum at the 3.4 – 3.7 GHz band is proposed to be re-allocated from FSS to MS, where MNOs will be the late comers and the recipients of the re-allocated resources. Although it is a common practice in the telecommunications sector that a late comer will be held accountable to resolve problems affecting an existing user, there is no statutory stipulation on which party should bear the cost of the mitigating work. Technically speaking, to enable co-existence of FSS and MS operating in the C-Band, there is a need to implement appropriate mitigating measures at all the radiocommunications systems concerned. EFTNS/SPETS licensees should arrange to implement the necessary mitigating measures before the Re-Allocation. Regarding the affected SMATV systems which are serving the general public, the CA is mindful of the need for a funding mechanism to support the upgrade of these SMATV systems as the scale of SMATV deployment is much larger than other FSS users and the owners/users of SMATV systems may not have the required expertise or resources. This issue will be dealt with in the forthcoming public

consultation regarding the assignment arrangements for spectrum in the 3.4 – 3.6 GHz band. With necessary mitigating measures implemented in SMATV/EFTNS/SPETS systems, MNOs should be held accountable for protecting these incumbent systems in case of interference caused by their mobile base stations. TVRO systems are recommended to implement similar measures as SMATV to minimise the negative impact, though they are not protected from interference.

3.25 On technologies for better sharing between FSS and MS, the CA has taken into account the current technology for network deployment, receiver performance and relevant advanced mitigating solutions when deciding the necessary mitigating measures/implementation and the sharing requirements. It is expected that various mobile terminals may be available as the use of the C-Band for 5G services becomes popular. The design of mobile terminals typically complies with international standards, where the sharing with FSS in adjacent bands should have been duly considered. The demonstration on the out-of-band performance of specific mobile terminals is therefore considered unnecessary.

3.26 The CA notes and appreciates the concerns raised by respondents regarding impact assessment on SMATV/EFTNS/SPETS and how interference issues may be mediated. While some of the deployment information of SMATV is publicly available on the OFCA's website, those for EFTNS/SPETS systems are considered commercially and operationally sensitive, and therefore inappropriate for release to third parties. In relation to mediating interference issues, since MNOs will be held accountable only if the interference arises in a system with necessary mitigating measures already implemented, the number of such cases is expected to be small. In case where there are interference complaints between FSS and public mobile services which cannot be settled between the parties concerned, such complaints will be mediated by OFCA in the light of the protection principle. OFCA may evaluate technically whether the necessary mitigating measures have been implemented and whether there is harmful interference to the FSS concerned, with a view to determining which party should take action to solve the problem.

3.27 Recognising the role of mitigating measures for successful band sharing between FSS and MS, the CA is of the view that the guard band at the 3.6 – 3.7 GHz band is needed to reduce any potential interference caused by

public mobile services operating in the 3.4 – 3.6 GHz band to the FSS operating in the 3.7 – 4.2 GHz band. The CA welcomes the suggestions on feasible mitigating measures and sharing studies, which have been taken into account by the CA in devising the necessary mitigating scheme.

3.28 The CA agrees that using downlink capacity solely in the 3.7 – 4.2 GHz band for the provision of EFTNS/SPETS may involve reconfiguration of transponder downlink capacity. In view of the comparatively low FSS utilisation and with a view to facilitating the development of public mobile (including 5G) services in Hong Kong, the CA considers that such reconfiguration is technically feasible and the lower part of the C-Band should be allocated to MS for deployment of 5G services as in many other economies. The CA considers that the Re-Allocation involving the lower part of the C-Band has struck a right balance in catering for the need of the satellite industry and public mobile services.

Section 4: Protection for TT&C Stations at Existing Locations

4.1 Assuming that the Re-Allocation is adopted, the local satellite operators who have the necessary technical expertise and resources should implement mitigating measures. To further protect existing TT&C Stations, the CA has proposed, in the Consultation Paper, to impose restriction zones constraining the deployment of mobile base stations of public mobile services operating in the 3.4 – 3.6 GHz band as an additional safeguard.

Question 5: ***What are your views on the need to protect the TT&C channels of the licensed satellite networks at their specific locations from any harmful interference to be caused by public mobile services?***

Views and Comments of the Respondents

4.2 A total of 17 submissions offer comments to this question. Among these respondents, 12 (ABS, APSCC, APT, AsiaSat, CASBAA, ESOA, GSMA&GSA, GVF, HKT, MEASAT, PSI and Ruckus) consider it necessary to protect the TT&C Stations. ABS further indicates that it will be wholly inappropriate if the CA does not require protection of TT&C Stations or asks the satellite operators to vacate the sites. The remaining five respondents (CMHK, Ericsson, HKGCC, Hutchison and SmarTone) do not explicitly express support or objection, but comment on the proposed protection with restriction zones. There is no submission objecting to the need to protect TT&C Stations.

4.3 On the proposed protection scheme with the use of restriction zones, four respondents (GSMA&GSA, HKGCC, HKT, and SmarTone) consider that only the present TT&C Stations at the two existing locations (Stanley and Tai Po) should be protected. In contrast, APSCC is of the view that both existing and future TT&C Stations operating in the adjacent band of the 3.7 – 4.2 GHz band require protection with mitigating measures.

4.4 The two satellite operators (ABS and AsiaSat) are concerned about the efficacy of imposing restriction zones for the protection of TT&C Stations. They comment that large separation distances would be required based on the relevant ITU studies. AsiaSat also doubts whether any realistic IMT

operation in Hong Kong can offer adequate protection in this regard. SmarTone suggests that the use of restriction zones should be taken as the last resort in case interference arises after implementation of other mitigating measures.

4.5 Apart from the important role of TT&C channels on satellite operation, APT opines that traffic monitoring also forms an essential part for network management. It emphasises that any interference to the 3.4 – 3.7 GHz band will cause loss of services or even loss of control to its satellites.

4.6 With regard to the implementation of restriction zones, three respondents (HKGCC, HKT, and SmarTone) request the CA to disclose information on the frequency and usage of TT&C channels operating in the 3.4 – 3.7 GHz band, and the geographical extent of the restriction zones. APT opines that MNOs should provide detailed methodologies to fulfil the separation distance required.

4.7 As the geographical extent of the restriction zones depends, among others, on the locations of existing TT&C Stations, Hutchison is of the view that the TT&C Stations in Tai Po should be relocated to some other remote areas in Hong Kong so that 5G services could be provided in Tai Po where many commercial and residential premises are located. CMHK suggests using Stanley and Tai Po as primary and backup sites for TT&C respectively. It further suggests OFCA to evaluate the potential constraint on the deployment of mobile base stations in Stanley and Tai Po.

4.8 AsiaSat highlights that for in-band mitigating measures (e.g. for protecting existing TT&C Stations), sufficient attenuation of IMT signal at TT&C locations is the only way to proceed, and emphasizes that TT&C Stations in any portion of the C-Band should be protected. While admitting that satellite operators have the required technical expertise, AsiaSat indicates that they do not have the authority to enforce measures for TT&C protection (e.g. imposing restriction zones for protection in the 3.4 – 3.6 GHz, 3.6 – 3.7 GHz and / or 3.7 – 4.2 GHz bands, imposing unwanted emission masks on IMT equipment, etc.).

4.9 Apart from the implementation of restriction zones, respondents are also concerned about the liability issues and other mitigating measures.

SmarTone agrees with the CA that all necessary mitigating measures should be implemented in TT&C Stations before they can require rectification by MNOs. Four respondents (CASBAA, ESOA, MEASAT and GVF) are of the view that mitigating measure for TT&C Stations should be carried out at the expense of MS licensees as late comers. CASBAA further comments that in respect of possible damage to or losses suffered as a result of the inability to access satellites due to interference, the CA should be held accountable for this, while any increase in insurance should be borne by MS licensees or the CA.

4.10 In connection with other mitigating measures for TT&C Stations, AsiaSat points out that sufficient attenuation of IMT signals at earth station locations can be done by various measures, e.g. multiple-input-multiple-out ("MIMO"), antenna downtilting, indoor only deployment, low power mobile base stations and restriction zones. Ericsson suggests using shielding and antenna discrimination (smart antenna) to reduce the distance between IMT and FSS stations, so that co-existence of the two services can be achieved.

Responses of the CA

4.11 The CA notes that more than half of the respondents who comment on this question agree that there is a need to protect TT&C functions and there is no submission indicating objection. Given the importance of TT&C functions to satellite operation and safety, the CA considers that it is necessary to offer a higher protection to TT&C Stations, especially for those operating in the 3.4 – 3.7 GHz band, so as to prevent any harmful effect which might jeopardise the operation of satellites in orbit.

4.12 Regarding the use of restriction zones, the present TT&C Stations at the two existing locations will be covered under the proposed protection scheme, while new TT&C Stations outside the aforesaid locations will not be covered. With reference to notation [1] in Figure 2 of the Consultation Paper, the protection is intended for existing TT&C Stations operating in the 3.4 – 3.7 GHz band at the two existing locations. Use of the 3.4 – 3.7 GHz band for FSS will only be allowed at licensed TT&C Stations. In principle, any TT&C Stations established after the date of the CA Statement which are not situated at the existing two locations will not be allowed to operate in the 3.4 – 3.7 GHz band. Any new location for TT&C Stations using that frequency band will be

considered only if it will neither incur any change of the restriction zones, nor impose additional constraints on development of mobile base stations.

4.13 Some of the respondents raise concerns on the efficacy of the use of restriction zones for protection of TT&C Stations. The relevant ITU studies recommend a large separation distance for interference-free protection to FSS for co-frequency re-use by MS in some other areas. However, co-frequency re-use is largely irrelevant to the proposed Re-Allocation as different sub-bands are used for MS and FSS, save for the TT&C applications. The implementation of restriction zones aims to ensure electromagnetic compatibility between FSS and IMT operating in different frequencies within the 3.4 – 3.6 GHz band so that it would not lead to de-sensitisation of the receivers at TT&C Stations. The implementation of restriction zones has taken into account the geographic landscape and buildings surrounding the TT&C Stations as well as the technical and operational characteristics of the satellite dishes and receivers, etc. Specifically, since there are many mountains surrounding the TT&C Stations in Tai Po serving as shielding obstacles and the TT&C Stations in Stanley are facing the sea, such environmental barriers will help protect the stations. Coupled with other mitigating measures and the introduction of the guard band, co-existence of IMT and the operation of the TT&C operation in the 3.4 – 3.7 GHz band should be feasible. The traffic monitoring function will continue to be allowed, though following the Re-Allocation, local satellite operators will not be entitled to claim protection for the continuance of any such monitoring functions. As for the special case of co-channel interference to a TT&C channel by IMT operating near the edge of the 3.4 GHz band, further interference mitigation would be required, as detailed in paragraph 4.16 below.

4.14 The CA does not agree to disclose the frequencies and other technical parameters of TT&C channels, which are commercially and operationally sensitive information. In devising the restriction zones, the CA has already taken them into account. Furthermore, as the restriction zones will constrain operators' deployment of mobile base stations and their technical characteristics, the CA will include such requirements and the need to protect the TT&C Stations as conditions in the licenses to be granted to the assignees of the spectrum in the 3.4 – 3.6 GHz band.

4.15 Similar to the frequencies and other technical parameters of TT&C

channels, the choice of TT&C Stations and their locations are commercial decisions of satellite operators, which are constrained by, among other things, land acquisition.

4.16 The CA appreciates AsiaSat's concerns on TT&C protection. The CA will ensure that IMT equipment complying with the relevant international standards will be adopted in the future. Proposed restriction zones are developed based on the worst case scenario of desensitisation of in-band FSS signal in the said 3.4 – 3.6 GHz sub-band. Requirements will also be imposed on MNOs to constrain the use of 3.4 – 3.6 GHz band by their subscribers' mobile terminals (or handsets) as detailed in paragraph 4.17 so as to effect protection to the TT&C Stations. In addition, since there is one TT&C channel operating near the lower band edge of the 3.4 – 3.6 GHz band, on top of being confined by the restriction zones, the prospective MNO deploying any radio channel overlapping with this TT&C channel will have to ensure that there will be no harmful interference to the TT&C channel.

4.17 A network-based solution is identified in the Consultancy Study report whereby the public mobile network may force handover of connected mobile terminals to another overlapping mobile base station operating in a frequency band other than the 3.4 – 3.6 GHz band. It actually provides a means to create "uncovered areas" of the public mobile service in the 3.4 – 3.6 GHz band in order to prevent inadvertent operation of a mobile terminal (or handset) of the 3.4 – 3.6 GHz band that might cause interference with a particular FSS system in the vicinity. The CA will impose this requirement as a licence condition for prospective spectrum assignees to better protect respective TT&C Stations and other essential satellite receiving systems to be determined by the CA.

4.18 On the liability issues and other mitigating measures for TT&C protection, the CA welcomes suggestions made on mitigating measures. The CA considers that operators of TT&C Stations should implement necessary mitigating measures at their own cost in line with other FSS operators.

Section 5: Timeframe and Advance Notice Period for Change in Allocation of the 3.4 – 3.7 GHz Band

5.1 The CA proposes to effect the Re-Allocation in early 2020, with an advance notice of about two years to be given to the affected licensees.

<u>Question 4</u>: ***What are your views on effecting the Proposed Re-Allocation in the early 2020, giving an advance notice period of two years if the relevant decision of the CA is made in early 2018?***

<u>Views and Comments of the Respondents</u>

5.2 18 respondents offered comments to this question —

(a) four respondents (CMHK, Ericsson, Hutchison, and Ruckus) support the implementation of the proposed Re-Allocation in early 2020;

(b) six respondents (ABS, APSCC, CASBAA, ESOA, GVF and MEASAT) object to the proposed Re-Allocation and timeframe;

(c) seven respondents (APT, AsiaSat, GSMA&GSA, HKGCC, HKT, PSI and SmarTone) make recommendations on the Re-Allocation timeframe (either longer or shorter); and

(d) one respondent (Telstra) expresses that it has no view on this point.

5.3 Three respondents (APT, AsiaSat, and PSI) consider that a longer period of advance notice should be offered. APT and AsiaSat are of the view that the advance period should cover typical satellite life span, while PSI considers a two-year advance notice period too short and prefers a notice period of three to four years. Four respondents (APSCC, CASBAA, ESOA, and GVF) object to the shortened notice period on grounds of inadequate rationale or justification since satellite operators, content providers and users have been operating in the 3.4 – 3.7 GHz band for years.

5.4 Four other respondents (GSMA&GSA, HKGCC, HKT, and SmarTone) suggest an earlier Re-Allocation with a notice period of one year.

HKT and Hutchison point out that the use of the 3.4 – 3.6 GHz band for public mobile services in the Mainland may take place earlier than 2020. Likewise, GSMA&GSA emphasises that as the Mainland is going to launch the C-Band 5G network in 2019, an earlier release of the 3.4 – 3.7 GHz band to MS would be appropriate.

Responses of the CA

5.5 The CA notes the respondents' views and comments on the timeframe for the Re-Allocation and the advance notice period to be given to the affected licensees.

5.6 In deciding the timeframe for the Re-Allocation and the notice period, the CA has taken into account the interests of various parties including the general public, latest development of the mobile and satellite communications in Hong Kong, alignment with the worldwide development of 5G services, the fact that the 3.3 – 3.6 GHz band is going to be deployed for the provision of 5G services in the Mainland, that the Mainland has issued a notice in November 2017 setting out the regulatory details for the use of the 3.3 – 3.6 GHz band, and the need to ensure a smooth transition of the proposed Re-Allocation. The CA considers that given the circumstances, a notice period of two years is appropriate and the Re-Allocation should be effective from 1 April 2020.

Section 6: Other Views on Proposed Change of Allocation of the 3.4 – 3.7 GHz Band

<u>Question 6</u>: ***Do you have any views on other aspects of or issues relevant to this consultation?***

<u>Views and Comments of the Respondents</u>

6.1 Seven respondents (Ericsson, GSMA&GSA, HKGCC, HKT, Hon Charles Mok, Hutchison, SmarTone) urge the CA to further make available additional spectrum apart from the 3.4 – 3.6 GHz band, possibly from the 698 – 806 MHz, 3.3 – 3.4 GHz, 3.7 – 4.2 GHz, 4.4 – 5 GHz, 24.25 – 29.5 GHz, 37 – 43.5 GHz bands and some other millimeter waves, and to provide a long-term spectrum release plan with sufficient amount of spectrum to be assigned to each MNO. Similarly, Hutchison suggests that the CA should provide a spectrum roadmap for 5G and take a more holistic approach to the review and development of the 5G spectrum. Hon Charles Mok suggests a review of the allocation approach, to enhance the efficiency in assigning spectrum bands such as by allowing spectrum trading, and to utilise the revenue generated from SUFs for improving telecommunications infrastructure in remote areas.

6.2 APT queries why those less congested bands in 850 – 3400 MHz, especially those already allocated to MS, are currently unused. Drawing reference from the frequency allocations table of Hong Kong, PSI criticises the very low utilisation of the 837.5 – 870 MHz band after re-allocation to land mobile service, and similarly, in other frequency bands allocated to land mobile service. On the other hand, HKT proposes the CA to critically review the role of SMATV in the future.

6.3 HKT wonders why the Consultancy Study is confined to the impact on SMATV, but not other satellite services. It also proposes to have the Consultancy Study based on typical rather than the worst case scenarios.

6.4 ABS queries why a receive-only service (SMATV and TVRO systems) seems to be given a lower status by the CA as compared to a transmit/receive service or a transmit-only service simply because no license is required. It considers that SMATV and TVRO systems are popular and widely used by the general public and they should be protected.

6.5 APSCC suggests having further studies and giving more warning to relevant parties affected by the Re-Allocation. PSI considers that there should be sufficient notification to the public, including industry parties and building management companies.

6.6 Ruckus points out that the CA should consider the need for shared access of the 3.4 – 3.7 GHz band by different sectors. Ericsson comments that lower frequencies (850, 900, 1800, 2100 MHz) might be used in combination with the spectrum in the C-Band to be allocated to MS for coverage improvement.

6.7 PSI comments that the 3.4 – 3.625 GHz band is the extended C-Band based on Wikipedia reference. Hence, with the 100 MHz of guard band, the frequency range subject to the Re-Allocation should be 3.4 – 3.525 GHz band.

Responses of the CA

6.8 The CA acknowledges the requests of respondents for making available additional spectrum. Apart from the 3.4 – 3.7 GHz band, the CA has been actively working on making available additional spectrum for public mobile services in the 26 GHz band (24.25 – 27.5 GHz) and the 28 GHz band (27.5 – 28.35 GHz). There will be a contiguous bandwidth of 4.1 GHz to be made available as the first batch of spectrum for 5G services in Hong Kong. The relevant consultative work is underway with the objective of releasing the spectrum to the market in 2019 at the earliest. Details can be found in the CA press release published on 21 March 2017, which set out the spectrum roadmap for 5G. Regarding telecommunications infrastructure in remote areas, as promulgated in the 2017 Policy Address, the Government will take the lead to provide telecommunications companies with financial incentives to encourage the extension of fibre-based network to rural and remote villages. As regards the 3.3 – 3.4 GHz band, it is currently assigned for use of radiolocation service in Hong Kong and is not available for mobile service use.

6.9 On spectrum utilisation, the CA has been reviewing the use of spectrum and where necessary, will propose changes to the frequency allocations/assignments. In addition, Hong Kong will follow the international

practice to align local frequency allocations with ITU's global frequency allocations.

6.10 On HKT's comments on the Consultancy Study, as explained in the Consultation Paper, SMATV systems are large in number in Hong Kong, with about 890 000 user outlets, and SMATV licensees are contractors responsible for system installation and maintenance. Unlike satellite operators, SMATV users/owners may not have the necessary expertise and resources to devise suitable mitigating measures. To reduce the impact on existing SMATV systems and to ensure smooth transition of the Re-Allocation, the Consultancy Study is confined to SMATV, although the Consultancy Study also serves as useful reference for other satellite receiving systems. The CA's views on protecting TVRO are detailed in Section 3 above. In summary, the CA treats all satellite services alike so long as they are licensed by the CA, irrespective of whether they are receive-only services.

6.11 The CA takes note of the suggestion for more publicity on the Re-Allocation. In this regard, the CA issued a press release back in March 2017 on the CA's work plan to make available additional spectrum for public mobile services (where the 3.4 – 3.7 GHz band, among others, are stated therein) for public information. Another press release was issued in July 2017 on the public consultation on the proposed Re-Allocation of the 3.4 – 3.7 GHz band. In addition, OFCA has arranged briefing sessions for SMATV operators, local satellite operators and MNOs, etc. on issues relating to the proposed Re-allocation. OFCA will continue to conduct regular meetings with industry parties on frequency allocation matters.

6.12 On Ruckus' suggestion of shared access of the 3.4 – 3.7 GHz band by different sectors, the CA considers that the band is best used for public mobile services exclusively. Concerning the use of lower frequencies in combination with the 3.3 – 4.2 GHz band, while the present consultation covers the Re-Allocation of the 3.4 – 3.7 GHz band, it is up to prospective spectrum assignees to decide how the band may be used in combination with their existing spectrum assignments for better provision of public mobile services.

6.13 The CA notes the comment from PSI on the naming of C-Band frequencies. Regardless of the nomenclature, the Re-Allocation is based on the use of the 3.4 – 3.6 GHz band for public mobile services, which is in line with

the spectrum planning widely deployed elsewhere for 5G development.

Communications Authority
28 March 2018

Annex B

Restriction Zones
for Protection of the Telemetry, Tracking and Control Stations

Some frequency channels in the 3.4 – 3.7 GHz band are deployed for telemetry, tracking and control functions ("TT&C channels") of the licensed satellites in orbit at the existing earth stations ("TT&C Stations") situated at the Tai Po Industrial Estate and in Stanley. In order to offer additional protection to these TT&C Stations, which are important to the normal operations of the licensed satellite networks, from interference caused by the prospective systems of public mobile services to be operating in the 3.4 – 3.6 GHz band, restriction zones are imposed whereby deployment of such mobile base stations will be prohibited.

THE RESTRICTION ZONES

2. The necessary spatial separations between TT&C Stations and mobile base stations in different directions, i.e. the restriction zones, are devised to prevent desensitisation of satellite receivers caused by in-band signals of the public mobile services in the 3.4 – 3.6 GHz band[1], taking into account the actual terrain, clutters, buildings in the surrounding areas and deployment of base stations over the years, among others.

3. Using computer simulations of the receivable signal power at the earth station dish antenna, geographical extents of two restriction zones in Tai Po Industrial Estate and Stanley are determined with the following technical parameters using a hypothetical deployment of mobile base stations –

P_{desen} – maximum level of interference signal receivable at the earth station front-end receiver without causing desensitisation (or overload) = -60 dBm

[1] The mitigation measure of retrofitting a waveguide filter to constrain signal reception to within the 3.7 – 4.2 GHz band as recommended for Satellite Master Antenna Television systems is not applicable to TT&C Stations, as it will deteriorate the reception of the weak TT&C signals in the 3.4 – 3.7 GHz band.

M – margin to cater for possible signal aggregation of interfering mobile base stations and other unwanted effects = 20 dB

P_{Tx} – maximum effective radiated power of interfering mobile base stations = 50 dBm (equivalent to 100 W)

L_m – radio propagation loss between the m^{th} interfering mobile base station and the receiving earth station, including clutter loss (including penetration loss through building materials and vegetation), etc.) (in dB)

G_{sat_m} – gain of dish antenna at earth station (towards the m^{th} interfering mobile base station) conforming to Rec. ITU-R S.465-6[2] (in dB)

P_{Rx_m} – interference signal power received at the earth station front-end receiver as contributed by the m^{th} interfering mobile base station (in dBm)

P_{Rx} – aggregate interference signal power received by earth station front-end receiver (in dBm)

$$P_{Rx_m} = P_{Tx} - L_m + G_{sat_m}$$

$$P_{Rx} = 10 \times \log_{10} \sum_m 10^{\frac{P_{Rx_m}}{10}}$$

Goal: $P_{Rx} \leq P_{desen} - M$

4. After taking into account the terrain shielding and implementation factors, the restriction zones are depicted in pink colour in Figure 1 below.

[2] Entitled "*Reference radiation pattern for earth station antennas in the fixed-satellite service for use in coordination and interference assessment in the frequency range from 2 to 31 GHz*"

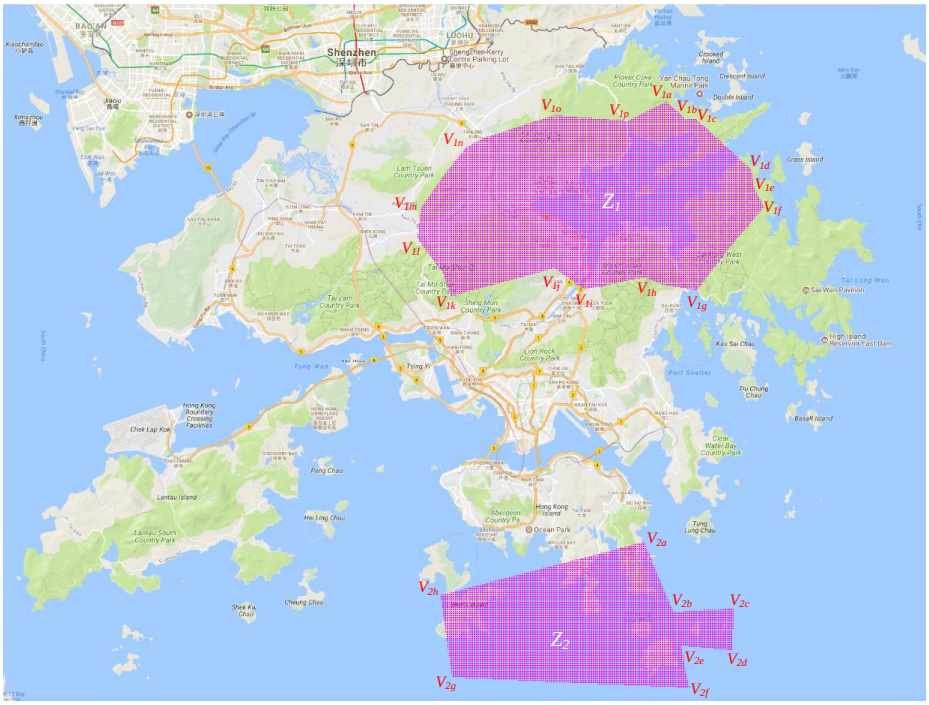


***Figure 1*: Restriction zones to be implemented.**

5. The two restriction zones are defined by polygon vertices (please see Figure 1) using the Hong Kong 1980 Grid Coordinates, as follows —

Restriction Zone 1 ("Z_1")
[Easting (m), Northing (m)]

- V_{1a} [845599, 841275]
- V_{1b} [846879, 840075]
- V_{1c} [847599, 840155]
- V_{1d} [851359, 836555]
- V_{1e} [851599, 835355]
- V_{1f} [852239, 834075]
- V_{1g} [847759, 828395]
- V_{1h} [844159, 829195]
- V_{1i} [839999, 828475]
- V_{1j} [837919, 829835]
- V_{1k} [830879, 827995]
- V_{1l} [828559, 831835]
- V_{1m} [828719, 833915]
- V_{1n} [832399, 838475]
- V_{1o} [837919, 840315]
- V_{1p} [842959, 839995]

Restriction Zone 2 ("Z_2")
[Easting (m), Northing (m)]

- V_{2a} [843999, 811035]
- V_{2b} [846079, 806315]
- V_{2c} [850159, 806555]
- V_{2d} [849999, 803755]
- V_{2e} [846639, 803915]
- V_{2f} [847119, 801195]
- V_{2g} [830959, 801835]
- V_{2h} [830159, 807435]

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