**Joint Statement of the Communications Authority and the Secretary for Commerce and Economic Development**

**Arrangements for Assignment of the Spectrum in the 3.4 – 3.6 GHz Band for the Provision of Public Mobile Services and the Related Spectrum Utilisation Fee**

**13 December 2018**

## PURPOSE

This Statement promulgates the decision of the Communications Authority ("CA") to adopt a market-based approach to assign 200 MHz of spectrum in the 3.4 – 3.6 GHz band (the "3.5 GHz band"). This Statement also announces the decision of the Secretary for Commerce and Economic Development ("SCED") on the method for determining the related spectrum utilisation fee ("SUF"), which SCED will propose to prescribe by subsidiary legislation.

## INTRODUCTION

2. To pave the way for the fifth generation mobile ("5G") services that are expected to be available for commercial launch around 2020, the CA has been striving to make available additional spectrum supply to meet the market demand for higher capacity and deployment of state-of-the-art technologies for mobile communications.

3. On 21 March 2017, the CA published a Work Plan[1] for making available additional radio spectrum to meet the demand for public mobile services, including 5G services, towards 2020 and beyond. The 3.5 GHz band is one of the spectrum bands identified in the Work Plan as a source of additional spectrum supply. Having conducted a consultation from July to September 2017 on the proposed re-allocation of radio spectrum in the 3.4 – 3.7 GHz band from fixed satellite service (space-to-Earth) to mobile service,

[1] The relevant press release is available at: https://www.coms-auth.hk/en/media_focus/press_releases/index_id_1423.html. The spectrum concerned includes spectrum in the 698 – 806 MHz band, the 3.5 GHz band, the 24.25 – 27.5 GHz band and the 27.5 – 28.35 GHz band.

the CA issued a statement on 28 March 2018 and decided that the re-allocation shall take effect from 1 April 2020 (the "Re-allocation Statement")[2].

4. On 2 May 2018, the CA and SCED jointly issued a consultation paper (the "Consultation Paper") entitled "Arrangements for Assignment of the Spectrum in the 3.4 – 3.6 GHz Band for the Provision of Public Mobile Services and the Related Spectrum Utilisation Fee" to seek views and comments on the assignment arrangements for the 200 MHz of spectrum in the 3.5 GHz band (the "3.5 GHz Spectrum") and the related SUF[3]. Having considered the views and comments received in the public consultation, the CA and SCED set out in this Statement their respective decisions on the arrangements for the assignment of the 3.5 GHz Spectrum and the related SUF. Major views and comments of the respondents received in the consultation exercise as well as the respective responses of the CA and SCED are summarised in **Annex 1**.

## LEGISLATIVE AND POLICY FRAMEWORK

5. Under section 32G(1) of the Telecommunications Ordinance (Cap. 106) ("TO"), the CA has the statutory duty to promote the efficient allocation and use of the radio spectrum as a public resource of Hong Kong. Sections 32H(2) and 32I(1) of the TO empower the CA to assign radio frequencies and to designate which of them shall be subject to the payment of SUF following consultation with the telecommunications industry and other affected persons as is reasonable in all the circumstances of the case.

6. Section 4(4) of the Communications Authority Ordinance (Cap. 616) ("CAO") stipulates that the CA, in performing its functions, must have regard to the following as appear to it to be relevant in the circumstances: (a) the fostering of an environment that supports a vibrant communications sector to enhance Hong Kong's position as a communications hub in the region; (b) the encouragement of innovation and investment in the communications market; (c) the promotion of competition and adoption of best practices in the communications market for the benefit of the industry and consumers; and (d) acting in a manner consistent with the provisions of the Hong Kong Bill of Rights Ordinance (Cap. 383).

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[2] The Re-allocation Statement is available at: https://www.coms-auth.hk/filemanager/statement/en/upload/441/ca_statements20180328_en.pdf.

[3] The Consultation Paper is available at: https://www.coms-auth.hk/filemanager/en/content_711/cp20180502.pdf.

7. Sections 32I(2) and 32I(4) of the TO empower SCED to prescribe the method for determining the SUF and to specify the minimum fee of the SUF (including the minimum fee or reserve price of an auction where it is used for determining the SUF).

8. Section 32J(1) of the TO stipulates that the use of an apparatus, regardless of whether it is for telecommunications, shall not cause direct or indirect harmful interference with any telecommunications service lawfully carried on, or other apparatus for telecommunications lawfully operated, in or outside Hong Kong. There is on-going frequency coordination between Hong Kong and the Mainland to avoid cross-boundary harmful interference. Operators concerned should always observe the requirements of the CA on the control of interference in this regard.

9. The Radio Spectrum Policy Framework ("Framework") promulgated by the Government in April 2007 identifies the policy objectives and the guiding principles in spectrum management which the CA should take into account in discharging its spectrum management responsibilities under the TO[4]. The former Telecommunications Authority ("TA") explained in his statement issued in April 2007 that, in exercising his statutory powers under the TO, he would, in addition to all relevant considerations as required by law, give due regard to the Framework to the extent that there would be no inconsistency with the objectives and provisions of the TO[5]. The Framework states that the policy inclination is that a market-based approach in spectrum management will be used wherever the CA considers that there are likely to be competing demands from providers of non-Government services, unless there are overriding public policy reasons to do otherwise.

## THE CA'S DECISION ON THE ASSIGNMENT ARRANGEMENTS FOR THE SPECTRUM IN THE 3.5 GHZ BAND

### Spectrum Assignment by Auction

10. On the basis that there are likely to be competing demands for the 3.5 GHz Spectrum, the CA proposed in the Consultation Paper to assign the 3.5 GHz Spectrum by way of auction as it is a market-based approach that

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

[5] The TA Statement on the Framework is available at: http://tel_archives.ofca.gov.hk/en/tas/others/ta20070424.pdf.

provides a fair, transparent, objective and economically efficient means to determine the prospective assignees.

11. As mentioned in the Consultation Paper, the 3.5 GHz band is amongst the first frequency band(s) identified by many economies for 5G deployment, and the spectrum in this band has good radio propagation characteristics comparable to that in the sub-3 GHz band (i.e. spectrum in frequency bands lower than or equal to 3 GHz) which is being widely used for the provision of public mobile services. In addition, according to the latest market information, manufacturers and vendors are expected to make available 5G equipment and devices operating in the 3.5 GHz band to the market as early as in next year. In response to the Consultation Paper, incumbent mobile network operators ("MNOs") have shown keen interest in using the 3.5 GHz Spectrum to deploy 5G services. Some MNOs suggest giving priority to them when assigning the 3.5 GHz Spectrum, or even on an administrative basis assigning all the 200 MHz of spectrum in equal portions among them. In any case, the CA notes the industry responses and affirms its view that there is likelihood of competing demands for the 3.5 GHz Spectrum. The CA has not identified any overriding public policy reason to administratively assign the 3.5 GHz Spectrum to MNOs.

12. Based on the above considerations, **the CA decides to conduct an auction for assignment of the 3.5 GHz Spectrum**.

## Band Plan

13. In the Consultation Paper, it was proposed to divide the 3.5 GHz Spectrum into ten frequency blocks, each with a bandwidth of 20 MHz. The CA notes from the submissions received, including submissions of three MNOs and one joint submission from two mobile industry organisations, that frequency blocks with a bandwidth of 10 MHz each will provide greater flexibility to the spectrum assignees in the 3.5 GHz band which can accommodate channel bandwidths of odd multiples of 10 MHz (including channel bandwidths of 10, 30, 50 and 70 MHz). The CA also notes that the first set of 5G technical specifications recently finalized in June 2018 and adopted internationally is able to support a channel bandwidth of 10 MHz in the 3.5 GHz band[6].

[6] The 3rd Generation Partnership Project ("3GPP") technical specification TS 38.104 entitled "NR; Base Station (BS) radio transmission and reception" specifies that the channel bandwidths in the 3.5 GHz band range from 10 MHz up to 100 MHz (see NR Bands n77 and n78). The aforesaid specification is available at: https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=3202.

14. Taking into account the above, **the CA decides to divide the 3.5 GHz Spectrum into 20 frequency blocks, each with a bandwidth of 10 MHz**, as shown in Table 1 below –

Table 1: Frequency blocks and bandwidth

| Frequency Block | Frequency Range (in MHz) | Bandwidth |
|---|---|---|
| A1 | 3400 – 3410 | 10 MHz |
| A2 | 3410 – 3420 | 10 MHz |
| A3 | 3420 – 3430 | 10 MHz |
| A4 | 3430 – 3440 | 10 MHz |
| A5 | 3440 – 3450 | 10 MHz |
| A6 | 3450 – 3460 | 10 MHz |
| A7 | 3460 – 3470 | 10 MHz |
| A8 | 3470 – 3480 | 10 MHz |
| A9 | 3480 – 3490 | 10 MHz |
| A10 | 3490 – 3500 | 10 MHz |
| A11 | 3500 – 3510 | 10 MHz |
| A12 | 3510 – 3520 | 10 MHz |
| A13 | 3520 – 3530 | 10 MHz |
| A14 | 3530 – 3540 | 10 MHz |
| A15 | 3540 – 3550 | 10 MHz |
| A16 | 3550 – 3560 | 10 MHz |
| A17 | 3560 – 3570 | 10 MHz |
| A18 | 3570 – 3580 | 10 MHz |
| A19 | 3580 – 3590 | 10 MHz |
| A20 | 3590 – 3600 | 10 MHz |

## Auction Rules

### *Eligible Bidders*

15. The CA does not see any compelling reason to restrict the assignment of the 3.5 GHz Spectrum to incumbent operators only. The effectiveness of a market-based approach such as auction will be best assured by allowing the bidding to be participated by any interested party such that the spectrum will be assigned to the party which can make the most efficient use of it, be it an incumbent operator or a new entrant. As such, **the CA decides that the auction for the 3.5 GHz Spectrum will be open to all interested**

**parties**, subject only to minimal qualification requirements for registering bidders' interest and for demonstrating the capability of the bidders to provide satisfactory service. The CA will provide details of such qualification requirements in the Information Memorandum for the auction.

***Spectrum Cap***

16. In the Consultation Paper, the CA proposed to impose a cap of 100 MHz on any bidder in the auction of the 3.5 GHz Spectrum. Two MNOs suggest in their submissions a spectrum cap of 80 MHz, one MNO submits a cap of 70 MHz, while the remaining one does not agree to impose any spectrum cap. All MNOs share the same view that an over-concentration of spectrum in the 3.5 GHz band should be avoided to safeguard against competition risks.

17. The original proposal of a cap of 100 MHz as set out in the Consultation Paper aims at safeguarding against competition risks and promoting the most efficient use of spectrum from a technical angle. The cap will however create a possible scenario where there might only be two successful bidders in the auction, with each acquiring the maximum amount of 100 MHz of spectrum as allowed under the cap. If the spectrum cap is lowered to 70 MHz or 80 MHz, at least three successful bidders or consequently three MNOs would be providing 5G services, instead of two as in the original proposal. This brings more choices of service providers for consumers and provides assurance in effective competition among service providers. From the technical angle, a channel bandwidth of 70 MHz or 80 MHz is on the high side of the channel bandwidth range set out in the abovementioned 5G technical specification[7]. Although the maximum data speed and technical efficiency achieved by using the spectrum acquired by any successful bidder under the revised cap might be less optimal compared to a cap of 100 MHz, this might be balanced with the possible increase in allocation efficiency if more operators can acquire the spectrum thereby putting it into efficient use. Between a cap of 70 MHz or 80 MHz, the choice of 70 MHz would likely achieve a slightly more even distribution of spectrum among the successful bidders and thus would promote more effective competition among the 5G operators.

18. Taking into account comments received in the submissions and in light of the above considerations, **the CA decides to impose a spectrum cap of 70 MHz in the assignment of spectrum in the 3.5 GHz band** with a view

[7] The largest channel bandwidth in the 3.5 GHz band is 100 MHz. Please refer to the 3GPP technical specification TS 38.104 which is available in footnote 6 in this Statement.

to achieving the objectives of ensuring effective competition, promoting spectral efficiency, and enabling the provision of reasonably good and efficient 5G services by the successful bidders.

### *Auction Format and Timing*

19. The CA proposed in the Consultation Paper to conduct the auction of the 3.5 GHz Spectrum using a clock auction format, followed by an assignment stage, to ensure that contiguous frequency blocks can be assigned to the successful bidders. Respondents to the consultation generally express no objection to the proposed auction format. Some MNOs however are of the view that the requirement for the spectrum assignee of Frequency Block A1 (now the frequency range 3400 – 3410 MHz) to coordinate with the relevant satellite service provider licensed for the Telemetry, Tracking and Control ("TT&C") Station [8] concerned for the implementation of the necessary measures to protect the TT&C channel operating within the frequency range of 3400 – 3405 MHz in one of the restriction zones makes this frequency block less preferable as compared with the other frequency blocks.

20. Taking into account the respondents' views, **the CA decides to conduct the auction in two stages, namely the Quantity Stage** to first decide the number of frequency blocks to be assigned to each bidder using a clock auction format; **followed by the Assignment Stage** to determine the specific and contiguous frequency blocks to be assigned to each bidder which has successfully bid for frequency blocks at the Quantity Stage.

21. Auction at the Quantity Stage is further divided into two parts, namely Quantity Stage Part 1 and Quantity Stage Part 2. At Quantity Stage Part 1, bidders will bid for the number of frequency blocks they wish to acquire in rounds at the round price set by the auctioneer. Rounds of bidding will continue until the total number of frequency blocks in demand is equal to or less than the total supply of 20 frequency blocks. The SUF payable at the end of Quantity Stage Part 1 for each frequency block sold is the amount that a bidder has bid for in the last round of Quantity Stage Part 1.

22. Where the total number of frequency blocks in demand in the last round of Quantity Stage Part 1 is less than the total supply, Quantity Stage Part 2, consisting of a single-round of bidding by bidders, will take place to deal with the unsold number of frequency blocks. In that single round, bidders

[8] "TT&C Station" refers to the licensed earth station that operates in the 3.400 – 3.405 GHz or in the 3.6 – 4.2 GHz band and located in Tai Po Industrial Estate or Stanley for telemetry, tracking and control of satellites in orbit.

may submit bids for the unsold number of frequency blocks. Where the number of bids received in the round is more than the unsold number of frequency blocks, the bids will be ordered from the highest to the lowest so that the unsold number of frequency blocks will be acquired by the bidders placing the higher bids. The SUF payable at Quantity Stage Part 2 by those bidders are the bids they have submitted in the round.

23. At the Assignment Stage, successful bidders from the Quantity Stage may submit a single bid for determining the priority of assignment with contiguous blocks from the top of the frequency blocks (i.e. Frequency Block A20). The value of the bids as submitted will be ordered from the highest to the lowest, for the purpose of setting the priority[9]. As such, the bidder which submits the lowest bid (including no bid) will be assigned Frequency Block A1, and it will not be required to pay any SUF for the Assignment Stage. As for the remaining bidders who are assigned frequency blocks other than Frequency Block A1, each will pay an SUF for the Assignment Stage at an amount equal to the lowest bid submitted among these remaining bidders.

24. The CA will provide details of the auction rules in the terms and conditions of the auction and the Information Memorandum for the auction of the 3.5 GHz Spectrum, which will be issued nearer the time of auction. The CA targets to conduct the auction in around July/August 2019, taking into account the preparatory work required to implement the decisions of the CA and SCED for the auction.

## Licensing Arrangements

### *Licensing and Validity Period*

25. In line with the existing licensing regime for the provision of public mobile services, any new entrant or incumbent operator which has successfully bid for the 3.5 GHz Spectrum will each be granted a new Unified Carrier Licence ("UCL") to effect the assignments of the successfully acquired frequency blocks of the 3.5 GHz Spectrum from 1 April 2020 with a validity period of 15 years for the provision of public mobile services. For existing UCL holders who successfully acquire spectrum in the auction, it is their own choice and initiative to apply to the CA for combining their existing UCLs with the new UCL to be issued. As the licensing arrangement concerned has been consistently followed in the past and there are no specific

[9] For the purpose of determining the assignment priority, the bidder who does not submit a bid at the Assignment Stage will be considered as having submitted a bid with zero amount.

comments raised in the consultation, the CA decides to maintain the prevailing practice.

***Restriction of Frequency Swap***

26. With regard to the proposed requirement of restricting successful bidders to swap assigned frequency blocks within the first five years, the CA notes that only one respondent considers that the obligation is not required. The CA's proposed restriction of frequency swap is to ensure genuine competition in the auction, such that the spectrum would be assigned to bidders who value it most in order to realise the full market value of each frequency block in the auction. Hence, **the CA maintains that swapping of any frequency assignment in the 3.5 GHz band within the first five years counting from the date of the frequency assignment will generally not be considered.**

***Open Network Access Requirement***

27. In the Consultation Paper, the CA proposed that any successful bidder who is assigned spectrum in the 3.5 GHz band will be required to open up at least 30% of its network capacity for access by other non-affiliated mobile service providers, taking into account that a proposed spectrum cap of 100 MHz is imposed. All four MNOs submit that the sharing of network capacity can be achieved by commercially agreed arrangements and they consider it unnecessary to impose an open network access ("ONA") requirement in the licence condition.

28. Given the decision of the CA to lower the spectrum cap from 100 MHz to 70 MHz (see paragraphs 17 and 18 above) which could allow at least three successful bidders in the auction, the market should accordingly have at least three facilities-based operators to choose from. This should provide sufficient competitive supply of wholesale 5G network services in the market such that interested parties should be able to negotiate and agree commercially with the spectrum assignees about leasing or sharing of network capacity for the provision of 5G services.

29. Based on the above considerations, **the CA decides that there is no longer a need to impose any ONA requirement on spectrum assignees in the 3.5 GHz band**. Interested parties may negotiate with spectrum assignees for the leasing of network capacity on a commercial basis.

***Protection of TT&C Stations***

30. As set out in the Re-allocation Statement, the CA has decided to impose two restriction zones to constrain the deployment of mobile base stations of public mobile services operating in the 3.5 GHz band so as to protect the TT&C Stations located in Tai Po and Stanley from desensitisation or harmful interference caused by strong radio emissions of the public mobile services. To address the concern raised by the mobile industry, a working group was formed under the Radio Spectrum and Technical Standards Advisory Committee of the Office of Communications Authority ("OFCA") to consider feasible technical arrangements for deployment of mobile base stations operating in the 3.5 GHz band within the restriction zones. The working group comprises representatives of MNOs, TT&C Station operators, Hong Kong Science and Technology Parks Corporation, and Hong Kong Applied Science and Technology Research Institute. Seen from discussion and field trials conducted so far, controlled deployment subject to a maximum permissible interference level at the receiving system of the TT&C Stations (e.g. mobile base stations for indoor coverage only) should be technically feasible. The working group will continue its work and aims to come up with recommendations by the first quarter of 2019 for consideration by the CA. The decision of the CA in this regard, together with any other requirements relating to the use of the 3.5 GHz band in Hong Kong as a result of the on-going frequency coordination with the Mainland to avoid cross-boundary harmful interference to existing services operating in the 3.4 – 4.2 GHz band, would be included in the Information Memorandum for the auction of the 3.5 GHz Spectrum.

31. In the public consultation, the CA proposed, among other measures, that spectrum assignees in the 3.5 GHz band should be responsible for taking all necessary measures to prevent or to rectify desensitisation or interference to the receivers of the TT&C Stations caused by mobile base stations located outside the restriction zones, and that the spectrum assignee of Frequency Block A1 should coordinate with operator of the TT&C Station concerned for implementation of necessary protection measures to avoid the operation of the TT&C Station being affected. Furthermore, the spectrum assignees shall take all necessary measures to prevent mobile terminals operating in the 3.5 GHz band from affecting TT&C Stations.

32. In response to the public consultation, satellite operators emphasise the need and importance to protect the TT&C Stations from interference from mobile base stations; while MNOs express grave concerns on the extensiveness of the restriction zones. The MNOs consider that a large number of telecommunications service consumers will be affected by the

restriction zones and urge for additional mitigating measures to be imposed to help reduce the size of the restriction zones, such as adding shielding covers for the TT&C Stations, optimising the radiation directions of mobile base station antennas, and relocating the TT&C Stations from Tai Po to other remote areas.

33. Since radio base stations may be deployed within the restriction zones subject to feasible technical arrangements identified by the aforementioned working group and adopted by the CA, the requirements for preventing or rectifying desensitisation by radio base stations should be applied to all radio base stations operating with the 3.5 GHz Spectrum, be they located outside or inside the restriction zones. As mentioned in the Consultation Paper, in view of the need to protect existing TT&C Stations from desensitisation or other interference from public mobile services operating in the 3.5 GHz band, the CA will impose relevant requirements in the form of licence conditions for compliance by the spectrum assignees. In line with the decision of the CA as promulgated in the Re-allocation Statement and having regard to the comments received in response to the consultation, **the CA decides to impose a new Special Condition ("SC") in the UCLs of all licensees authorised to provide public mobile services using the 3.5 GHz Spectrum**. Details of the SC are at **Annex 2**.

34. The CA and SCED will endeavour to proactively explore feasible arrangements with different stakeholders to reduce the size of the restriction zones or to enable controlled deployment of public mobile services using the 3.5 MHz within the restriction zone. An update of the progress of the working group and additional measures in this regard, if any, would be provided nearer to the time of the auction.

***Subsidy Scheme to Support Upgrade of Existing Satellite Master Antenna Television ("SMATV") Systems***

35. Since prospective spectrum assignees will benefit from re-allocation of the spectrum concerned from fixed satellite service (space-to-Earth) to mobile service, the CA proposed in the Consultation Paper that they would be required to set up and to administer a fund for a subsidy scheme (which will include and cover the administrative cost of the scheme) to support the upgrade of the eligible SMATV systems affected by the re-allocation and assignment exercise. The subsidy for upgrading eligible SMATV systems (i.e. those covered by existing SMATV licences on or before 28 March 2018) will be granted on a one-off basis and will not cover recurrent expenses such as maintenance or repair. Only one count of upgrade per

SMATV system is allowed and the maximum amount of subsidy will be capped at HK$20,000 per SMATV system.

36. In response to the CA's proposal, one satellite operator submits that as the market demand for upgrading SMATV systems rises within a short period of time, OFCA should consider increasing the subsidy amount. The MNOs submit that the subsidy scheme should be funded out of the SUF for the use of the 3.5 GHz Spectrum; or from the licence fees relevant to the use of the 3.5 GHz band; or from resources of the OFCA Trading Fund. The CA does not agree that the subsidy scheme should be funded by the licence fees, the OFCA Trading Fund, or the SUF. This is because the licence fees collected by the OFCA Trading Fund are for the purpose of supporting the operation of OFCA in administering and carrying out regulatory duties on licensees. Using the OFCA Trading Fund would produce the effect that other licensees, in addition to the successful bidders, also bear the cost of the subsidy scheme; on the other hand, the CA considers it fair and reasonable for a successful bidder, which will benefit from the abovementioned spectrum re-allocation exercise, to bear an amount of subsidy proportionate to the amount of the 3.5 GHz Spectrum acquired by it in the auction. The CA also considers it inappropriate to use part of the SUF to fund the subsidy scheme since the purpose of collecting SUF is to enable the general public to recap financial benefit from the commercial use of spectrum as a finite public resource. In other words, the subsidy for upgrade of SMATV systems does not fall within the scope of the use of the licence fees, the OFCA Trading Fund or the SUF. **The CA considers that it is reasonable to require the successful spectrum assignees to collectively fund the subsidy scheme.**

37. As regards the administrative arrangement for the subsidy scheme, all MNOs are of the view that OFCA shall be responsible for administering the scheme. In view of the feedback of MNOs, if OFCA is elected by all successful bidders to administer the subsidy scheme, **the CA considers it acceptable for OFCA to administer the subsidy scheme** in order to facilitate the early upgrading of the eligible SMATV systems. Detailed arrangements in respect of the subsidy scheme will be specified by the CA in the Information Memorandum to be issued for the auction of the 3.5 GHz Spectrum.

***Technology Neutrality***

38. In assigning the 3.5 GHz Spectrum for the provision of public mobile services, the CA will continue to adopt the principle of technology neutrality. The relevant spectrum assignees will be free to use the spectrum for providing 5G or other generations of mobile services under their licences,

so long as the technology to be used is a widely recognised standard and will not cause any harmful interference to legitimate services. The approach will enable successful bidders to deploy the state-of-the-art technology in a timely and flexible manner to best meet the market demand.

39. As there is no objection from the respondents to the proposal, **the CA decides not to impose any particular technical standards on the use of the 3.5 GHz Spectrum**.

***Network and Service Rollout Obligations***

40. In order to prevent spectrum hoarding and to ensure timely provision of 5G services for the benefit of the general public, the CA proposed in the Consultation Paper to impose network and service rollout obligations on the successful bidders. However, there is general concern from respondents that part of Hong Kong's population reside within the restriction zones and counting them in the network and service rollout obligations does not deem fit.

41. The CA agrees that the deployment will be subject to constraints at least in the initial years and hence it is amenable to excluding the population residing within the restriction zones from the calculation of the network rollout obligation. With about 740 000 individuals (or about 10% of the total population) residing in the restriction zones, **the CA decides that each successful bidder will be required to provide a minimum coverage of 45% of the population with regard to mobile services within five years from the grant of the licence, and shall lodge a performance bond as a guarantee of its compliance with the aforesaid network and service rollout obligations**. The amount of performance bond will be specified by the CA in the Information Memorandum to be issued for the auction of the 3.5 GHz Spectrum.

42. Please refer to **Annex 1** for more detailed responses of the CA to the views and comments received in the public consultation on matters in relation to the above arrangements for assignment, auction and licensing of the 3.5 GHz Spectrum.

## THE DECISION OF SCED ON THE RELATED SPECTRUM UTILISATION FEE

### Level of SUF

43. Given that radio spectrum is a scarce public resource, it is incumbent upon the Government to ensure that the SUF of spectrum is set to reflect as close as possible its full market value so that spectrum assignees, which run their commercial operation in a fully liberalised market, would put the spectrum so acquired to its most efficient use.

44. In paragraphs 10 to 12 above, the CA concludes that there are likely to be competing demands and that auction as a market-based approach should be used for the assignment of the 3.5 GHz Spectrum. The SUF would therefore naturally be determined through auction whereby the bidders would determine the level of their bids based on clear information on the supply of spectrum and their assessment of the business potential and opportunities. The auction results would reflect the full market value of the 3.5 GHz Spectrum. SCED decides to propose a regulation under section 32I(2) of the TO to prescribe that the SUF of the 3.5 GHz Spectrum be determined by auction, subject to an auction reserve price to be specified nearer the time of auction.

45. SCED has taken note of the need for substantial upfront investments required for operators to roll out their 5G network infrastructure, and the fact that bidders will take into account those costs in planning their bidding prices to be put up at the auction. With this in mind, SCED does not intend to set an auction reserve price at a high level which might discourage competition and bidders' eagerness to participate in the auction. Rather, SCED considers that it should be set at a level that represents the minimum base value of the spectrum for the purpose of kick-starting the competitive bidding process, while balancing the need to forestall non-serious bidders. This coincides with MNOs' views received from the consultation that the auction reserve price should not be set at a high level, such that their investment in deploying 5G networks and services in Hong Kong need not be severely increased.

46. SCED will take into account various factors outlined in the preceding paragraphs when determining the auction reserve price nearer to the time of the auction.

**Method of Payment**

47. The current assignment exercise involves a total of 200 MHz of spectrum, and the amount of SUF involved is potentially substantial. There is a need to allow for greater flexibility for spectrum assignees to make financial arrangement for the payment of SUF having regard to their individual circumstances. In view of the above, SCED proposed in the Consultation

Paper that spectrum assignees would be given a choice to pay the SUF either by lump sum payment upfront or annual instalments.

48. The majority of the responding MNOs welcome the additional choice to pay the SUF by annual instalments. SCED decides to propose a regulation under section 32I(2) of the TO to prescribe that all spectrum assignees (which may include the MNOs and new entrants into the market) will be given a choice to pay the SUF either by –

(a) lump sum payment upfront, which is the lump sum amount determined in auction as elaborated in paragraphs 44 to 45 above; or

(b) annual instalment, with the first instalment equivalent to the lump sum amount obtained in (a) above divided by 15 (i.e. the number of years of assignment), and subsequent instalments increased every year by 2.5%, the latest medium-range underlying inflation forecast, to reflect the time value of money to the Government.

49. If a spectrum assignee chooses to pay the SUF by annual instalments, the Government would require a five-year rolling guarantee of the SUF payment throughout the whole assignment period. This is because of the potential size of the SUF, and the Government needs to ensure the security of its cash flow.

50. The regulation referred to in paragraphs 44 and 48 above will be tabled at the Legislative Council for negative vetting.

51. As to the annual royalty payment approach proposed by some MNOs, please refer to paragraph 80 of **Annex 1** for reasons why the approach is not adopted for the assignment exercise.

## IMPLEMENTATION OF THE ARRANGEMENTS FOR SPECTRUM ASSIGNMENT

52. The CA and SCED will make the necessary arrangements to enable the assignment of the 3.5 GHz Spectrum to proceed as per their respective decisions in this Statement, including the necessary legislative amendments. As mentioned above, subject to the completion of the legislative process, the CA targets to conduct the auction of the 3.5 GHz Spectrum in around July/August 2019.

53. For the avoidance of doubt, nothing in this Statement will affect, limit or prejudice the exercise of the powers of the CA and SCED under the CAO, TO or its subsidiary legislation.

**Communications Authority**
**Secretary for Commerce and Economic Development**
**13 December 2018**

**Annex 1**

# Summary of Submissions to the Consultation Paper and the Responses of the Communications Authority and the Secretary of Commerce and Economic Development

On 2 May 2018, the Communications Authority ("CA") and the Secretary for Commerce and Economic Development ("SCED") jointly issued a consultation paper to seek the views and comments of the industry and interested parties on the arrangements for assignment of the spectrum in the 3.4 – 3.6 GHz band (the "3.5 GHz band") for the provision of public mobile services and the related spectrum utilisation fee ("SUF") (the "Consultation Paper").

2. At the close of the public consultation on 13 June 2018, submissions were received from the following 12 respondents (listed in alphabetical order) –

Commercial Firms or Organisations

(1) APT Satellite Company Limited ("APT")
(2) Asia Satellite Telecommunications Company Limited ("AsiaSat")
(3) Cable and Satellite Broadcasting Association of Asia ("CASBAA")
(4) China Mobile Hong Kong Company Limited ("CMHK")
(5) GSM Association and Global Mobile Suppliers Association (hereinafter collectively referred to as "GSMA&GSA")
(6) Hong Kong Science and Technology Parks Corporation ("HKSTP")
(7) Hong Kong Telecommunications (HKT) Limited ("HKT")
(8) Hutchison Telephone Company Limited ("Hutchison")
(9) Qualcomm Incorporated ("Qualcomm")
(10) SmarTone Mobile Communications Limited ("SmarTone")

Individuals

(11) Mr Francis Fong
(12) The Honourable Charles Peter Mok ("Hon. Charles Mok")

3. The CA and SCED set out in this Annex their respective responses to the views and comments received in the public consultation. The CA and SCED have taken into account and given thorough consideration to all

the submissions which are relevant to the arrangements for assignment of the spectrum in the 3.5 GHz band for the provision of public mobile services and the related SUF, though, for practical reasons, not all of the issues raised are specifically mentioned or addressed herein. Please refer to the statement (the "Statement") to which this Annex is attached for the respective decisions made by the CA and SCED after the public consultation on the matter.

4. The responses set out in this Annex are without prejudice to the exercise of the powers by the CA or SCED under the Communications Authority Ordinance (Cap. 616), Telecommunications Ordinance (Cap. 106) ("TO") or any other relevant legislation, save to the extent that they have informed the respective decisions made by the CA and SCED in the Statement.

## ASSIGNMENT ARRANGEMENTS FOR THE SPECTRUM IN THE 3.5 GHZ BAND

### Assignment of Spectrum by Auction

5. Having considered that there are likely to be competing demands for the spectrum in the 3.5 GHz band and the policy inclination of the Radio Spectrum Policy Framework ("Framework") [1] whereby a market-based approach will be adopted in spectrum management wherever the CA considers that there are likely to be competing demands from providers of non-Government services unless there are overriding public policy reasons to do otherwise, the CA proposed, after giving due regard to the Framework and considering the appropriate approach for assignment of spectrum in this case, in the Consultation Paper to assign the 200 MHz of spectrum in the 3.5 GHz band for the provision of public mobile services (the "3.5 GHz Spectrum") by way of auction.

Views and Comments of the Respondents

6. Qualcomm supports the CA's proposal to assign the 3.5 GHz Spectrum by way of auction. SmarTone has no particular comments on the CA's proposal. CMHK is of the view that assigning the 3.5 GHz Spectrum to the incumbent mobile network operators ("MNOs") administratively instead of by way of auction may encourage the fifth generation mobile ("5G") technology and smart city development in Hong Kong. Having considered the characteristics of 5G technology which demands for more and wider

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

frequency spectrum than the 4G technology, the number of MNOs and the size of Hong Kong, Hutchison is of the view that the amount of 3.5 GHz Spectrum per MNO is inadequate for the provision of superb quality of services and hence considers that priority should be given to the MNOs in the assignment of the 3.5 GHz Spectrum. HKT holds similar views and opines that spectrum auction is not the only available option nor the only market-based approach for spectrum assignment. HKT suggests the CA to consider assigning the 3.5 GHz Spectrum administratively to the four MNOs in equal portions, i.e. 50 MHz of spectrum for each MNO. HKT also suggests the CA to assign all the available spectrum as well as those planned for re-assignment in one go, i.e. spectrum in the 900/1800 MHz bands, the 26/28 GHz bands, as well as the 3.5 GHz band.

Responses of the CA

7. The Framework promulgated by the Government in 2007 clearly states that the policy inclination is that a market-based approach in spectrum management will be adopted wherever the CA considers that there are likely to be competing demands from providers of non-Government services, unless there are overriding public policy reasons to do otherwise. As seen from the MNOs' submissions, it is clear that there are likely to be competing demands for the 3.5 GHz Spectrum for the provision of public mobile services. The CA notes that the 3.5 GHz band is amongst the first frequency bands identified by many economies for 5G deployment. Indeed, the United Kingdom and South Korea completed auctions of the spectrum within or near the 3.5 GHz band in April 2018 and June 2018 respectively for 5G services[2]. The 3.5 GHz Spectrum has good radio propagation characteristics comparable to that in the sub-3 GHz band (i.e. spectrum in frequency bands lower than or equal to 3 GHz) which is being widely used for the provision of public mobile services in the existing 2G, 3G and 4G services[3]. In addition, according to the latest market information, manufacturers and vendors are expected to make available 5G equipment and devices operating in the 3.5 GHz band to the market as early as in next year. Qualcomm, a major chipset manufacturer,

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[2] In the United Kingdom, 150 MHz of spectrum in the frequency ranges of 3410 – 3480 MHz and 3500 – 3580 MHz was assigned through auction in April 2018. Please refer to the relevant information at: https://www.ofcom.org.uk/__data/assets/pdf_file/0018/112932/Regulation-111-Final-outcome-of-award.pdf.

In South Korea, 280 MHz of spectrum in the frequency range of 3420 – 3700 MHz was assigned through auction in June 2018. Please refer to the relevant information at (in Korean only): http://www.msit.go.kr/web/msipContents/contentsView.do?cateId=mssw311&artId=1386500.

[3] 2G, 3G and 4G services refer to second generation, third generation and fourth generation mobile services respectively.

also provides similar information in its submission to the Consultation Paper. Based on the above, the CA maintains its view that there are likely to be competing demands for the 3.5 GHz Spectrum.

8. The CA does not find that there is any overriding public policy reason to justify assigning the 3.5 GHz Spectrum administratively, or giving priority to MNOs in the assignment of the spectrum. Nor have the submissions of the MNOs provided additional public policy reasons that the CA deems are overriding. An open and competitive auction bidding process would identify the parties who will value the spectrum most and hence will make the best use of the spectrum.

9. In sum, the CA considers that there is insufficient justifications for assigning the 3.5 GHz Spectrum to MNOs administratively. The CA maintains its view that the 3.5 GHz Spectrum should be assigned by way of auction, which should be open for participation by all interested parties.

10. As for HKT's suggestion for the CA to assign all relevant spectrum (including those planned to be assigned and re-assigned) in one go, it should be noted that the CA has strived to make available additional spectrum and release it as early as possible for the provision of public mobile services, taking into account the demand as well as the development of international standard for public mobile services including 5G services operating in the relevant frequency bands. As a matter of fact, the CA has updated the Spectrum Release Plan ("SRP") on 26 July 2018 and included spectrum of two more bands, namely 100 MHz of spectrum in the 3.3 – 3.4 GHz band ("3.3 GHz band") and another 100 MHz of spectrum in the 4.83 – 4.93 GHz band ("4.9 GHz band"). They are in addition to (a) the 200 MHz of spectrum in the 900/1800 MHz bands for re-assignment; (b) the 200 MHz of spectrum in the 3.5 GHz band; and (c) the 4 100 MHz of spectrum in the 26 and 28 GHz bands[4]. It is planned that the 4 100 MHz of spectrum in the 26 and 28 GHz bands will be assigned administratively to the MNOs in the first quarter of 2019 (for details about the arrangements, please refer to a separate joint statement issued by the CA and SCED on 13 December 2018)[5], while the spectrum in the 3.5 GHz band will be put to auction in around July/August 2019. Spectrum in the 3.3 GHz and 4.9 GHz bands are also planned to be

[4] The latest SRP is available at: https://www.coms-auth.hk/filemanager/en/content_613/spectrum_plan2018_en.pdf.

[5] The statement "Allocation of the 26 GHz and 28 GHz Bands to Mobile Service and the Associated Arrangements for Spectrum Assignment and Spectrum Utilisation Fee" issued jointly by the CA and SCED on 13 December 2018 is available at: https://www.coms-auth.hk/filemanager/statement/en/upload/480/joint_statement_st_052018.pdf.

assigned by way of auction (please refer to another joint statement issued by the CA and SCED on 13 December 2018)[6]. The CA therefore considers that MNOs and other interested parties should be well informed of the amount of spectrum available in different frequency bands and should be able to make informed decisions on whether, and if so the amount of spectrum to be acquired in these frequency bands if they are interested in acquiring such. The CA will consider arranging auctions of new spectrum in different frequency bands one after another in around July/August 2019.

**Band Plan**

11. To cater for different amounts of spectrum that may be required by MNOs for meeting their business demands and taking into account the 5G technologies that will be deployed, the CA proposed in the Consultation Paper to divide the 3.5 GHz Spectrum into ten frequency blocks, each with a bandwidth of 20 MHz.

Views and Comments of the Respondents

12. Two MNOs (Hutchison and SmarTone) as well as GSMA&GSA opine that adopting a smaller frequency block size of 10 MHz will allow more flexibility for the spectrum assignees in configuring their networks to support various 5G services. HKT is of the view that it would be better to adopt frequency block size of 10 MHz or 50 MHz. CMHK suggests dividing the 3.5 GHz Spectrum into four frequency blocks of 40 MHz each, and another four frequency blocks of 10 MHz each to allow more possible options of channel bandwidths including 10 MHz, 20 MHz, 30 MHz, 40 MHz, 50 MHz, 60 MHz, 70 MHz, 80 MHz, 90 MHz and 100 MHz.

Responses of the CA

13. Having considered the comments of the respondents, the CA notes that frequency blocks with a bandwidth of 10 MHz each will provide more flexibility to the spectrum assignees in planning for the provision of 5G services. The CA also notes that channel bandwidths (e.g. 10, 30, 50 and 70 MHz) which are odd multiples of 10 MHz are adopted in the first set of 5G technical specification developed by the 3rd Generation Partnership Project

[6] The statement "Arrangements for Assignment of the Spectrum in the 3.3 GHz and 4.9 GHz Bands for the Provision of Public Mobile Services and the Related Spectrum Utilisation Fee" issued jointly by the CA and SCED on 13 December 2018 is available at: https://www.coms-auth.hk/filemanager/statement/en/upload/482/joint_statement_st_072018.pdf.

("3GPP")[7]. The CA therefore decides that the 3.5 GHz Spectrum will be divided into 20 frequency blocks, each with a bandwidth of 10 MHz as set out in Table 1 of the Statement.

**Spectrum Cap**

14. The CA proposed in the Consultation Paper to impose a spectrum cap of 100 MHz on any bidder in the auction of the 3.5 GHz Spectrum. The proposal aims at promoting the most efficient use of spectrum from a technical point of view.

Views and Comments of the Respondents

15. CMHK and SmarTone propose to lower the spectrum cap to 80 MHz to prevent the risk of over-concentration of spectrum. Hutchison shares a similar view but suggests a cap of 70 MHz. HKT does not agree to impose any spectrum cap. All MNOs share the same view that an over-concentration of spectrum in the 3.5 GHz band should be avoided to safeguard against competition risks.

Responses of the CA

16. The CA has already provided responses in paragraphs 7 to 9 above regarding the suggestion of assigning the 3.5 GHz Spectrum to the MNOs administratively.

17. The CA notes that the proposals of CMHK, SmarTone and Hutchison to lower the spectrum cap to 70 MHz or 80 MHz may allow at least three successful bidders in the auction and accordingly at least three MNOs will be providing 5G services. This should provide consumers with more choices of service providers and provide more assurance in effective competition among service providers. The CA notes that the maximum data speed and technical efficiency achieved by using the spectrum acquired by any successful bidder under a cap of 70 MHz or 80MHz might be slightly less optimal as compared to a cap of 100 MHz, but this might be balanced with the possible increase in allocation efficiency if more operators can acquire the spectrum thereby putting it into efficient use. Between a cap of 70 MHz or 80 MHz, a cap of 70 MHz would likely achieve a slightly more even

[7] The 3GPP technical specification TS 38.104 entitled "NR; Base Station (BS) radio transmission and reception" specifies that the channel bandwidths in the 3.5 GHz band range from 10 MHz up to 100 MHz (see NR Bands n77 and n78). The 3GPP technical specification TS 38.104 is available at: https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=3202.

distribution of spectrum among the successful bidders and thus would promote more effective competition among the 5G operators. Taking into account comments received in the submissions and in light of the above considerations, the CA will lower the spectrum cap to 70 MHz with a view to achieving the objectives of ensuring effective competition, promoting spectral efficiency, and enabling the provision of reasonably good and efficient 5G services by the successful bidders.

**Auction Format and Timing**

18. The CA proposed in the Consultation Paper to conduct the auction of the 3.5 GHz Spectrum using a clock auction format, followed by an assignment stage, to ensure that contiguous frequency blocks can be assigned to the successful bidders. Taking into account the time needed for enacting the relevant legislative amendments, the CA proposed in the Consultation Paper to conduct the auction at the end of 2019.

Views and Comments of the Respondents

19. Respondents commenting on the auction format (CMHK, SmarTone, Hutchison, GSMA&GSA, and Qualcomm) either welcome or express no objection to the proposed auction format. SmarTone and Hutchison consider that the CA should provide more information about the auction format for better understanding by the industry. In particular, they request the CA to clarify how the unsold frequency block(s) would be dealt with after the clock auction where the total demand for frequency blocks from all the bidders is less than the total supply of frequency blocks.

20. CMHK and SmarTone opine that Frequency Block A1 is less preferable than the other frequency blocks in the 3.5 GHz band and suggest that the successful bidder assigned with Frequency Block A1 at the assignment stage should be compensated. HKT considers that Frequency Block A1 shall not be auctioned on the same terms as the other blocks.

21. As for the timing of conducting the auction, most respondents are of the view that the auction should be conducted as soon as possible in 2019 or end of 2018.

Responses of the CA

22. In response to the request for more information and clarification of the auction format and arrangement, the CA would like to supplement that the auction of the 3.5 GHz Spectrum will comprise two stages, namely the

Quantity Stage to first decide the number of frequency blocks to be assigned to each bidder using a clock auction format; followed by the Assignment Stage to determine the specific and contiguous frequency blocks to be assigned to each bidder which has successfully bid for frequency blocks at the Quantity Stage. For more details about the auction format, please refer to paragraphs 20 to 23 of the Statement.

23. Regarding the timing for the auction, having considered the views and comments received from the public consultation and taking into account the time needed for the enactment of the relevant subsidiary legislation, the CA targets to conduct the auction in around July/August 2019.

## LICENSING ARRANGEMENT

### Licensing and Validity Period

24. The CA proposed in the Consultation Paper to issue to each successful bidder, be it a new entrant or an incumbent licensee, with a new Unified Carrier Licence ("UCL"). In line with the term of a UCL, the 3.5 GHz Spectrum will be assigned from 1 April 2020 with a validity period of 15 years for the provision of public mobile services. For existing UCL holders who successfully acquire spectrum in the auction, it is their own choice and initiative to apply to the CA for combining their existing UCLs with the new UCL to be issued.

Views and Comments of the Respondents

25. HKT comments that a longer period of spectrum assignment must be granted in order to permit operators sufficient time to recoup their investment, both in terms of the price paid for use of the spectrum and the cost of the associated network rollout. Other respondents have no comments on the proposed licensing or the validity period of the assignment.

Responses of the CA

26. The CA considers that a 15-year term of spectrum assignment for the provision of public mobile services has long been adopted in Hong Kong and is well accepted by the industry. A finite period of assignment period will allow review of the use of the spectrum and adoption of other better arrangement for reassignment if considered appropriate at the end of the period. The CA is of the view that the MNOs and other interested parties can make informed decisions in considering the amount of investment for the

spectrum and the associated network rollout against the 15-year term of spectrum assignment. As the licensing arrangement concerned has been consistently followed in the past and the CA is of the view that there is no justified reason for a departure from the prevailing practice, the CA decides to maintain the prevailing practice.

**Restriction on Frequency Swap**

27. The CA proposed in the Consultation Paper that in order to ensure genuine competition and to realise the full market value of each individual frequency block, swapping of any frequency assignment in the 3.5 GHz band within the first five years counting from the date of the frequency assignment will generally not be considered.

Views and Comments of the Respondents

28. Among the 12 respondents, only HKT comments on the CA's proposal. HKT opines that if frequency swapping is only permissible after the first five years counting from the date of the frequency assignment, this will result in greater expense incurred by the operators concerned, and they should hence be permitted to swap their assigned spectrum after the conclusion of spectrum auction. HKT also considers that spectrum trading and pooling should be allowed.

Responses of the CA

29. The CA considers it appropriate and reasonable to maintain the proposed restriction on frequency swap in order to ensure genuine competition and to realise the full market value of each individual frequency block. Henceforth, the CA decides that swapping of any frequency assignment in the subject bands within the first five years from the date of the frequency assignment will generally not be considered.

30. Regarding HKT's view on spectrum trading, the Commerce and Economic Development Bureau ("CEDB") has recently commissioned a consultant to assess the relevant implementation issues relating to spectrum trading. Taking into account the findings and recommendations of the consultancy study[8] as well as other considerations, CEDB does not see a justifiable case to pursue spectrum trading in the short to medium term. CEDB has elucidated to Members of the Legislative Council on its policy

[8] The full consultancy report is available at: http://www.cedb.gov.hk/ccib/eng/report/doc/spectrum_trading/2018_report.pdf.

position on spectrum trading and its underlying considerations at the Legislative Council Panel on Information Technology and Broadcasting 11 June 2018[9], and the CA notes this policy position.

31. As for spectrum pooling, the CA considers that permitting such pooling of radio spectrum resources might result in enforcement complications when dealing with interference related to the pooled spectrum. On this basis, the CA does not plan to allow such arrangement for the time being. The CA will keep in view the technological and market development and may initiate discussions with the industry separately if necessary.

**Open Network Access Requirement**

32. In the Consultation Paper, the CA proposed to impose a spectrum cap of 100 MHz on any bidder in the auction of the 3.5 GHz Spectrum, and hence there could be a scenario whereby there will only be two successful bidders in the auction. In order to promote competitive supply of 5G services to end customers by providing an avenue to enable mobile service providers to access to future 5G mobile network operating in the 3.5 GHz band, the CA proposed to impose the requirement whereby a successful bidder assigned with spectrum in the 3.5 GHz band will be required to open up at least 30% of its network capacity for access by other non-affiliated mobile service providers (hereinafter referred to as "ONA requirement").

Views and Comments of the Respondents

33. Among the four MNOs, Hutchison has no adverse comment on the proposed ONA requirement. CMHK, HKT and SmarTone consider the ONA requirement unnecessary since sharing of network capacity can be achieved through commercial agreements among the spectrum assignees of the 3.5 GHz Spectrum and prospective mobile service providers.

Responses of the CA

34. As mentioned in paragraph 17 above, the CA considers that given the lowering of spectrum cap from the originally proposed 100 MHz to 70 MHz, this should allow at least three successful bidders in the auction and accordingly consumers should have at least three facilities-based operators to choose from. With better assurance of competitive supply of wholesale 5G

[9] Please refer to the paper about the policy position of CEDB on spectrum trading presented at the meeting of Legislative Council Panel on Information Technology and Broadcasting on 11 June 2018: https://www.legco.gov.hk/yr17-18/english/panels/itb/papers/itb20180611cb4-1200-5-e.pdf.

network services in the market such that interested parties should be able to negotiate and agree commercially with the spectrum assignees about leasing of network capacity for the provision of 5G services, the CA considers that there is no longer a need to impose any ONA requirement on the spectrum assignees.

## Protection of Telemetry, Tracking and Control ("TT&C") Stations

35. In the CA Statement issued on 28 March 2018[10] on the change in the allocation of the 3.4 – 3.7 GHz band from fixed satellite services ("FSS") (space-to-Earth) to mobile services for the provision of public mobile services with effect from 1 April 2020 (the "Re-allocation Statement"), the CA has decided to impose restriction zones in Tai Po and Stanley in order to protect existing TT&C Stations[11] operating in the 3.4 – 4.2 GHz band. The CA proposed in the Consultation Paper to impose relevant licence conditions to mandate implementation of additional mitigating measures (as detailed in the ensuing paragraphs) on successful bidders of the 3.5 GHz Spectrum.

### *Spectrum Assignees responsible for interference caused by mobile base stations located outside restriction zones*

Views and Comments of the Respondents

36. APT generally supports the protection of TT&C services. CASBAA welcomes the CA's proposal but considers that it lacks clarity on how MNOs would know their mobile base stations have caused desensitisation or interference to the existing satellite earth stations. AsiaSat agrees that spectrum assignees should be responsible for rectifying interference caused by mobile base stations located outside the restriction zones.

37. MNOs express concerns on the size of the restriction zones. They consider that a large number of telecommunications service consumers will be affected by the restriction zones and urge for additional mitigating measures to be imposed to help reduce the size of the restriction zones, such as adding shielding covers for the TT&C Stations, optimising the radiation directions of

[10] The CA statement "Change in the Allocation of the 3.4 – 3.7 GHz Band from Fixed Satellite Service to Mobile Service" is available at: https://www.coms-auth.hk/filemanager/statement/en/upload/441/ca_statements20180328_en.pdf.

[11] "TT&C Station" refers to the licensed earth station located in Tai Po Industrial Estate or Stanley for telemetry, tracking and control of satellites in orbit.

mobile base station antennas, and relocating the TT&C Stations from Tai Po to other remote areas.

Responses of the CA

38. The CA notes that there is no disagreement by respondents with regard to spectrum assignees' responsibility to protect the existing TT&C stations. Since mobile base stations may be deployed within the restriction zones subject to feasible technical arrangements identified by the working group under the Radio Spectrum and Technical Standards Advisory Committee of the Office of the Communications Authority ("OFCA") established for such purpose and adopted by the CA, the requirements for preventing or rectifying desensitisation to the receivers of the TT&C Stations caused by mobile base stations should be applied to all base stations operating with the 3.5 GHz Spectrum, rather than limited to those outside the restriction zones. The relevant requirement will be specified in the Special Condition to be incorporated in the licences which will be granted to the spectrum assignees.

***Spectrum assignee of Frequency Block A1 to coordinate with operator of the TT&C Station concerned***

Views and Comments of the Respondents

39. CMHK agrees with the need for coordination. It further requests the involvement of OFCA in the process of co-ordination and that the cost incurred in necessary protection measures be subsidised from the licence fee relevant to the use of this particular block. SmarTone requests details of the TT&C Channel operating in the Frequency Block A1 and the exact protection measure required. APT is concerned that the restriction zone does not provide sufficient protection to their satellite services operating in the 3.400 – 3.405 GHz band. HTCL urges OFCA to specify the level of protection to the TT&C Channel at the soonest. HKT makes reference to the relevant ITU report and considers that successful coordination for using the Frequency Block A1 is technically infeasible and is of the view that the CA is irresponsible in proposing to auction this frequency block on the same terms as the other spectrum blocks.

Responses of the CA

40. Given that details of the TT&C Channel in question are commercially sensitive information, the CA considers that relevant

information should only be disclosed to the successful bidder assigned with Frequency Block A1.

41. As regards the supply of Frequency Block A1 for auction, the CA endeavours to inform potential bidders of possible constraints in the deployment of this frequency block for 5G services for their consideration in making their individual commercial decisions whether to bid for this frequency block.

***Spectrum assignees shall prevent mobile terminals operating in the 3.5 GHz band from affecting TT&C Stations***

Views and Comments of the Respondents

42. APT would like OFCA to request MNOs to submit network-based mitigating measures for avoiding mobile terminals' aggregate interference signals affecting TT&C services. AsiaSat agrees that the spectrum assignees should be responsible for avoiding mobile terminals causing interference to TT&C services, including a licence obligation requiring the mobile terminals to be operated in the "listen before talk" mode.

43. CMHK considers that as mobile signal levels of the 3.5 GHz band in the vicinity of TT&C Stations should be weak, mobile terminals would hand over connections to use of other frequency bands operated by the operator concerned in the restriction zones. It also advises that a network-based solution that forces the existing connection of mobile terminals to another frequency band is currently not available.

Responses of the CA

44. In the Consultation Paper, the CA proposed that spectrum assignees should take all necessary measures to avoid interference caused by mobile terminals in close vicinity to the TT&C Stations. It is necessary to protect TT&C Stations as the aggregate effect of emissions from mobile terminals could be strong enough to cause harmful interference. The relevant requirement will be specified in the Special Condition to be incorporated in the licences which will be issued to the spectrum assignees.

**Other views which are outside the scope of the Consultation Paper**

***Restriction Zones***

Views and Comments of the Respondents

45. Hon. Charles Mok and Mr Francis Fong opine that the imposition of restriction zones would have serious adverse impact on the provision and development of 5G services in Hong Kong. HKSTP, which is situated within a restriction zone, opines that imposition of the restriction zone would have significant impact on the innovation development of the companies, incubates and research institutes located in the Hong Kong Science Park.

46. All MNOs and GSMA&GSA generally find the dimensions of the restriction zones to be too large and consider that they could be reduced by implementing additional mitigating measures including the relocation of satellite stations in Tai Po as a long term solution. On the other hand, AsiaSat considers that the dimensions of the restriction zones should be enlarged taking into consideration the relevant ITU reports. APT expresses that the requirement of restriction zones is still under discussion.

Responses of the CA

47. To address the concern regarding the restriction zones, a working group has been formed under the Radio Spectrum and Technical Standards Advisory Committee of OFCA to consider feasible technical arrangements for deployment of mobile base stations operating in the 3.5 GHz band within the restriction zones currently prescribed by the CA. The working group comprises representatives of MNOs, TT&C Station operators, HKSTP and Hong Kong Applied Science and Technology Research Institute. According to the discussion and field trials conducted so far, controlled deployment (in particular mobile base stations for indoor coverage) subject to a maximum permissible interference level at the receiving system of the TT&C Stations should be technically feasible.

48. The scope of study of the working group includes the three mitigating measures jointly proposed by MNOs on 24 May 2018. These measures are adding shielding cover for the TT&C Stations, optimizing the radiation directions of mobile base station antennae, and relocating the existing TT&C Stations from Tai Po Industrial Estate to a more remote area or co-location in Stanley. The working group aims to complete its work by the first quarter of 2019. Recommendations of the working group would be submitted to the CA for consideration. Subject to adoption by the CA, the relevant requirements and mitigating measures in regard to the deployment of mobile base stations in the restriction zones will be provided in the Information Memorandum, which will be issued for the auction of spectrum in the 3.5 GHz band.

***Protection of monitoring function of satellite stations***

Views and Comments of the Respondents

49. APT strongly objects to the CA's decision that only TT&C functions of satellite stations would be protected from interference. It considers that the CA has neglected the need to protect satellite services and the network management function (i.e. monitoring function) of satellite stations operating in the 3.4 – 3.7 GHz band. APT indicates that this would result in total loss of APT's capability to provide FSS and managing 40 x 36 MHz transponders in this frequency band. CASBAA suggests that if the monitoring function is not protected, satellite operators should be fully compensated for the costs of monitoring traffic of the satellites in another location covered by the foot-print of the satellites and conveying the monitored signals on those satellites back to Hong Kong.

Responses of the CA

50. In the Re-allocation Statement, the CA has decided that satellite operators will not be entitled to protection for performing monitoring functions at the TT&C Stations after the re-allocation of the 3.4 – 3.7 GHz band to mobile services on 1 April 2020. Following the re-allocation of the band to mobile services, the continued protection of satellite monitoring function would impose unrealistic constraints on the provision of 5G services in Hong Kong.

51. Unlike TT&C function which must be performed at the designated TT&C Stations, monitoring of traffic from satellites can be performed at any location covered by the satellites' foot-print. The CA considers that there are technical options available for the satellite operators to continue to perform the monitoring function at the 3.4 – 3.7 GHz band. In line with the CA's decision that licensees of external fixed telecommunications network services ("EFTNS") and self-provided external telecommunications systems ("SPETS") should implement appropriate measures to enable co-existence of FSS and mobile services operating in the 3.4 – 4.2 GHz band, the satellite operators should also be responsible for any technical arrangements (including the cost incurred) to enable continuance of their monitoring function. In striking a balance between the co-existence of mobile services and satellite services in the 3.4 – 4.2 GHz, the CA maintains that satellite traffic monitoring function in the 3.4 – 3.7 GHz band would not be protected.

52. The CA does not agree with APT's view that it will totally lose its capability to provide FSS services in Hong Kong. As stated in the Re-allocation Statement, the 3.6 – 3.7 GHz band would be deployed as a guard band to facilitate co-existence of both satellite and mobile services in the 3.4 – 4.2 GHz band. The satellite operators who have the necessary technical expertise and resources should be capable of implementing appropriate mitigating measures to continue with the provision of their FSS.

***Reduction of bandwidth of the guard band***

Views and Comments of the Respondents

53. HKT, SmarTone and GSMA&GSA suggest that the bandwidth of the guard band (i.e. 3.6 – 3.7 GHz) should be reduced in order to release more spectrum for the provision of 5G services.

Responses of the CA

54. The Re-allocation Statement has already addressed the issue of using a smaller guard band for protecting the satellite service operating in the 3.7 – 4.2 GHz band. As stated in the Re-allocation Statement, after conducting field trials, the consultant has concluded that a guard band of 100 MHz will reduce the impact of mobile services on FSS after the re-allocation and facilitate the implementation of interference mitigating measures. On the other hand, the respondents have not provided any technical justification to support the proposal for a smaller guard band. The CA considers that there is no evidence to justify a reduction in the guard band.

***Aggregate spurious and out-of-band emission levels of 5G signals***

Views and Comments of the Respondents

55. CASBAA further recommends that OFCA should specify a maximum aggregate spurious and out-of-band emission limit from 5G mobile service into the 3.7 – 4.2 GHz band at the licensed satellite reception antennas as a planning criterion for placement of mobile base station antennas.

Responses of the CA

56. Limits on spurious and out-of-band emissions of radio equipment, including 5G equipment and the associated mobile terminals, are specified by international standardisation body after soliciting the inputs of all contributing parties worldwide and balancing the interests of various stakeholders.

CASBAA's proposal of setting an aggregate limit on spurious and out-of-band emissions from 5G mobile terminals is not practical because in theory, all radio equipment may generate spurious signals in different frequency bands and it is not limited to 5G equipment only.

**Subsidy Scheme to Support Upgrade of Existing Satellite Master Antenna Television ("SMATV") Systems**

57. The CA proposed in the Consultation Paper that prospective spectrum assignees of the 3.5 GHz band would be required to establish and administer a subsidy scheme to support the upgrade of the eligible SMATV systems[12] and the associated administrative costs. Only one count of upgrade per SMATV system is allowed with the maximum amount of subsidy capped at HK$20,000 per SMATV system.

Views and Comments of the Respondents

58. All MNOs disagree with the proposed subsidy scheme. They consider that the subsidy scheme should be funded out of the SUF for the use of the 3.5 GHz Spectrum; or from the licence fees relevant to the use of the 3.5 GHz band; or from resources of the OFCA Trading Fund, and that the scheme should be administrated by OFCA. GSMA&GSA cautions that any subsidy scheme needs to be planned carefully so as not to create additional burden on the successful bidders. It also indicates that such kind of subsidy scheme in other jurisdictions is usually managed by the government and funded out of the auction proceeds.

59. CASBAA opines that compensation for necessary upgrade costs of EFTNS, SPETS and other Hong Kong licensed earth stations should also be covered by the subsidy scheme. Moreover, it points out that some SMATV systems may need to have their receiving antennas upgraded and $20,000 subsidy may not be enough to cover the cost. It proposes that claims for planned but not yet completed upgrades should also be handled under the proposed scheme, as it may not be feasible to upgrade all SMATV systems within one year. APT submits that as the market demand for upgrading SMATV systems will rise within a short period of time, OFCA should consider increasing the subsidy amount.

[12] According to OFCA's record, there are some 1 600 existing SMATV systems that are licensed on or before 28 March 2018 that are covered by the subsidy scheme (see paragraphs 33 and 34 of the Consultation Paper).

60. AsiaSat submits that subsidy for upgrade of earth station antennas of satellite operators in Tai Po Industrial Estate and Stanley should also be discussed. APT considers that the subsidy scheme may require time extension due to delays during implementation.

Responses of the CA

61. The CA considers that the proposed subsidy scheme falls outside the ambit of the licence fees, the OFCA Trading Fund and the SUF. Specifically, licence fees collected by the OFCA Trading Fund are for the purpose of supporting the operation of OFCA in administering and carrying out regulatory duties on licensees and hence should not be used to fund the subsidy scheme. The CA does not consider it appropriate to fund the subsidy scheme by the OFCA Trading Fund because doing so would effectively require other licensees, in addition to the successful bidders, also bear the cost of the subsidy scheme. The CA also considers it inappropriate to use part of the SUF to fund the subsidy scheme since the purpose of collecting SUF is to enable the general public to recap financial benefit from the commercial use of spectrum as a finite public resource. The CA therefore considers that it is reasonable to require the successful spectrum assignees to collectively fund the subsidy scheme[13].

62. Taking into account comments received, if OFCA is elected by all successful bidders to administer the subsidy scheme, the CA considers it acceptable for OFCA to administer the subsidy scheme in order to facilitate early upgrading of the eligible SMATV systems. Detailed arrangements in respect of the subsidy scheme will be specified by the CA in the Information Memorandum to be issued for the auction of the 3.5 GHz Spectrum.

63. Regarding CASBAA's suggestion for the subsidy scheme to compensate the upgrade costs of EFTNS, SPETS and other Hong Kong licensed earth stations and AsiaSat's request to discuss about subsidising the upgrading of the earth station antennas of satellite operators in Tai Po Industrial Estate or Stanley, the CA considers that unlike SMATV users/owners, local satellite operators have the necessary technical expertise and resources, and accordingly can implement appropriate mitigating measures to protect their existing earth stations from any harmful interference from the mobile base stations to be operating in the 3.5 GHz band.

[13] Assuming that (a) the total number of SMATV system to be subsidised for upgraded is 1 600; (b) the maximum amount of subsidy capped at HK$20,000 per SMATV system; and (c) the 200 MHz of spectrum are all released through the auction, the contributing amount for the subsidy scheme by the successful bidders in the auction will be HK$ 0.16 million per MHz bandwidth acquired plus administrative fee.

## Technology Neutrality

64. In the Consultation Paper, the CA proposed to adopt a technology neutral approach whereby the spectrum assignees are free to use whatever technology they choose based on widely recognised standards for providing 5G or other generations of mobile services. Such an approach will enable successful bidders to deploy the state-of-the-art technology in a timely and flexible manner to best meet the market demand.

Views and Comments of the Respondents

65. MNOs (CMHK, HKT, Hutchison and SmarTone), CASBAA, GSMA&GSA and Qualcomm support the CA's proposal to adopt a technology neutral approach in respect of the use of the 3.5 GHz Spectrum.

Responses of the CA

66. As there is no objection from the respondents, the CA will uphold the technology neutrality principle under which no particular technical standards on the use of the 3.5 GHz Spectrum will be mandated.

## Network and Service Rollout Obligations

67. The CA proposed in the Consultation Paper that in order to prevent spectrum hoarding and to ensure that the auctioned spectrum will be put into efficient use for the timely provision of advanced telecommunications services for the benefit of the general public, each spectrum assignee will be required to roll out its network and service in order to provide a minimum coverage of 50% of the population with regard to its mobile services within the first five years counting from the date of issue of the licence ("rollout obligation").

Views and Comments of the Respondents

68. Two MNOs (Hutchison and SmarTone) consider that the population within the two restriction zones should be excluded in determining whether the rollout obligation has been met. CMHK shares the same view, and considers that an even lower requirement for the rollout obligation (i.e. to provide a minimum coverage of 10% of the population with regard to its mobile services within the first five years counting from the date of issue of the licence) should be adopted. HKT disagrees with the CA's proposal and considers that neither minimum coverage obligations nor a performance bond

would be necessary in this case. HKT opines that if the CA is to impose any network and service rollout obligation on the spectrum assignees of the 3.5 GHz Spectrum, the Government must also make a commitment to facilitate speedy approval of street level furniture for the installation of 5G small cells.

69. GSMA&GSA disagree with the CA's proposal and consider that the proposed performance bond is not necessary.

70. CASBAA suggests that the CA should impose requirements on the spectrum assignees to share the information on their 5G base station locations and deployment schedule in a timely manner with all relevant satellite earth station operators (including satellite operators, owners of SMATV systems, operators of EFTNS and SPETS) so that they could timely schedule relevant retrofitting or upgrade works of their satellite receiving equipment to minimise the risk of disruption to the satellite services concerned. In addition, APT and CASBAA recommend the CA to issue guidelines for the spectrum assignees of the 3.5 GHz Spectrum to follow in deploying their 5G base stations in order to safeguard existing satellite services from harmful interference.

Responses of the CA

71. The CA notes the comments of the MNOs that the population in the restriction zones should be excluded from the calculation of the minimum coverage of 50% of the population. Taking into account the fact that there are constraints in deploying mobile base stations to be operating in the 3.5 GHz band, the CA agrees to make suitable adjustment in this regard. With about 740 000 individuals (or about 10% of the total population) residing in the restriction zones, the CA considers it justified to lessen the network and service rollout obligations by one-tenth of the proposed level, i.e. from a minimum coverage of 50% of the population to a minimum coverage of 45% of the population. However, the CA does not agree to further reduction of the minimum coverage requirement below 45%. Otherwise, it cannot ensure that the scarce radio spectrum will be put into use in a timely and efficient manner. For a similar reason, the CA does not agree with GSMA&GSA's suggestion of not requiring a performance bond, otherwise compliance with the minimum coverage requirement cannot be secured.

72. Regarding HKT's view on Government's facilitation for 5G base station deployment using street furniture, OFCA has in fact been coordinating with relevant government departments to facilitate MNOs' use of government properties and public street facilities (including but not limited to lamp posts

and public payphone kiosks) to install mobile base stations for the provision of public mobile services. As announced by the Chief Executive in her 2018 Policy Address, to assist MNOs in rolling out 5G networks, the Government will proactively open up suitable government premises to assist MNOs in installing mobile base stations. This further demonstrates the Government's commitment to provide the necessary assistance to the industry in the development of 5G infrastructure.

73. Concerning CASBAA's suggestion to require spectrum assignees of the 3.5 GHz Spectrum to disclose and share the information (including installation locations and deployment schedule) about their 5G base station deployment with the licensed SMATV operators, since such information is commercially sensitive in nature, the CA does not consider it appropriate to impose such a requirement on the spectrum assignees. The CA has adopted the protection principle that the MNOs operating in the 3.5 GHz band would be held accountable for harmful interference to those SMATV systems operating in the 3.7 – 4.2 GHz band which have been licensed on or before 28 March 2018 and implemented with appropriate mitigating measures. All affected licensees are advised to upgrade their systems promptly so as to be protected from radio interference of public mobile services operating in the 3.5 GHz band. Given the promulgation of this principle, the CA does not see a need at this stage to issue further guidelines for the spectrum assignees to follow in the planning, installation and commissioning of their 5G base stations.

## SPECTRUM UTILISATION FEE

### Method of Payment

74. SCED proposed in the Consultation Paper that spectrum assignees of the 3.5 GHz Spectrum will be given a choice to pay the SUF either by –

(a) lump sum payment upfront, which is the lump sum amount determined in auction; or

(b) annual instalments, with the first instalment equivalent to the lump sum amount obtained in (a) above divided by 15 (i.e. the number of years of assignment), and subsequent instalments increased every year by a pre-set fixed percentage which aims to reflect the time value of money to the Government.

Views and Comments of the Respondents

75. CMHK, Hutchison and SmarTone support SCED's proposal that spectrum licensee will be given a choice of paying the SUF by lump sum upfront or by annual instalments. CMHK does not agree with SCED's proposed increment of a pre-set fixed percentage every year for subsequent instalments after the first payment, and considers that the annual instalments should only mean that the SUF can be split equally into 15 annual instalments.

76. Three MNOs (CMHK, Hutchison and SmarTone) and the other respondents (GSMA&GSA, Hon. Charles Mok and Mr Francis Fong) submit that SCED should not set reserve price for the spectrum at a high level as it would severely increase the spectrum assignees' investment in deploying 5G networks and services in Hong Kong and might result in high consumer prices.

77. HKT considers that SCED should adopt a different approach to determine SUF, by charging economic activity (such as certain percentage of revenue earned by the spectrum assignee) from the use of the spectrum rather than by the use of the spectrum itself. HKT reiterates its disagreement on auctioning the 3.5 GHz Spectrum, and accordingly the SUF being set by way of auction. It also comments that the reserve price has risen significantly over the past four spectrum auctions (according to HKT, local MNOs paid SUF in multiples of what operators of other jurisdictions paid) and therefore this has made mobile industry in Hong Kong less competitive.

Responses of SCED

78. SCED notes that almost all MNOs expressed support for the choices provided for the payment method of SUF. While CMHK expresses disagreement on the proposed increment of a pre-set fixed percentage every year for subsequent instalments after the first payment, SCED maintains the view that such increment has the important function of reflecting the time value of money to the Government. Non-inclusion of such increment would essentially reduce the amount obtained by the Government in real terms. It is also common international practice to include increments for instalment arrangements.

79. As to the level of SUF, SCED notes the submissions by most MNOs that the reserve price for the spectrum should not be set a high level. SCED needs to emphasize that, as in many previous auctions, SCED has no intention to set the auction reserve price as a pre-estimate of an expected market price. SCED considers that the level should be set so that it would serve the purpose of kick-starting the competitive bidding process. A fine

balance should also be achieved between forestalling non-serious bidders and encouraging competition and participation in the auction exercise. Attention of SCED has been paid on the need for substantial upfront investments required for MNOs and non-MNOs to roll out their 5G network infrastructure. SCED also acknowledges the uncertainty of market value of the 3.5 GHz Spectrum, as full potential of 5G services is still unclear. SCED will take all these into considerations into account in setting the reserve price.

80. Regarding the proposed approach by HKT to determine SUF by charging from economic activity from the use of the spectrum (i.e. annual royalty payment that links the amount of SUF to revenues of the MNOs), not only is it not the common international practice, the approach would also impose administrative costs on both the Government and the MNOs in implementing accounting separation to ensure that all relevant revenues are suitably apportioned in the calculation of royalty payments. OFCA and MNOs will need to discuss and agree on the segregation methodology for determining network turnover attributable to different frequency bands. Past experience indicates that this accounting separation and reporting processes are resource-consuming and difficult to implement for both OFCA and MNOs.

**Communications Authority**
**Secretary for Commerce and Economic Development**
**13 December 2018**

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**Annex 2**

## Special Condition – Protection of TT&C Stations

## X. PROTECTION OF TT&C STATIONS

X.1 The spectrum that falls within the 3.4 – 3.6 GHz band shall not be used by the licensee to provide service through any base station located within the restriction zones designated by the Authority where licensed earth stations for telemetry, tracking and control ("TT&C") of satellites in orbit ("TT&C Stations") are located, unless the licensee complies with the relevant guidelines and directions issued by the Authority. Detailed information about the restriction zones is in Schedule Y.

X.2 The licensee shall ensure that no act or omission of the licensee arising out of or in connection with installing, maintaining and/or operating the service and the network, and in particular the operation of the radio channel overlapping with the frequency range of 3.400 – 3.405 GHz shall cause or be likely to cause any harmful interference to licensed TT&C Stations within the restriction zones referred to at Special Condition X.1. Without limitation to the foregoing, the licensee shall coordinate with the operator of any applicable licensed TT&C Station for the implementation of appropriate protection measures.

X.3 The licensee shall take all necessary measures to protect the TT&C Stations from harmful interference caused by the licensee's mobile base stations, including the removal of such mobile base stations as a last resort

X.4 The licensee shall ensure that the operation of customer equipment connected to the licensee's network or having access to services provided under this licence does not cause harmful interference to any licensed TT&C Stations within the restriction zones referred to Special Condition X.1.

X.5 The Authority may give such reasonable directions as it thinks fit in relation to avoiding harmful interference and desensitisation to TT&C Stations for the purposes of Special Conditions X.2 to X.4. The licensee shall comply with all such directions at its own cost.

X.6 For the purposes of Special Condition X:

"customer equipment" means, without limitation, mobile terminal, mobile handset and any other device which is used by a customer of the licensee for connection to the licensee's network or access to services provided under this licence.

# SCHEDULE Y

## RESTRICTION ZONE

Two restriction zones are defined by polygon vertices (see Figure Y.1 below) using the Hong Kong 1980 Grid Coordinates, as follows –

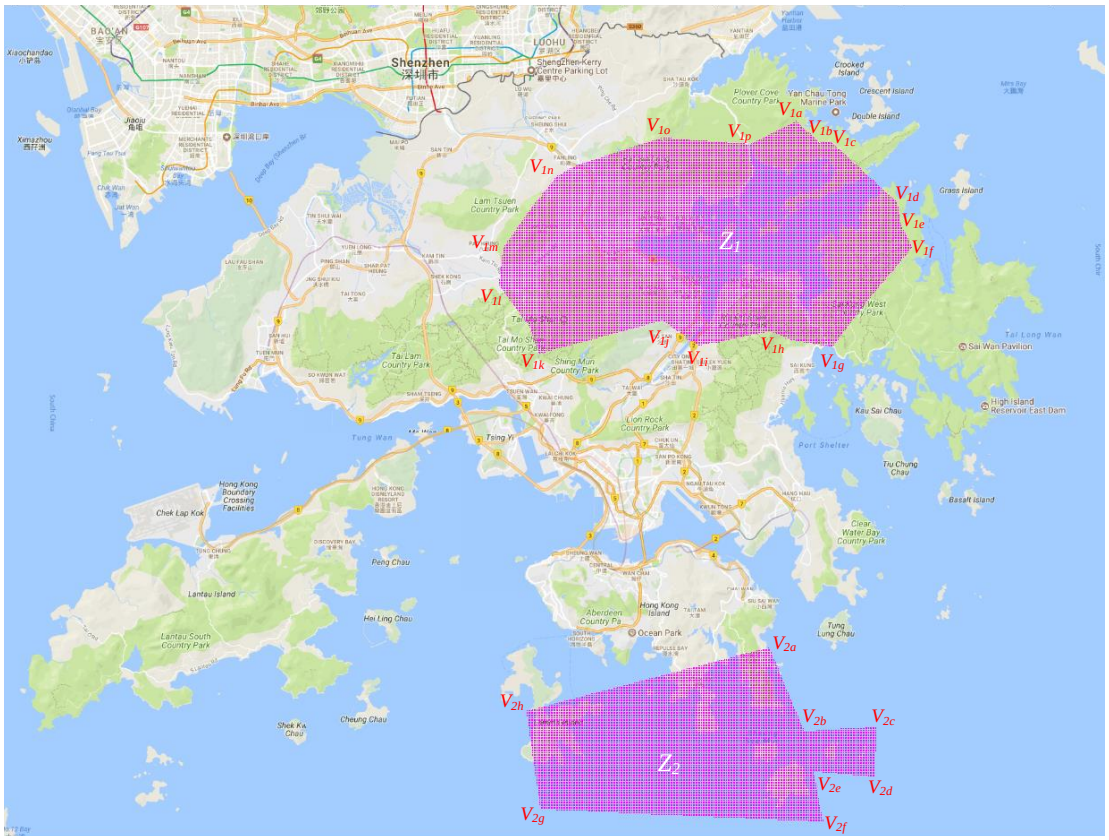


**Figure Y.1 Restriction Zones**

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]