

**Arrangements for the Frequency Spectrum in the 1.9 – 2.2 GHz Band
upon Expiry of the Existing Frequency Assignments
for 3G Mobile Services**

– Second Consultation Paper –

28 December 2012

FOREWORD

This paper (the “Second Consultation Paper”) seeks further views and comments on how the frequency spectrum in the 1.9 – 2.2 GHz band should be re-assigned when the existing assignments for third generation (“3G”) mobile services expire on 21 October 2016.

Having carefully considered the views and comments received in response to the first consultation paper issued on the subject in March 2012 (the “First Consultation Paper”) ¹, the Secretary for Commerce and Economic Development (“SCED”) and the Communications Authority (“CA”) propose to put forward in the Second Consultation Paper a hybrid option of administratively-assigned cum market-based approach in the 3G spectrum re-assignments for further consultation. The SCED also proposes two methods for setting the spectrum utilisation fee (“SUF”) of the spectrum to be re-assigned, which is premised upon the market-based approach, and invites views and comments from the industry and interested parties.

For the avoidance of doubt, all the views expressed in the Second Consultation Paper are for the purpose of discussion and consultation only. Nothing in this consultation paper represents or constitutes any decision made by the SCED or the CA. The consultation contemplated by the Second Consultation Paper is without prejudice to the exercise of the powers by the SCED or the CA under the Telecommunications Ordinance (the “Ordinance”) or any subsidiary legislation².

¹ The First Consultation Paper is available at http://www.coms-auth.hk/filemanager/common/policies_regulations/consultations/papers/cp20120330.pdf.

² Sections 32H(1) and 32I(1) of the Ordinance empower the CA to assign the radio frequency and to designate the frequency bands for the payment of SUF following consultation with the industry and interested parties. Sections 32I(2) and 32I(4) of the Ordinance empower the SCED to prescribe the method for determining the SUF and to specify the minimum fee of the SUF.

Any person wishing to respond to this consultation paper should do so on or before 28 February 2013. The Office of the Communications Authority (“OFCA”) may publish all or any part of the views and comments received, and disclose the identity of the source in such manner as we see fit. Any part of the submissions considered commercially confidential should be clearly marked. The SCED and the CA would take such markings into account in making the decision as to whether or not to disclose such information. Submissions should be addressed to –

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An electronic copy of the submission should be provided by e-mail to the e-mail address indicated above.

INTRODUCTION

Frequency spectrum in the 1.9 – 2.2 GHz band was assigned through auction to four mobile network operators (“MNOs”) for the provision of 3G mobile services in October 2001 for a tenure of 15 years (hereinafter referred to as “3G spectrum”). The four incumbent 3G operators are CSL Limited, Hong Kong Telecommunications (HKT) Limited, Hutchison Telephone Company Limited and SmarTone Mobile Communications Limited. Their existing 3G frequency assignments will expire on 21 October 2016. Another MNO, China Mobile Hong Kong Company Limited, has not been assigned with any spectrum in this frequency band. It is currently providing 3G services under commercial agreements with some of the incumbent 3G operators by deploying the latter’s 3G network capacity.

2. According to the statement issued by the former Telecommunications Authority (“former TA”)³ in January 2008 on minimum notice periods for variation or withdrawal of spectrum assignments upon and before their expiry,⁴ insofar as it is practicable in the circumstances, the decision of the CA on whether to renew the frequency assignments with different frequencies assigned, or not to renew the assignments at all upon their expiry, should be notified to the incumbent operators at least three years in advance, i.e. by October 2013 at the latest for the 3G spectrum re-assignment exercise.

3. The SCED and the former TA jointly issued the First Consultation Paper in March 2012 to solicit the views and comments of the industry and interested parties on the arrangements for re-assignment of the 1.9 – 2.2 GHz spectrum upon expiry of the existing assignments. The consultation was originally scheduled to close on 15 June 2012. Upon the requests from the industry, the deadline for submission of views and comments was extended by one month to 15 July 2012.

4. In response to the First Consultation Paper, submissions were received from 12 respondents, including the five MNOs, a business partner of an MNO, three equipment vendors/works contractors, and three members of

³ Pursuant to the Communications Authority Ordinance (Cap 616), with effect from 1 April 2012, all duties and powers of the Telecommunications Authority are conferred on the Communications Authority, and all duties and powers of the Office of the Telecommunications Authority are conferred on OFCA, the executive arm of the CA.

⁴ The TA Statement is available at http://tel_archives.ofca.gov.hk/en/tas/others/ta20080131.pdf.

the public. Subsequently, the five MNOs and two members of the public provided supplementary submissions.⁵ The respondents are listed below in alphabetical order –

- China Mobile Hong Kong Company Limited (“CMHK”);
- CSL Limited (“CSL”);
- Hong Kong Telecommunications (HKT) Limited (“HKT”);
- Huawei Technology Investment Company Limited (“Huawei”);
- Hutchison Telephone Company Limited (“Hutchison”);
- Mr Daniel Ngai;
- Mr. Lau Yat Ming;
- Mr. Simon Lo;
- Nokia Siemens Networks H.K. Limited (“NSN”);
- NTT Docomo Incorporation (“NTT Docomo”);
- SmarTone Mobile Communications Limited (“SmarTone”); and
- Top Express Communications Limited (“Top Express”).

5. A summary of the views and comments received and the responses of the SCED and CA are at **Annex 1**. The second consultation exercise will continue to focus on the re-assignment of the 2 x 60 MHz⁶ of paired spectrum in the 1.9 – 2.2 GHz band. The proposal for the 20 MHz of unpaired spectrum in the same frequency band is set out in paragraph 68 of this paper.

⁵ The submissions and supplementary submissions are available at http://www.coms-auth.hk/en/policies_regulations/consultations/completed/index_id_132.html.

⁶ It is for the sake of simplicity that all the slots of the 3G spectrum are referenced in terms of “2 x 5 MHz” slots, with each of the four incumbent 3G operators holding 2 x 15 MHz of the concerned spectrum, giving a total of 2 x 60 MHz or 120 MHz of 3G spectrum. To be precise, each incumbent holds 2 x 14.8 MHz of 3G spectrum. The total amount of 3G spectrum available for re-assignment is 2 x 59.2 MHz or 118.4 MHz.

OPTIONS PROPOSED IN THE FIRST CONSULTATION PAPER

6. In accordance with the policy on spectrum management as promulgated by the Government in the Spectrum Policy Framework (the “Policy Framework”)⁷ in April 2007, and taking into account the explosive growth in mobile data traffic in recent years as against the limited supply of frequency spectrum as a scarce public resource, the following three options were proposed in the First Consultation Paper for re-assignment of the 2 x 60 MHz of spectrum in the 1.9 – 2.2 GHz band –

- Option 1: An administratively-assigned approach – right of first refusal to be offered to the incumbent 3G operators;
- Option 2: A full-fledged market-based approach – re-auctioning all the spectrum; and
- Option 3: A hybrid between administratively-assigned and market-based approach – right of first refusal to the incumbent 3G operators for them to retain part of the spectrum (“RFR Spectrum”), while part of the spectrum will be returned to the CA for re-auction (“Re-auctioned Spectrum”).

7. The First Consultation Paper sets out a list of objectives in spectrum re-assignment, viz. ensuring customer service continuity, efficient spectrum utilisation, promotion of effective competition, and encouragement of investment and promotion of innovative services. It also provides an analysis of the relative pros and cons of each of the above option in meeting these objectives. The focus of the Second Consultation Paper is on the arrangement for spectrum re-assignment which would best meet these multiple objectives, in accordance with the policy principles promulgated in the Policy Framework.

⁷ The Spectrum Policy Framework is available at <http://www.cedb.gov.hk/ctb/eng/legco/pdf/spectrum.pdf>.

SUMMARIES OF RESPONDENTS' VIEWS ON THE THREE OPTIONS PROPOSED IN THE FIRST CONSULTATION PAPER

8. All the four incumbent 3G operators, namely CSL, HKT, Hutchison and SmarTone, together with NSN, NTT Docomo and Top Express regarded Option 1, which offered the incumbents the right of first refusal to acquire all their existing 3G spectrum, as the only option that met all the objectives in spectrum re-assignment as outlined in the First Consultation Paper. The incumbents referred to the re-assignment of the spectrum in the 900 MHz and 1800 MHz bands to the incumbent MNOs through the offer of right of first refusal in 2004 as providing the relevant precedent for the present case.⁸ They regarded the public interest grounds considered in re-assigning the 900 MHz and 1800 MHz spectrum as providing “good public policy reasons” for offering them the right of first refusal to acquire their original frequency holding in the 1.9 – 2.2 GHz band. These include consideration of the importance of providing a stable investment environment and ensuring continuity of customer services. HKT and Hutchison also argued that they were entitled to claim legitimate expectation for renewal of the 3G spectrum licences.

9. All incumbent 3G operators objected to Options 2 and 3, viz. re-auction of either all or part of the currently assigned 3G spectrum. They opined that they had all deployed their holding of 2 x 15 MHz of frequency spectrum for the provision of 3G services in the most efficient manner, with customers enjoying competitive prices and state-of-the art technology and services. Any prospect of variation or withdrawal of the 3G spectrum would create regulatory uncertainty and as such a chilling effect on investment in the remaining period of the 3G spectrum assignment period. The resulting slow-down in the growth in network capacity, coupled with the sustained growth in mobile data traffic, would lead to congestion and customer service degradation. Specifically, CSL and HKT pointed to the massive and costly reconfiguration work required in order to continue to provide indoor coverage for 3G services, if they were assigned with spectrum in different frequency sub-bands. The incumbent 3G operators pointed out that a distinction had to be drawn between assignment of “greenfield” spectrum and spectrum that had already been fully deployed for service provisioning like the 3G spectrum.

⁸ HKT referred also to the re-assignment of the spectrum originally used for the provision of analogue mobile services to the incumbent licensees to provide digital mobile services in the early 1990s as providing a relevant precedent to the present 3G spectrum re-assignment.

10. On the comparison between Options 2 and 3, CSL and SmarTone opined that Option 3 might be slightly less disruptive. CSL further pointed out in particular that the incumbents should be offered the right of first refusal to acquire a contiguous band of 2 x 10 MHz of 3G spectrum.

11. On the setting of SUF for the spectrum to be re-assigned to the incumbent 3G operators through right of first refusal under Option 1, the incumbent operators generally did not support the mock auction method or the least cost alternative (“LCA”) method, as the former could lead to artificially high bids and the latter was considered subjective and difficult to administer. Rather, they preferred the market benchmarking method, e.g. setting the SUF at the level they are currently paying for the second generation (“2G”) spectrum or as determined by selected past auctions in Hong Kong. Also, HKT and Hutchison suggested a zero or minimal level of SUF to be paid for the re-assigned spectrum to achieve resources saving for the industry and to benefit consumers.

12. CMHK, which does not possess any spectrum in the 1.9 – 2.2 GHz band at the moment, supported Option 2. It considered that Option 1, which offered right of first refusal to the incumbent 3G operators to acquire the spectrum, as running counter to the market-based approach and there was no overriding public policy reason justifying its adoption. On the other hand, it considered spectrum re-auction under Option 2 a fair arrangement as it would allow all the interested parties to participate in the bidding exercise. Specifically, it pointed out that spectrum was a scarce resource with competing demands, the quantity of the spectrum at stake was huge and auction would enable the spectrum to be assigned to the operators which valued it the most and as a result would enhance competition in the mobile market. In contrast to the incumbents, CMHK did not regard the opportunities of obtaining spectrum in the other frequency bands through auction or merger and acquisition, or the mobile virtual network operator (“MVNO”) arrangement, as fair substitutes for an opportunity to acquire the 1.9 – 2.2 GHz spectrum through auction. Further, while CMHK did not support Option 3, it regarded this approach as acceptable if it would be given the chance of obtaining a contiguous band of 2 x 10 MHz of the re-auctioned spectrum.

13. In line with its support for re-auctioning the spectrum, CMHK also supported determining the SUF by auction. Notwithstanding that it did not prefer Option 3, it supported the proposal of benchmarking the SUF of the RFR Spectrum with the SUF of the Re-auctioned Spectrum, and considered it the best method to reflect the true market value of the spectrum. On the contrary,

the incumbent 3G operators opposed this benchmarking arrangement in setting the SUF of the RFR Spectrum, as they would have to commit themselves to an unknown level of SUF and this was considered tough and risky for them.

14. There are likewise two different sets of views among the three members of the public making submission to the First Consultation Paper. One advocated re-assigning the spectrum to enable five 3G operators to compete in the market, the other to re-auction all the spectrum in order to better reflect the value of the spectrum. The remaining one supported Option 1, as he was appreciative of the quality mobile services currently enjoyed by consumers and was concerned that spectrum re-auction would put that into jeopardy.

CONSIDERATION AND RESPONSES OF THE SCED AND THE CA

15. The following paragraphs set out the responses of the SCED and CA to the major views of the respondents as outlined above. Detailed responses to the views and comments raised in the submissions are at **Annex 1**.

Precedent, Legitimate Expectation and Regulatory Certainty

The 2007 Spectrum Policy Framework

16. According to the incumbent 3G operators, the former TA had offered the right of first refusal to the incumbent operators in 2004, for them to acquire their original holding of frequency spectrum in the 900 MHz and 1800 MHz bands upon expiry, having taken into account the public interest consideration. What the incumbent operators have not pointed out in their submissions is the fact that subsequently both the Government and the industry⁹ had come to the view that such an ad hoc approach was less than satisfactory. At the request of the industry and in view of the need to formulate a long-term spectrum management policy, the then Secretary for Commerce, Industry and Technology promulgated the Policy Framework in April 2007 following a public consultation exercise.

17. The SCED and the CA are guided by the following major policy principles in spectrum management formulated in the Policy Framework in 2007 in considering the re-assignment arrangements for the 120 MHz of spectrum in the 1.9 – 2.2 GHz band –

- A market-based approach in spectrum management will be used for spectrum 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;
- There is no legitimate expectation that there will be any right of renewal or right of first refusal of any licence or spectrum

⁹ For example, 13 operators (including the four incumbent 3G operators and CMHK) sent a joint letter to the then TA on 21 November 2005. In paragraph 18 of the submission attached to that letter, the industry opined that “*issues that arose from the 2G mobile licence mobile renewal process have clearly demonstrated the problems of the lack of long-term spectrum policy for Hong Kong. A comprehensive long-term spectrum policy is long overdue*”.

assignment upon the expiry of a licence or spectrum assignment;
and

- If a spectrum assignment is to be renewed with different radio frequencies assigned, or not renewed upon the expiry of an assignment, notification would be given to the spectrum assignee within a reasonable time before expiry.

Competing Demands

18. In 2004, when spectrum in the 900 MHz and 1800 MHz bands was re-assigned to the incumbent operators through the right of first refusal, the spectrum was deployed primarily for the provision of voice services. However, with the advent of smartphones in 2007, when the Policy Framework was promulgated, the mobile market has since undergone significant transformation and the demand for mobile spectrum has skyrocketed. Mobile data usage per customer surged from just 11 megabytes (“MB”) per month at end 2007 to 667 MB per month in September 2012. The total volume of mobile data traffic carried doubled each year in 2011 and 2012, having gone through upsurges of three to five times every year in the preceding three years. Looking ahead, while all the MNOs have launched the fourth generation (“4G”) mobile services and spectrum in the 1.9 – 2.2 GHz band can be refarmed for the provision of 4G services, the 3G technology utilising spectrum in this frequency band is still evolving. The SCED and the CA are given to understand that by 2016, when the existing 3G frequency assignments expire, the 3G service platforms will continue to play an important role in the mobile market.

19. The latest market and technological developments have clearly reinforced the phenomenon of intense competing demands for the spectrum in the 1.9 – 2.2 GHz band. In addition, CMHK, which does not possess such spectrum, has indicated interest in the spectrum both in its submissions to the First Consultation Paper and openly before the media and in public. ***There is therefore no doubt in the minds of the CA that there are competing demands for the 3G spectrum for the years to come.*** In accordance with the Policy Framework, with the competing demands, a market-based approach should be adopted for re-assigning the spectrum in the 1.9 – 2.2 GHz band such that the scarce spectrum resource will be put to the hand of the operators which value it the most, the caveat being ***“unless there are overriding public policy reasons to do otherwise”***. In this regard, given the concerns about the disruptive impact on customers that may be brought about by re-auctioning all the spectrum, the SCED and the CA have considered the impact assessment on

Option 2 as outlined in paragraphs 22 - 27 below, examined in particular whether Option 2 can meet the objective of preserving service continuity, in coming to a view on the possible way forward with the 3G spectrum re-assignment arrangement for further consultation with the industry and interested parties.

Legitimate Expectation and Regulatory Certainty

20. On the point about legitimate expectation and regulatory certainty, the Policy Framework, which, as pointed out in paragraph 16, was promulgated, following consultation with the industry and interested parties, by the Government in April 2007 – some nine years prior to the expiry of the current assignments of 3G spectrum, already states clearly that there exists no legitimate expectation on the part of the licensees that there will be any right of first refusal of any spectrum assignment upon expiry. In addition, Schedule 3 on “*Technical Particulars of Radio Stations for the Provision of the Service*” attached to the relevant licences of the incumbent 3G operators clearly states that frequencies in the 1.9 – 2.2 GHz band have an assignment period till 21 October 2016. The incumbents are thus fully aware of the fact that their licences and the associated 3G spectrum assignment would co-terminus on 21 October 2016, and it is only reasonable to expect that they would have taken this into account in their investment and business plans.

21. The SCED and the CA fully appreciate the importance of regulatory certainty to all parties who are making (or plan to make) long-term investments in the Hong Kong telecommunications industry. The formulation of the Policy Framework seeks inter-alia to address this need for regulatory certainty for the industry. Also, the preparation of the 3G spectrum re-assignment exercise was launched in March 2012, some 55 months before the expiry of the current assignment, in order to provide the industry with ample time to partake in the consultation exercises to be conducted on this important subject and to make plans for the possible change in the spectrum assignments post October 2016. Also, in accordance with the Policy Framework, the CA will insofar as it is practicable give three years’ advance notice as to whether the spectrum assignments will be renewed and whether there will be variations in the assignments. The timing of the two consultation exercises is so arranged to enable the CA to provide the three-year advance notice insofar as it is practicable to the affected licensees, in instances where the final decision entails possible changes in the 3G spectrum assignments post October 2016.

Impact Assessment on Option 2

22. As pointed out in paragraphs 18 and 19, the CA has established that there are competing demands for spectrum in the 1.9 – 2.2 GHz band. In accordance with the Policy Framework, a market-based approach should be adopted for spectrum re-assignment, unless there are overriding public policy reasons to do otherwise. Option 2 proposed in the First Consultation Paper is a full-fledged market-based approach, where all the 120 MHz of 3G spectrum will be put to auction. Under this arrangement, the outcome of the auction is highly uncertain. The incumbents may end up with the same level of spectrum holding in the 1.9 – 2.2 GHz band, whether in the same or different frequency sub-band. They may acquire more than their existing spectrum holding. They may lose part of their existing spectrum holding. In the worst case scenario, an incumbent may fail to obtain any of the concerned spectrum altogether. The Government is aware of the possible adverse impact that such full-fledged changes in frequency assignment could have on the quality and continuity of service. This would adversely impact upon the millions of mobile service subscribers in Hong Kong. OFCA has conducted an assessment on the magnitude of the impact as detailed below.

Customer Service

23. According to OFCA's assessment, the loss of spectrum by an incumbent will, depending on the actual extent, result in degradation of customer service quality in terms of slower data download speed and more drop calls, and also weakening or complete loss of indoor mobile coverage for 3G services. This will occur after the handover of spectrum in October 2016 and continue during a transitional period, which may last for two to three years after the spectrum changeover, until the affected customers have eventually moved their service contracts to the operators which possess more spectrum. While the auction to be conducted under Option 2 is planned to take place in October 2014, customers are not expected to consider changing operators until they actually experience degradation in service quality following spectrum handover in October 2016.

24. In the worst case scenario, according to OFCA's assessment, if an incumbent fails to obtain any spectrum in the 1.9 – 2.2 GHz band in the auction, the resulting reduction in its network capacity is expected to lower its data

download speed by 36% on average¹⁰ during the transitional period. The impact will be more prominent on the network of those operators which possess less spectrum in the other frequency bands that could be used to compensate for the loss of the spectrum in the 1.9 – 2.2 GHz band. In the foreseeable future, the MNOs are expected to continue to utilise spectrum in the 1.9 – 2.2 GHz and 850/900 MHz bands for their 3G services. If an incumbent does not possess spectrum in the 850/900 MHz band, it will no longer be able to provide 3G services if it fails to obtain any spectrum in the 1.9 – 2.2 GHz band in the auction. In general, some of the 3G customers will be squeezed into the 850/900 MHz band and some will change to use 4G services utilising spectrum in the 1800 MHz and/or 2.5/2.6 GHz bands. Therefore, depending on the mitigating measures to be adopted by the concerned operators (e.g. splitting sectors and installing more base stations), it is possible that a substantial number of customers on the network of the incumbents losing spectrum may be affected, not just the 3G customers. In regard to the increase in the number of drop calls due to spectrum loss, it is not possible to quantify the impact as it depends on the traffic pattern at different locations and at different times of the day. But it is certain that the decrease in network capacity of base stations due to spectrum loss will have impact on the continuity of calls or data connections when mobile customers move from one location to another.

25. OFCA has also looked into the concern about the massive reconfiguration work required for the hundreds of existing integrated radio systems (“IRS”) installed for the provision of 3G services indoors, if the incumbents are assigned with spectrum located in a totally different frequency sub-band in the auction to be conducted in October 2014. If system reconfiguration is not carried out in a timely manner, the provision of indoor 3G coverage will be seriously affected after the handover of the spectrum in October 2016. This will affect mobile services at popular hotspots where data traffic is much heavier than the average, such as the MTR lines and stations, airport terminals, Hong Kong Convention and Exhibition Centre, Asia World Expo and major shopping malls.

¹⁰ The assessment on customer service degradation in terms of slow-down in the data download speed is based on an assumption of a six-fold increase in mobile data traffic between 2012 and 2016. It is also assumed that the four incumbent 3G operators as well as their customers would be willing to invest in the network infrastructure/devices with the latest technology available in the market which would in essence double the network capacity. Further details about the estimation assumptions and methodology are given in Annex 2.

26. Unlike the mobile network serving outdoor areas, which allows software-based retuning to be remotely conducted, reconfiguration of the IRS as a result of variation in frequency assignments requires hardware rework and labour-intensive on-site retuning. Moreover, reconfiguration works cannot be carried out before the existing frequency assignments expire in October 2016, if ongoing mobile services are not to be interrupted. Coupled with the complication that the IRS are not totally under the control of the incumbent 3G operators as many of the major indoor IRS are owned by the landlords of the facilities, it is likely that re-configuration of the IRS cannot be completed by the time the spectrum changes hands in October 2016. In this case, mobile data customers are expected to face severely degraded mobile services indoors. For MNOs which do not have any spectrum in the 850/900 MHz band, their customers will experience a complete loss of indoor 3G service coverage during the transitional period of two to three years.

27. As stated in paragraph 17, the Policy Framework specifies that a market-based approach in spectrum management will be used for spectrum 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. On the basis of the above analysis, *the SCED has come to the view that in light of the potentially severe and long lasting effect on service quality and reception especially in indoor areas under option 2 during the transitional period, there are overriding public policy reasons for the Government to deviate from the full-fledged market-based approach of 3G spectrum re-assignments.*

Pros and Cons of the Three Options Against the Multiple Policy Objectives in Spectrum Re-assignment

28. The concern about the potentially severe and the long lasting effect on service quality and reception especially in indoor areas does not, however, tip the balance automatically to the adoption of Option 1, viz. the offer of right of first refusal as advocated by the incumbent 3G operators, which seems to ensure a seamless transition, or Option 3, viz. the hybrid option, which by virtue of its overall design seems to mitigate to a substantial extent the public policy concerns identified under Option 2. To facilitate consideration of the way forward, OFCA has evaluated the extent to which the options may meet the objectives in spectrum re-assignment as outlined in the First Consultation Paper, as detailed in the following paragraphs.

Maintenance of Customer Service Continuity

29. As discussed in the First Consultation Paper, by October 2016, a sizable number of the 3G customers will have migrated to the 4G-long term evolution (“LTE”) services. This view is reinforced by the fact that by September 2012, all the five MNOs, including the four incumbent 3G operators, have already launched their 4G services using spectrum in the 1800 MHz and/or 2.5/2.6 GHz bands, and increasingly more 4G or multi-band handsets/tablets have become available in the market. In the migration from 2G to 3G services, the voice-only users might be reluctant to take up the 3G mobile data services because they are two distinct services. For the migration from 3G to 4G services, which are primarily data services, the latter provides much enhanced user experience. The CA believes that mobile data users will have incentive to switch from 3G to 4G services. This is particularly so when the price for the two services are more or less the same. The only additional cost to consumers would be to upgrade their mobile devices to those that are 4G capable. Besides, spectrum in the 850/900 MHz band will also contribute to maintaining continuity in the provision of 3G services.

30. From the perspective of maintaining customer service continuity, Option 1 has the obvious advantage over the other two in being able to maintain a more or less seamless transition, but it fares less well in terms of meeting the other objectives in spectrum re-assignment. Between Options 2 and Options 3, according to OFCA’s assessment (which is also the view of CSL and SmarTone), if the incumbents are offered the right of first refusal for two-thirds of the spectrum in the 1.9 – 2.2 GHz band as proposed under Option 3 in the First Consultation Paper, the disruption to customer services, if any, is expected to be much less severe than is the case under Option 2.

31. Specifically, under Option 3, at worst, each incumbent 3G operator may lose one-third of the spectrum in the 1.9 – 2.2 GHz band in the auction. In this case, OFCA estimates the degradation of customer service quality in terms of reduction in data download speed would be restricted to at most 18% on average during the transitional period, based on the same assessment methodology as described in footnote 10 and **Annex 2**. However, approximately half of the reduction is expected to occur in any case even without any change in frequency assignments, due to the strong growth in mobile data traffic envisaged. More importantly, this option will help relieve the concern about indoor mobile coverage for 3G services. Given the incumbents can hold on to two-thirds of their frequency holding in the 1.9 – 2.2 GHz band, they can continue to provide 3G services indoors using those

frequencies and the legacy IRS facilities during the transitional period, while reconfiguration works on the affected frequencies are being carried out. As a result, an acceptable level of indoor 3G mobile service coverage could be expected to be maintained at those indoor data usage hotspots such as the MTR lines and stations and the airport terminals. The impact on data service coverage along the MTR lines and stations stemming from the loss of one-third of the 3G capacity to some or all of the incumbents will also be relieved by the launch of 4G services recently, which is expected to be in full strength on seven of the nine MTR routes by early 2013. Service coverage is expected to improve further by 2016.

32. Under Option 3, it is anticipated that re-auction of the spectrum will take place in around October 2014. The affected incumbent 3G operators will know by then whether they will need to give up part of their frequency holding in the 1.9 – 2.2 GHz band, gain additional spectrum, or maintain the status quo of having 2 x 15 MHz of spectrum in the band. They will have a transitional period of around two years to, if necessary, carry out system re-planning and to prepare for customer migration.

Efficient Spectrum Utilisation, Encouragement of Investment and Promotion of Innovative Services

33. Option 1 will give effectively a status quo position in spectrum holding. As highlighted in the First Consultation Paper, the existing frequency assignments were made more than a decade ago in 2001 and the technical and application aspects of the spectrum and the mobile market have undergone phenomenal developments since then. Notwithstanding the claim by the incumbent 3G operators that they have already put the spectrum to the most efficient use, this does not preclude the possibility that the efficiency cannot be enhanced further. In this regard, it is noteworthy that HKT pointed out in its submission to the first consultation that the 3G equipment has been designed to work with 2 x 20 MHz of spectrum and that optimum LTE-Advanced services could only be offered with the availability of 2 x 20 MHz spectrum. In a similar vein, Hutchison referred to the multi-carrier High-Speed Downlink

Packet Access (“HSDPA”) technology under the 3GPP¹¹ Release 10 that required 2 x 20 MHz of contiguous spectrum to provide a peak data download speed up to 84 Mbps. It should be quite clear that Option 1, which seeks to preserve the status quo of 2 x 15 MHz spectrum holding per incumbent, would not enable HKT (and other incumbents) to provide optimum LTE-Advanced services, or enable Hutchison (and other incumbents) to achieve a peak data download speed of up to 84 Mbps. Option 1, accordingly, falls short of meeting the Government’s objective in enhancing spectral efficiency.

34. On the contrary, the opportunity to re-auction part of the 1.9 – 2.2 GHz spectrum under Option 3 will facilitate assignment of spectrum to the MNOs which value it the most and which can put it to the most efficient use. This option provides the possibilities for the incumbents to build up contiguous spectrum in excess of its existing assignment. If they are allowed to retain two-thirds of the spectrum under concern, an incumbent 3G operator will have the chance to acquire adjacent spectrum slots through the auction to attain a contiguous band of 2 x 20 MHz spectrum. This will allow the full potential of the LTE-Advanced technology to be realised, enhance spectral efficiency, and foster the development of innovative and higher speed mobile services. New entrants may obtain 2 x 5 MHz spectrum and up to 2 x 20 MHz spectrum in the 1.9 – 2.2 GHz band through competing with the incumbent 3G operators in auction. It is envisaged that a wide range of innovative and advanced mobile services will be made available to the community by the incumbents and the new entrants, which cannot be achieved without introducing changes to the existing 3G frequency assignments. Option 1 would thus be less conducive to the development of a wide range of innovative and advanced mobile services when compared with Option 3. While Option 2 can be seen to be able to achieve also the potential benefits as outlined above as under Option 3, the downsides of the highly uncertain outcome of the auction exercise on the eventual spectrum assignment and its impact on different fronts should be given due regard in the overall balance of the pros and cons analysis.

35. In regard to encouragement of investment, the incumbent 3G operators opined that only Option 1 would provide the necessary regulatory

¹¹ Third Generation Partnership Project (“3GPP”) is an international collaboration of groups of telecommunications associations, including the Association of Radio Industries and Businesses (“ARIB”) of Japan, the Alliance for Telecommunications Industry Solutions (“ATIS”) of the USA, China Communications Standards Association (“CCSA”), European Telecommunications Standards Institute (“ETSI”), Telecommunications Technology Association (“TTA”) of Korea, and Telecommunication Technology Committee (“TTC”) of Japan. 3GPP produces technical specifications for 2G, 3G and 4G wireless communications technologies.

certainty for them to continue to invest in their network. The CA notes that they have invested in different system upgrades over the years for higher capacity and transmission speed in order to support the robust growth in mobile data usage by customers. It is agreed that uncertainty in the few years towards the end of the existing term of 3G frequency assignments may affect the investment incentive of some of the incumbents. Nevertheless, the CA considers that Option 3 will be able to alleviate the concern about regulatory certainty, particularly if the incumbents are notified sufficiently in advance (at least three years in advance on a best endeavour basis arising from the Policy Framework) that they will have the opportunity to retain two-thirds of their original frequency holding. Under this proposed arrangement, the incumbents will have the necessary incentive to continue to invest during and beyond the transitional period because their holding of a minimum of 2 x 10 MHz of the contiguous spectrum in the 1.9 – 2.2 GHz band *post 2016* will enable them to maintain to a significant extent the current service level of their 3G services, including the capability to support the current peak data download speed of 42 Mbps. New investments will come from the aggregation of the 1.9 – 2.2 GHz spectrum with spectrum in the other frequency bands, which is possible under 3GPP Release 9 and beyond. Besides, Option 3 itself will also encourage investment in the mobile network by both the incumbents and the new entrants, through their acquisition of spectrum in the auction.

36. Investment in the mobile network is a function of many factors. Even if some incumbents turn out to be unable to acquire any 1.9 – 2.2 GHz spectrum in the auction, they are expected to have an even greater incentive and in fact great commercial need to invest in the network in order to compensate for the loss of spectrum capacity, so long if they want to maintain the quality of services and remain competitive in the market. The development of new technologies and services will also stimulate investment. The new spectrum assignees, be they the incumbents or the new entrants, will also bring in investment to roll out the newly acquired spectrum and to provide innovative services.

Promotion of Effective Competition

37. The respondents pointed out that the market for mobile services in Hong Kong is already one of the most competitive in the world, with five MNOs serving a population of over seven million. The CA agrees with that but reasonably believes that Option 3 will equally (if not more likely) bring about innovative services and new business paradigms, leading to an even more competitive market with wider product choices for consumers. The

Government does not have in mind an optimum or a pre-set number of 3G mobile service licensees that should operate in the market, and the number of 3G operators may or may not change after the auction. However, the ability to acquire additional spectrum under Option 3 will provide an opportunity for the incumbents to obtain their desired amount of frequency holding in the 1.9 – 2.2 GHz band, taking into account their different profiles of frequency holding in different bands. By optimising their level of spectrum holding in the 1.9 – 2.2 GHz band under Option 3, the incumbents should be able to compete more efficiently with their counterparts in service provision to the benefits of consumers. Not to mention that Option 3 will also provide the opportunity for new entrants to enter the market. All these would bring about enhanced competition. In contrast, Option 1 can give only the status quo position.

38. In the submissions, the incumbent 3G operators and the non-incumbent held divergent views as to whether the MVNO arrangements was an effective substitute for re-auctioning of the 3G spectrum. The MVNO arrangement is a commercial means for licensees holding spectrum to provide network capacity to service providers if the concerned spectrum assignees possess spare network capacity. While this arrangement will enhance competition in the mobile market, MVNOs should not be deprived of the opportunity to acquire spectrum themselves if they do hold a carrier licence.

39. On the basis of the foregoing discussion, *the SCED considers that while there is a need to maintain customer service continuity when the current frequency assignments in the 1.9 – 2.2 GHz band expire in October 2016, there is insufficient justification for the Government to adopt Option 1 (i.e. to offer the right of first refusal to the incumbent 3G operators for all their existing frequency assignments in that band)*. Compared with Option 1, Option 3, apart from enabling an acceptable level of customer service continuity, is also more superior in enhancing spectral efficiency, encouraging investment and the introduction of innovative services. This will stimulate further competition in the mobile market. Also, Option 3 will provide an opportunity for new comers to enter the market, and for the incumbents and interested parties alike to seek to obtain their desired amount of frequency holding in the 1.9 – 2.2 GHz band through a market mechanism. *Thus the SCED concludes that Option 3, a hybrid of administratively-assigned and market-based approach, should be adopted for further consultation with the industry and interested parties.*

Spectrum Utilisation Fees

40. As mentioned in paragraph 11 above, two incumbent 3G operators argued that the spectrum should be re-assigned to them at zero or minimal cost. The SCED finds such a proposition totally unacceptable. A level of SUF that reflects the full market value of the spectrum is important in ensuring that the scarce spectrum resource is put in the hands of the operators which value it the most and which will put it to the most productive use. This is ideally obtained through the operation of a market mechanism which is free from distortion of any kind. To cater for the assignment of frequency spectrum administratively through the right of first refusal under Option 3, methods have to be devised to set the SUF of the RFR Spectrum. Four methods were proposed in the First Consultation Paper. Views of the SCED on the submissions received on the matter are set out in the following paragraphs.

41. The SCED agreed that the mock auction method proposed for setting the SUF of the RFR Spectrum under Option 1 has its drawbacks. As this would not be a genuine auction, bidders which are not incumbent 3G operators will have every incentive to push the SUF to an unreasonably high level, forcing the incumbent 3G operators to pay that amount if they want to exercise the right of first refusal to acquire the spectrum. In another extreme, there may not be bidders other than the incumbents joining the mock auction as no one will be able to obtain the spectrum once the incumbents exercise their right of first refusal. In this case, the auction will conceivably end at the first round of bidding and the objective of holding an auction in the first place (i.e. to discover the market price of the RFR Spectrum) will not be achieved.

42. As to the LCA method, it is considered subjective as the estimation results would necessarily be influenced by numerous assumptions relating to technology and traffic growth, etc. Nevertheless this method has been adopted for calculating the SUF of the fixed links, electronic news gathering/outside broadcasting links and satellite links, because there is no relevant market benchmark that can provide useful references for setting the SUF of the spectrum in these frequency bands. In the case of the frequency spectrum in the 1.9 – 2.2 GHz band, there are a number of past auction outcomes that can provide the references. If Option 3 is eventually adopted, the auction to be conducted for the Re-auctioned Spectrum will be the most relevant benchmark for reference. There is also the concern that when there are competing demands for the spectrum, like that in the 1.9 – 2.2 GHz band, the LCA method will likely underestimate the value of the spectrum, as it captures only the technical

value of the spectrum, but not its commercial and strategic value as can be reflected by the market mechanism.

43. The market benchmark approach has the support of the incumbent 3G operators. However, the levels of past auction benchmarks that they advocated are rather selective and serve more the interests of the incumbents. For example, the SUF adopted for re-assigning the 900 MHz and 1800 MHz spectrum in 2004, as proposed by the incumbent operators as a relevant benchmark, is less than one-tenth of the flat rate SUF of the 3G spectrum levied for each of the first five years of the current 15-year licence period and is thus on the low side. On the other hand, there is no reason to exclude the high level of SUF as determined by the auction of the 850/900 MHz spectrum in March 2011 as per the incumbents' proposal, given the spectrum has been deployed immediately for the provision of 3G services, meaning that this frequency band is closely akin to the 1.9 – 2.2 GHz band the re-assignment arrangement of which is currently under review.

44. The other method is to benchmark the SUF of the RFR Spectrum with the SUF of the Re-auctioned Spectrum under Option 3. The merits are that all the parties assigned with the spectrum in the 1.9 – 2.2 GHz band will pay the same SUF, and that the SUF will reflect the full market value of the spectrum provided the auction is well structured. While CMHK supported this method, the incumbents found this a risky and harsh arrangement as they would need to decide whether to exercise the right of first refusal before knowing the actual amount of SUF to be paid. The concern of the incumbents is noted.

45. In view of the above, *the SCED would like to propose on the basis of the market-based mechanism two other methods for determining the SUF of the RFR Spectrum in the next section for further consultation with the industry and interested parties.*

A SPECTRUM RE-ASSIGNMENT FRAMEWORK FOR FURTHER CONSULTATION

46. Under Option 3, the incumbent 3G operators will be offered the right of first refusal to acquire part of the spectrum subject to their payment of the SUF to be specified by the SCED, while the remaining spectrum will be returned to the CA and pooled together for an open auction. Detailed arrangements for taking forward Option 3 are proposed below for further consultation with the industry and interested parties.

Amount of RFR Spectrum And Re-auctioned Spectrum

47. From the point of view of efficient spectrum utilisation, it was proposed in the First Consultation Paper that, if Option 3 was adopted, each of the four incumbent 3G operators would be offered the right of first refusal for a contiguous block of 2 x 10 MHz spectrum from its original frequency holding in the 1.9 – 2.2 GHz band. The proposal received the support of CSL, although Option 3 is not its preferred option. *Taking into account the important objective of maintaining customer service continuity after October 2016, the SCED and the CA maintain their proposal that each of the four incumbent 3G operators will be offered the right of first refusal for two-thirds of their existing frequency holding in the 1.9 – 2.2 GHz band, if Option 3 is eventually adopted as the method for re-assignment of spectrum post October 2016.*

48. If each of the four incumbents exercises the right of first refusal to acquire 2 x 10 MHz of the spectrum in the 1.9 – 2.2 GHz band, a total of 2 x 20 MHz spectrum in the band can be made available for auction. This amount of Re-auctioned Spectrum will be sufficient to support a new operator rolling out a territory-wide network. If any incumbent 3G operator decides not to exercise the right of first refusal, the spectrum it is going to relinquish will be pooled together with the Re-auctioned Spectrum and put to auction.

Proposed Band Plan for Spectrum Re-assignment

49. In regard to the location of individual spectrum slots to be put out for re-auction, the CA indicated three possible options in the First Consultation Paper, i.e. (a) voluntary submission by each incumbent 3G operator; (b) a random pick by the CA from each of the incumbent 3G operators' portfolio; or (c) the CA to draw up a band plan delineating where the RFR Spectrum and the Re-auctioned Spectrum would exactly lie. It also indicated a preliminary

preference for option (c) so that it may create two contiguous spectrum slots of 2 x 10 MHz each for the subsequent auction. CMHK and CSL supported the CA to draw up such a band plan, while other respondents did not have specific comments on the matter.

50. Concerning contiguous spectrum, the CA takes note of the roadmap releases –

In terms of HSPA technology

- In release 8, DC-HSPA+ system could aggregate two adjacent carriers (i.e. two adjacent slots of the spectrum in the 1.9 – 2.2 GHz band) to deliver a peak downlink data rate at 42 Mbps;
- In release 9, paired cells can operate on two non-adjacent carriers/slots¹², delivering a downlink data rate up to 84 Mbps together with multiple-input and multiple-output (“MIMO”) technology;
- In release 10 and beyond, aggregation of four (or more) carriers¹³ would achieve a peak downlink data rate at 168 Mbps (4C-HSPA+) with MIMO; and

In terms of LTE-Advanced (3GPP LTE release 10 and beyond)

- Contrast with HSPA technology (where each aggregated carrier is of 5 MHz bandwidth), carriers for LTE-Advanced (known as component carriers in 3GPP terminology) can have various bandwidths of 1.4, 3, 5, 10, 15 or 20 MHz in downlink/uplink, and a maximum of five component carriers can be aggregated

¹² According to 3GPP TS 25.101, dual-band DC-HSPA+ can be operated in Hong Kong using spectrum in frequency bands of (a) 1.9 - 2.2 GHz (Band 1) and 900 MHz (Band 8); and (b) Band 1 and 850 MHz (Band 5).

¹³ Under 3GPP release 10, 4C-HSPA+ can be operated in (a) single-band using three carriers in 1.9 - 2.2 GHz (Band 1) or (b) dual-band using three to four carriers from Band 1 and 900 MHz (Band 8) or Band 1 and 850 MHz (Band 5). Under 3GPP release 11, single-band 8C-HSPA+ and single-band non-contiguous 4C-HSPA+ configurations are also supported.

- resulting in a maximum bandwidth of 100 MHz¹⁴ in either downlink/uplink or both. LTE-Advanced is envisaged to deliver a peak data rate of up to approximately 100 Mbps for high mobility and up to 1 Gbps for low mobility.¹⁵

51. As can be seen from the above, 20 MHz is the maximum contiguous bandwidth of a downlink/uplink component carrier defined under 3GPP release 8 and onwards for the LTE and LTE-Advanced technologies. While 3G (HSPA-based) services may continue to exist in the market after October 2016, as the technology becomes more mature, it will be a natural step for the MNOs, similar to the case of the 1800 MHz band at the present juncture, to refarm part or all of the spectrum in the 1.9 – 2.2 GHz band for LTE/LTE-Advanced services. In that case, a contiguous spectrum slot of up to 20 MHz will be able to realise the full potential of the LTE-Advanced technology, enhance spectral efficiency, as well as foster the development of innovative and even higher speed mobile services in Hong Kong.

52. In the light of the above considerations, *the CA puts forth a proposed band plan for re-assignment of the spectrum in the 1.9 – 2.2 GHz band as depicted in Figure 1 below –*

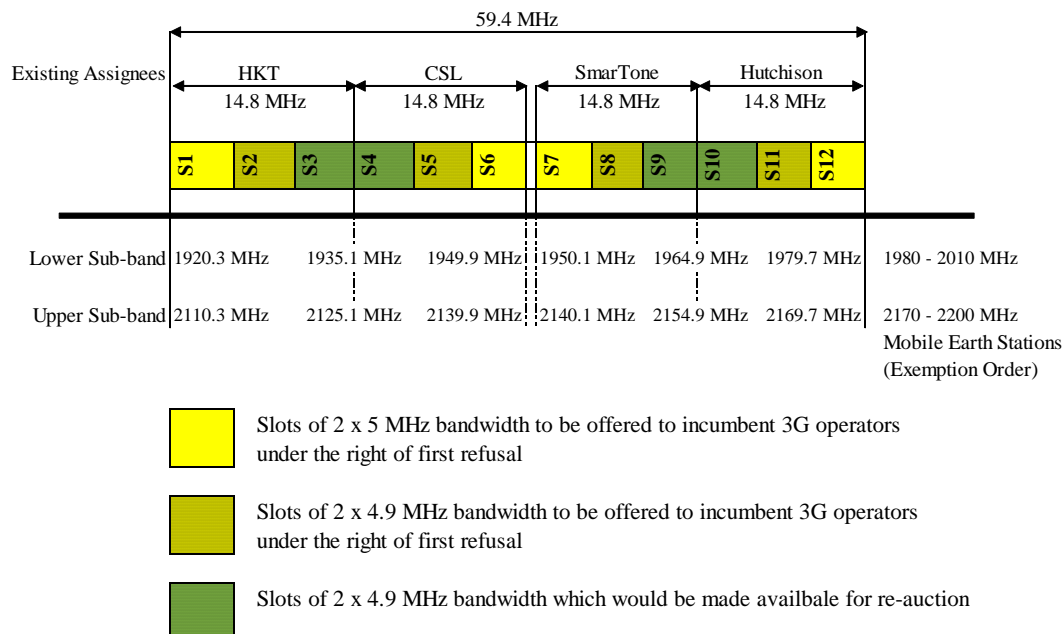


Figure 1 – Proposed Band Plan for Re-assignment of the Frequency Spectrum in the 1.9 - 2.2 GHz Band

¹⁴ See <http://www.3gpp.org/Carrier-Aggregation-explained>. According to 3GPP TR 36.808, carrier aggregation is supported under 3GPP LTE release 10 using (a) intra-band contiguous component carriers in 1.9 - 2.2 GHz (Band 1) or 2.3 GHz (Band 40); or (b) inter-band non-contiguous component carriers from Band 1 and 850 MHz (Band 5). More configurations are being defined in release 11 and beyond.

¹⁵ See <http://lte-world.org/wiki/lte-advanced>.

53. Under the proposed band plan, the individual frequency slots to be re-auctioned will not be scattered around the 1.9 – 2.2 GHz band, as may be the case if the exact Re-auctioned Spectrum to be returned by the incumbent 3G operators is proposed at their sole discretion. Rather, they can be aggregated as far as practical so that new spectrum assignees, be they the incumbent 3G operators or new entrants, can benefit from having a contiguous spectrum block of up to 2 x 10 MHz (in the case of new entrants) or up to 2 x 20 MHz (in the case of the incumbent 3G operators). As mentioned in paragraphs 50 and 51, in view of the efficiency gain provided by contiguous bandwidth using new technology, there is clear incentive for an incumbent 3G operator or a new entrant to acquire spectrum in blocks of 2 x 5 MHz and up to 2 x 20 MHz in total.¹⁶

54. Under this proposed arrangement, the four specific spectrum slots will be auctioned simultaneously. In the case of the incumbents, they may bid for the re-auctioned spectrum block assigned to them under the existing term of assignment and for the adjacent block, if they want to build up a contiguous block of 2 x 20 MHz of spectrum in the 1.9 – 2.2 GHz band. Therefore, the value of the four frequency slots proposed to be put out for auction will command different values to different bidders. The SUF of each frequency slot will be determined by the market through the bidding process. In order to ensure the derivation of the full market value of the spectrum, the CA will put in place a restriction that successful bidders will not be allowed to swap their holding of Slots 3, 4, 9 and 10, at least in the first five years of the spectrum assignment period.

Question 1: Do you agree that Slots 3, 4, 9, and 10 in the 1.9 – 2.2 GHz frequency band as depicted in Figure 1 should be put out for re-auction?

SUF of the Re-auctioned Spectrum

55. The SUF of the Re-auctioned Spectrum will be determined by auction.

¹⁶ As the maximum contiguous bandwidth of a component carrier is 2 x 20 MHz and in view of a strong competing demand for the spectrum in the 1.9 - 2.2 GHz band, it is neither technically necessary nor cost-effective for an operator to acquire a contiguous spectrum of more than 2 x 20 MHz (say 2 x 25 MHz).

SUF of the RFR Spectrum

56. As discussed in paragraph 44, the incumbent 3G operators' concern about the risk of committing to an unknown level of SUF by tying the SUF of the RFR Spectrum to the spectrum re-auction outcome is noted. It is however the duty of the Government to ensure that the SUF of the RFR Spectrum and that of the Re-auctioned Spectrum will as far as possible reflect the full market value of the spectrum. Guided by the Policy Framework, the SCED is minded to rely on the market-based mechanism as far as possible to derive the SUF for the RFR Spectrum, and accordingly proposes the following arrangements for further consultation.

57. As the First Method under consultation, it is proposed that reference should first be made to the annual royalty payment payable by the incumbent 3G operators for the right to use the spectrum in the 1.9 – 2.2 GHz band in 2015/16. This is the SUF that the incumbents will have to pay for the usage of the spectrum in the last year of the current 15-year licence period. ***The SUF of the RFR Spectrum is proposed to be set on the basis of the royalty payment for the 3G spectrum in 2015/16 or the level of SUF as determined by auction for the Re-auctioned Spectrum, whichever is the higher.*** Under this method, though the incumbents cannot be certain about the amount of SUF they have to pay eventually for the RFR Spectrum, they would have a general idea about the minimum or, as the case may be, the maximum amount of SUF payable and could prepare for their budget accordingly.

58. To further elaborate, according to Schedule 10 of the Unified Carrier Licence held by the four incumbent 3G operators, each incumbent will pay \$151 million for usage of the spectrum the 1.9 – 2.2 GHz band in 2015/16 alone, which is equivalent to \$5.1 million per MHz of the spectrum used. The value of the frequency spectrum is expected to increase over time amidst the sustained robust growth in mobile data traffic. Therefore, the SCED considers it more than reasonable that the relevant spectrum should fetch a level of SUF which is equal at least to the level calculated on the basis of the annual royalty payment to be made in 2015/16. On this basis, the SUF of the RFR Spectrum should stand at a minimum of \$77 million per MHz, covering the entire new licence period of 15 years. ***In order to reflect the full market value of the spectrum, the SUF of the RFR Spectrum is proposed to be set at \$77 million per MHz or the SUF of the Re-auctioned Spectrum as determined by auction, whichever is the higher.***

59. As the Second Method under consultation, *it is proposed to set the SUF of the RFR Spectrum at the average of the weighted average of the relevant past market benchmarks and the SUF of the Re-auctioned Spectrum as determined by auction.* The relevant past market benchmarks to be considered include a SUF calculated on the basis of the annual royalty payment for the 3G spectrum in 2015/16 under the existing assignments, the SUF of the broadband wireless access spectrum and the 850/900 MHz spectrum as determined by the auctions conducted in January 2009 and March 2011 respectively. The SUF of the broadband wireless access spectrum and spectrum in the 850/900 MHz spectrum are chosen as relevant references because both sets of spectrum are deployed for the provision of data services with mature technology support. *It should be made clear that under this Second Method, account would not be taken of the SUF in the upcoming auction of the spectrum in the 2.5/2.6 GHz band scheduled to be held in March 2013. This is to prevent any strategic bidding behaviour from distorting the outcome of the 2013 auction.* Accordingly, taking into account the increase in the value of the spectrum over time¹⁷ and with a greater weight attached to SUF of the 850/900 MHz spectrum, given this is the most recently established SUF for a frequency band and the fact that it is closely akin to the spectrum under concern, the weighted average of the past market benchmarks would amount to around \$80 million per MHz.

60. Under this method, after the SUF of the Re-auctioned Spectrum is known from auction, the SUF of the RFR Spectrum per MHz will be calculated as the average between \$80 million (the weighted average of the relevant past market benchmarks) and the SUF of the Re-auctioned Spectrum. This means that the incumbents will have partial information about the SUF of the RFR Spectrum as it is linked to the weighted average of the past market benchmarks. The uncertainty to them is nevertheless reduced compared with the method proposed in the First Consultation Paper of tying only with the SUF the Re-auctioned Spectrum as determined by auction. If it turns out that the SUF of the Re-auctioned Spectrum is higher than the weighted average of the past market benchmarks, the SUF to be paid for the RFR Spectrum by the incumbents will be lower than the SUF to be paid for the Re-auctioned Spectrum.

¹⁷ There is no precise method to measure the increase in the value of spectrum over time, but the level of SUF as determined by the auctions of paired spectrum in the past confirm that it has been on an upward trend. Therefore, the projected increase in the consumer price level up to 2016 (i.e. 3.5% per annum according to the Medium Range Forecast of the increase in the Composite Consumer Price Index as detailed in the Appendices to the 2012-13 Budget) has been adopted as a conservative proxy for lifting the value of the spectrum over time.

Question 2: What are your views on setting the SUF of the RFR Spectrum in accordance with the market-based mechanism as proposed in the First and the Second Methods for consultation as outlined in paragraphs 56 - 60 above?

Auction Design

61. On the basis of the above two methods proposed for setting the SUF of the RFR Spectrum, the SUF to be payable for the RFR Spectrum is tied to a different extent to the outcome of the re-auction of the spectrum in the 1.9 – 2.2 GHz band. Therefore, the auction has to be designed in such a way to avoid any gaming or distortion. This applies mainly to the setting of the auction reserve price to be discussed below.

Eligible Bidders

62. Incumbent 3G operators, irrespective of whether or not they have exercised the right of first refusal to acquire the 2 x 10 MHz of RFR Spectrum, can participate in the auction to compete with the other bidders. MNO without spectrum holding in the 1.9 – 2.2 GHz band and other interested parties are also eligible to participate in the auction. ***Effectively, all interested parties are welcomed to join the spectrum re-auction to be conducted.***

Question 3: Do you agree that the Re-auctioned Spectrum should be open for bidding by all interested parties, including the incumbent 3G operators?

Auction Reserve Price

63. The two methods proposed in paragraphs 56 – 60 for setting the SUF of the RFR Spectrum are both tied to the outcome of the auction of the Re-auctioned Spectrum. This means that the SUF as determined by auction of the Re-auctioned Spectrum will have direct implication on the SUF payable by the incumbent 3G operators for the RFR Spectrum. It is plausible that some of the incumbents may have the incentive to strategically adjust their demand for the Re-auctioned Spectrum or not to join the bidding at all, if the gain to be expected from paying less for the RFR Spectrum will outweigh the loss from obtaining less or none of the Re-auctioned Spectrum. In this case, the auction outcome will be distorted and the resultant SUF will not be able to reflect the true market value of the spectrum. Therefore, ***the SCED considers that the***

auction reserve price has to be set at a level which is indicative of the true minimum value of the Re-auctioned Spectrum. This is to be pitched at a level that will be significantly higher than the reserve price set for all the spectrum auctions in the past.

Question 4: What are your views on setting the auction reserve price at a relatively high level in order to forestall bid shading behaviour?

Auction Format

64. *It is proposed that the Re-auctioned Spectrum be assigned by way of a single auction using Simultaneous Multi-Round Ascending (“SMRA”) format.* Under this format, all four spectrum slots (i.e. slots s3, s4, s9 and s10 in [Figure 1](#)) will be auctioned simultaneously over multiple rounds with price changing on each spectrum slot independently. Bidders may bid for one or more slots, or all of them. Bidders may also switch their bids among slots from round to round, and withdraw highest bid submitted in the immediately preceding round subject to a potential withdrawal liability. The SMRA auction format has been adopted by the CA in the upcoming auction to be conducted in March 2013 for spectrum in the 2.5/2.6 GHz band, and by the former TA in a number of previous radio spectrum auctions in Hong Kong. The industry is familiar with this auction format.

Question 5: Do you have any views on the proposed SMRA auction format?

Spectrum Cap

65. Under Option 3, a total of 2 x 20 MHz¹⁸ of spectrum in the 1.9 – 2.2 GHz band will be available for re-auction, if all the incumbent 3G operators will exercise their right of first refusal to acquire two-thirds of their original frequency holding in the band. With this amount of spectrum for auction, the imposition of a spectrum cap is not recommended. Before the auction of the frequency spectrum in the 2.5/2.6 GHz band in March 2013, a total of 532 MHz¹⁹ of spectrum has been assigned for the provision of mobile services. The

¹⁸ According to the band plan as proposed in paragraph 52, the exact quantity of spectrum in the 1.9 – 2.2 GHz band to be put out for re-auction will amount to 39.2 MHz, comprising four slots of 2 x 4.9 MHz each from the original holding of the incumbent 3G operators.

¹⁹ This includes 442 MHz (2 x 221 MHz) of paired spectrum in the 800 MHz (for CDMA 2000), 850/900 MHz, 1800 MHz, 1.9 – 2.2 GHz, and 2.5/2.6 GHz bands, and 90 MHz of unpaired spectrum in the 2.3 GHz band.

40 MHz of spectrum to be re-auctioned will amount to 7.5% of the total spectrum available. Even if all the 40 MHz of spectrum is going to be acquired by the MNO which possesses the largest amount of spectrum, it will only raise its share of spectrum holding in the total by six percentage points to 29% and the next largest spectrum holder will have 21%. This is unlikely to exert much impact on the competition landscape of the Hong Kong mobile market.

66. However, if it turns out in the unlikely situation that two or more of the incumbent operators decide not to exercise the right to take up the RFR Spectrum, at least 80 MHz²⁰ of the spectrum in the 1.9 – 2.2 GHz band will be available for the re-auction. In this case, the CA would like to propose a spectrum cap of 40 MHz of spectrum. This means that the incumbents that have exercised their right of first refusal to retain the RFR Spectrum of 2 x 10 MHz will be allowed to bid for at most 2 x 10 MHz of the Re-auctioned Spectrum. Meanwhile, as discussed in paragraph 48 above, the acquisition of 2 x 20 MHz of the relevant spectrum by a new entrant will be sufficient for it to roll out a new territory-wide network. The CA notes that by setting the spectrum cap at this level, it is possible that the number of operators operating in the 1.9 – 2.2 GHz band may be reduced from four to three. This however should not be a concern because unlike the situation in 2001, the level of competition in the current mobile market is not directly related to the number of operators holding spectrum in this band, as there is spectrum in the 850/900 MHz band supporting the provision of 3G services, and also spectrum in the other frequency bands capable of providing 4G services.

Question 6: Do you agree that there should be no spectrum cap imposed if all the incumbent 3G operators exercise the right of first refusal to acquire two-thirds of their original frequency holding and 2 x 20 MHz of spectrum will be put out for re-auction?

Question 7: Do you agree that a spectrum cap should be imposed if the amount of spectrum to be put out for re-auction amounts to 2 x 40 MHz or more with some of the incumbent 3G operators deciding not to exercise the right of first refusal?

²⁰ According to the band plan as proposed in paragraph 52, the exact quantity of spectrum in the 1.9 – 2.2 GHz band to be put out for re-auction will amount to at least 78.8 MHz in this case.

ARRANGEMENTS FOR THE UNPAIRED SPECTRUM

67. It was proposed in the First Consultation Paper that the 20 MHz of unpaired spectrum in the 1905 – 1920 MHz and 2020 – 2025 MHz bands would be put back to reserve as it has been left idle ever since its assignment in 2001. The incumbents were generally in support of the proposal, except HKT, which suggested re-assignment of this unpaired spectrum to the incumbents along with the paired spectrum. The reason is that it envisaged the carrier aggregation technology defined under LTE-Advanced in the 3GPP standard in 2015/16 would be ready to facilitate aggregation of the 5 MHz unpaired spectrum blocks with the paired spectrum to provide additional capacity on the downlink.

68. The CA notes the aggregation of unpaired and paired spectrum being prepared for application by some MNOs, but this applies to the spectrum in the 2.3 GHz and 2.5/2.6 GHz bands only. It is understood that the unpaired spectrum in the 1.9 – 2.2 GHz band currently held by the incumbents is not yet a priority band for application in the near future. *Therefore, the CA maintains its position in the First Consultation Paper that the 20 MHz of unpaired spectrum will be put back to reserve.*

WAY FORWARD

69. The SCED and the CA will carefully consider the views and comments received in response to the Second Consultation Paper. Taking into account the experience in the first consultation exercise, the SCED and CA will request the co-operation of the respondents to send in their submissions timely within the deadline set. With the above, the SCED and the CA will in so far as it is practicable endeavour to announce the decision on how the frequency spectrum in the 1.9 – 2.2 GHz band should be re-assigned by October 2013 at the latest, thereby giving a three years' advance notice to the incumbent 3G operators on any possible variation to their frequency assignments in the 1.9 – 2.2 GHz band.

70. After the announcement of the decision, OFCA will prepare for the amendment of the relevant subsidiary legislation and enactment of new subsidiary legislation to facilitate re-assignment of the frequency spectrum in the 1.9 – 2.2 GHz band. If the decision is to re-auction part of the spectrum as currently proposed, OFCA will make the necessary preparations so that the auction can be conducted by October 2014. This will allow a transitional period of two years for the incumbent operators to prepare for the handover of the spectrum, if applicable, and for the new spectrum assignees to prepare for the roll-out of the network using the newly acquired spectrum.

**Commerce and Economic Development Bureau
(Communications and Technology Branch) and
Office of the Communications Authority
28 December 2012**

**Arrangements for the Frequency Spectrum in the 1.9 – 2.2 GHz Band
upon Expiry of the Existing Frequency Assignments
for 3G Mobile Services**

**Summary of Submissions to the First Consultation Paper
And the Responses of the Administration**

The First Consultation Paper proposed three options for re-assignment of the frequency spectrum in the 1.9 – 2.2 GHz band upon expiry of the existing frequency assignments. The views and comments of the respondents to the Questions raised therein and the response of the SCED and the CA (hereinafter referred to as “the Administration”) are summarised in the following paragraphs.

Option 1: An Administratively-Assigned Approach – Right of First Refusal to Be Offered to the Incumbent 3G Operators

Question 1: Given there is clear indication of competing demand for the 3G spectrum, are there good public policy reasons for the CA to adopt Option 1, instead of the market-based approach as stipulated in the Policy Framework, when the current 3G frequency assignments expire in October 2016?

Views and Comments of the Respondents

2. All the incumbent 3G operators, i.e. CSL, HKT, Hutchison and SmarTone, regarded the public interest grounds considered in re-assigning the 900 MHz and 1800 MHz spectrum to the incumbent licensees through right of first refusal in 2004 as providing good public policy reasons for the Administration to adopt Option 1 instead of the market-based approach in re-assigning the frequency spectrum in the 1.9 – 2.2 GHz band. These include the assurance of customer service continuity, provision of a stable investment environment, efficient use of the frequency spectrum, and continuous investments and improvements to the network. The incumbents emphasized that these were also consistent with the objectives in spectrum re-assignment as mentioned in the First Consultation Paper. NSN, Huawei and Top Express

likewise focused on continuous investment and customer service continuity in their support for Option 1. HKT, Hutchison and SmarTone also referred to Section 4 of the Communications Authority Ordinance (Cap. 616) (“CAO”), and CSL and HKT to the mission of the Commerce and Economic Development Bureau in their support for Option 1, as they considered only this option would create an environment that facilitated investment and innovation to the benefits of consumers.

3. CMHK’s response is that there was no good public policy reason justifying the adoption of Option 1. It argued that, according to the Policy Framework, there could indeed be the possibility of frequency assignments not being renewed upon expiry and hence disruption to customer services should not be a valid reason for the CA to adopt Option 1. Further, CMHK opined that spectrum was a scarce resource with competing demands but Option 1 precluded new players from making more efficient use of it. In its submission, CMHK cited Article 118 of the Basic Law, that “*the Government of the Hong Kong Special Administrative Region shall provide an economic and legal environment for encouraging investments, technological progress and the development of new industries.*”, in making its point that depriving an interested party of the chance to bid for the spectrum (and thereafter investment) is a clear violation of the above article in that the environment so created does not encourage investments or technological progress. CMHK argued that it is the major mission and task of CA to create a level playing field so that all interested parties can compete for the concerned spectrum.

The Administration’s Response

4. When the former TA took the decision in 2004 to re-assign the 900 MHz and 1800 MHz spectrum to the incumbent licensees through the right of first refusal, the Policy Framework had not been formulated by the Government then. Following the conduct of a public consultation in 2006, the Government promulgated the Policy Framework in April 2007, specifying inter-alia the spectrum policy objectives and the guiding principles in spectrum management. According to the Policy Framework, a market-based approach in spectrum management will be used wherever the CA considers that there are likely to be competing demands for the spectrum from providers of non-Government services, unless there are overriding public policy reasons to do otherwise. Guided by the Policy framework, the Administration has conducted a thorough assessment on whether there are competing demands for the spectrum in the 1.9 – 2.2 GHz band. The Administration has also considered carefully whether there are overriding public policy reasons for it to deviate from the market-

based approach in re-assigning the spectrum upon expiry of the existing assignments for 3G mobile services in October 2016. These are discussed in paragraphs 18 – 19 and 22 – 27 of the Second Consultation Paper.

5. As explained in paragraphs 22 – 27 of the Second Consultation Paper, *the SCED has come to the view that in light of the potentially severe and long lasting effect on service quality and reception especially in indoor areas under Option 2 during the transitional period, there are overriding public policy reasons for the Government to deviate from the full-fledged market-based approach in re-assigning the spectrum in the 1.9 – 2.2 GHz band.* The concerns relate primarily to degradation of customer service quality in terms of decrease in the data download speed, increase in the number of drop calls, and weakening or even a complete loss of indoor coverage for 3G mobile services. These concerns however do not tip the balance automatically to the adoption of Option 1, viz. the offer of right of first refusal as advocated by the incumbent 3G operators, which seems to ensure a seamless transition, or Option 3, viz. the hybrid option, which by virtue of its overall design seems to mitigate to a substantial extent the public policy concerns identified under Option 2. To facilitate consideration of the way forward, OFCA has evaluated the extent to which the options may meet the objectives in spectrum re-assignment as outlined in the First Consultation Paper.

6. On the basis of the discussion set out in paragraphs 22 – 39 of the Second Consultation Paper, *the SCED considers that while there is a need to maintain customer service continuity when the current frequency assignments in the 1.9 – 2.2 GHz band expire in October 2016, there is insufficient justification for the Government to adopt Option 1 (i.e. to offer the right of first refusal to the incumbent 3G operators for all their existing frequency assignments in that band).* Compared with Option 1, Option 3 enables an acceptable level of customer service continuity and is also more superior in enhancing spectral efficiency, encouraging investment and the introduction of innovative services. This will stimulate further competition in the mobile market. Also, Option 3 will provide an opportunity for new comers to enter the market, and for the incumbents and interested parties alike to seek to obtain their desired amount of frequency holding in the 1.9 – 2.2 GHz band through a market mechanism. *The SCED is of the view that Option 3 complies with Article 118 of the Basic Law since CMHK, similar to other parties who are interested in investing in radiocommunications services, would be given the opportunity to acquire the spectrum in the 1.9 – 2.2 GHz band through a market mechanism. This will foster an environment which is conducive to encouraging innovation and investment in the communications*

market as laid down in section 4(4) of the CAO. Thus the SCED concludes that Option 3, a hybrid of administratively-assigned and market-based approach, should be adopted for further consultation with the industry and interested parties in the Second Consultation Paper.

Question 2: *In offering the right of first refusal to the incumbent 3G operators to acquire the 1.9 – 2.2 GHz spectrum under Option 1, what would be the preferred method for setting the SUF so that it may reflect the full market value of the spectrum?*

Views and Comments of the Respondents

7. On the SUF of the spectrum assigned administratively under Option 1, CSL and SmarTone accepted that full market valuation of the spectrum was one of the considerations, but they also pointed to the needs to provide the incentive for investment by the incumbents and to cater for consumer welfare. CSL and HKT regarded the LCA method that estimated the opportunity cost of using the spectrum as subjective and difficult to administer as it depended on a host of assumptions concerning network configuration, evolution of technology, and projected growth in mobile traffic, etc. CSL was of the view that the SUF should be set below the opportunity cost due to the risk associated with spectrum acquisition in contrast to gradual network upgrade. CSL and HKT also did not prefer the conduct of an auction under Option 1 as the incumbents could be forced to pay an unreasonably high price to obtain the spectrum through right of first refusal. Meanwhile, CSL, HKT and SmarTone all favoured the market benchmarking method based on past auction outcomes, with the SUF of the 2G spectrum, average of the SUF of the 2.3 GHz and 2.5/2.6 GHz spectrum, and average of all past auction outcomes after taking out the highest and lowest outcomes proposed as the relevant past market benchmarks. The other suggestion by HKT and Hutchison was to set a zero or minimal SUF in order to save resources for the industry and to benefit consumers. Yet CMHK emphasized on reflecting the true market situation in setting the SUF of the administratively-assigned spectrum and considered auction to be the preferred method.

The Administration's Response

8. The Administration's response to the respondents' views on setting of the SUF of the spectrum assigned administratively are set out in paragraphs 40 – 45 of the Second Consultation Paper. In general, a level of SUF that

reflects the full market value of the spectrum has the vital function of ensuring that the scarce spectrum resource is put to the most productive uses. It is agreed that the conduct of an auction under Option 1 as proposed in the First Consultation Paper has its drawbacks as it would not be a genuine auction. It is also considered not appropriate to apply the LCA method to calculate the SUF for the administratively-assigned spectrum, when past market benchmarks are readily available and there are competing demands for the spectrum. As to the market benchmark approach, the respondents had suggested several benchmarks to be considered but they were rather selective and served more the interests of the incumbents. In light of this, the SCED has on the basis of the market-based mechanism proposed two other SUF benchmarking methods in the Second Consultation Paper for further views and comments in the case where spectrum is to be assigned administratively.

Option 2: A Full-Fledged Market-Based Approach – Re-auctioning All the Spectrum

Question 3: How would the prospect to re-auction the entire 120 MHz of spectrum in the 1.9 – 2.2 GHz band impact on the investment plan and network planning of the incumbent 3G operators, and how would that further impact on their mobile network capacity?

Views and Comments of the Respondents

9. All the incumbent 3G operators commented that re-auctioning the entire 120 MHz of spectrum in the 1.9 – 2.2 GHz band would create a high level of uncertainty to the industry, lead to the holding back of investment and technology upgrade in the remaining period of the current term of spectrum assignment. The resulting slow-down in the growth in network capacity was expected to cause severe service degradation as mobile data traffic would continue to increase unabated. HKT also cautioned that in view of the uncertainty operators would unlikely extend the 3G service coverage to the new development areas such as the West Kowloon Development area and the Hong Kong-Zhuhai-Macau Bridge. CSL added that re-auctioning the entire 120 MHz of spectrum would have major adverse impact on network planning, due to the need to take into account a shorter lifetime for the network equipment.

10. CMHK took the view that re-auctioning the entire spectrum would unlikely have any great impact on investment and network planning, as the

incumbent 3G operators should be well aware that they might not be able to retain their frequency holding upon expiry of the current term of assignment. Further, it considered that auction provided the best opportunity for the incumbents to obtain additional spectrum, if they were keen to put in further investment.

The Administration's Response

11. The incumbents' concern centres round the issue of regulatory certainty. As mentioned in paragraph 20 of the Second Consultation Paper, the licences for the frequency spectrum in the 1.9 – 2.2 GHz band clearly state that the spectrum has an assignment period till 21 October 2016. In fact, the incumbents are fully aware of the fact that their licences and the associated 3G spectrum assignment would co-terminus on 21 October 2016, and it is only reasonable to expect that they would have taken this into account in their investment and business plans. Furthermore, under the Policy Framework, there is no legitimate expectation on the part of the licensees that there will be any right of first refusal of any spectrum assignment upon expiry. The incumbents will however be given a notice period of three years to prepare for any change in the frequency assignments upon expiry of the current assignments.

12. As to the Option ahead, in the Second Consultation Paper, in light of the potentially severe and long lasting effect on service quality and reception especially in indoor areas under option 2 during the transitional period, and having compared the pros and cons of the options in meeting the multiple objectives in spectrum re-assignment, the Administration has put forward Option 3 for further consultation with the industry and interested parties.

Question 4: The number of players in the mobile telecommunications market may or may not remain unchanged after the auction. Would competition in the mobile market be enhanced if the entire 120 MHz of spectrum in the 1.9 – 2.2 GHz band is to be re-auctioned under Option 2?

Views and Comments of the Respondents

13. All the incumbent 3G operators commented that the Hong Kong mobile market is already keenly competitive, as evidenced by the high mobile subscriber penetration rate and low service charges. They doubted the benefits of bringing in further operators to the market, arguing that it would

unnecessarily replicate investment and sacrifice the long-term benefits of service innovations for short-term price reductions. It was added that if the number of players was reduced after auction of the entire 120 MHz of the spectrum in the 1.9 – 2.2 GHz band, it would adversely affect competition and reduce the choices available to consumers. The incumbents opined that new players could enter the market through other channels, such as acquisition of the newly released spectrum or the MVNO arrangements, and urged the Government to introduce spectrum trading. NSN, Huawei and Top Express shared the same view that the Hong Kong mobile market was very competitive. On the other hand, CMHK was of the view that even if the number of players remained unchanged after auction, competition in the market would be strengthened as re-assignment of the spectrum through auction would ensure the successful bidders putting the spectrum to the most productive uses.

The Administration's Response

14. The Administration agreed that the Hong Kong mobile market is already one of the most competitive in the world. It does not have a preset view on what is the optimum number of mobile players in the market. If there are new players which believe that they would be able to use the spectrum more efficiently than the incumbent 3G operators, through participating in the auction, they may have the opportunity to outbid the incumbents to obtain spectrum in the 1.9 – 2.2 GHz band and enter the market. The incumbents could also acquire additional spectrum through auction which will allow them to realise the full potential of the LTE-Advanced technology, enhance spectral efficiency as well as foster the development of innovative and even higher speed mobile services in Hong Kong. All these will stimulate competition in the mobile market.

15. It is agreed that there are other means for new players to enter the mobile market. The availability of other means to acquire frequency spectrum is however not a valid reason to preclude the non-incumbent 3G operators from obtaining the concerned spectrum when it is available upon expiry of the existing term of assignments. After all, auctioning off the spectrum will provide the fairest opportunity for the incumbents and interested parties alike to seek to obtain their desired amount of frequency spectrum in the 1.9 – 2.2 GHz band. On spectrum trading, the Administration will deal with the subject as a separate exercise from re-assignment of the 1.9 – 2.2 GHz spectrum.

Question 5: What would be the transitional plans for an incumbent 3G operator if under Option 2 (a) it cannot retain any of its original frequency assignment; (b) it can retain only part of its original frequency assignment; and (c) it gets spectrum in a different sub-frequency band?

Views and Comments of the Respondents

16. CSL and HKT opined that there could be no effective transitional plan. If the incumbent 3G operators could not retain any of its original frequency assignment, HKT pointed out that they would have to migrate their 3G customers to the 2G band but they would no longer have access to 3G mobile broadband services. CSL expected to migrate some of their 3G customers to the 2G band and those heavy data usage customers to the 4G band, but this would lead to congestion and service degradation. If the incumbents could retain only part of its original frequency assignment, their 3G customers would have to be squeezed into the remaining 3G band and this again would lead to congestion and service degradation. If the incumbents are assigned with spectrum in a different frequency sub-band, CSL and HKT envisaged that massive reconfiguration work would be required in order to continue to provide indoor 3G service coverage. In general, the incumbents commented that all the scenarios would be costly and represented wastage to the industry, with customers facing the risk of service termination. Yet CMHK foresaw no problem for the incumbents to migrate their 3G customers to the other frequency bands. It doubted whether it would still be necessary for the incumbents to keep all the 2 x 15 MHz of spectrum in the 1.9 – 2.2 GHz band, given the migration to 4G services and frequency reform.

The Administration's Response

17. The Administration is aware of the possible adverse impact that Option 2 could have on the service quality, in terms of data download speed and more importantly indoor 3G service coverage, to be experienced by the large number of mobile customers during the transitional period after the spectrum handover in October 2016. OFCA has conducted an assessment of the magnitude of such impacts. The impact assessment is discussed in paragraphs 22 – 27 of the Second Consultation Paper. The SCED comes to the view that, based on the impact assessment and in accordance with the Policy Framework, the need to maintain customer service continuity constitutes the overriding public policy reason for the Government to deviate from the full-fledged market-based approach under Option 2. This, however, has not provided sufficient justifications for the Government to adopt Option 1 to re-

assign all the spectrum in the 1.9 – 2.2 GHz band to the incumbents through right of first refusal.

18. Indoor 3G service coverage is a major area of concern since the IRS installed at hundreds of indoor sites, including the MTR stations, airport terminals, Hong Kong Convention and Exhibition Centre, Asia World Expo, and major shopping malls, etc., are all tuned to the specific frequency bands assigned to each incumbent 3G operator. Any relocation of frequency assignments within the 1.9 – 2.2 GHz band may render the IRS inapplicable and the reconfiguration works may take two to three years to be completed. To address this concern, there may be suggestion from some quarters that the 2 x 60 MHz of spectrum in the 1.9 – 2.2 GHz band could be re-auctioned in four frequency blocks of 2 x 15 MHz each as are the current assignments to the incumbents. This method has the merit of assuring the reuse of the existing IRS facilities, by the incumbents or new entrants. However, a major drawback of this auction arrangement is that with such a scheme design, it is entirely possible that an incumbent could be forced out of the 1.9 – 2.2 GHz band completely, thereby causing severe network congestion, service cessation and inconvenience to its customers. There is also no justification to artificially restrict the number of 3G operators in future to four as at present. Besides, it does not provide any flexibility in spectrum re-assignment. Even if the incumbents have successfully retained their original frequency holding in the auction, they will not have the opportunity to acquire additional spectrum to build up a contiguous band of 2 x 20 MHz of spectrum in order to attain a higher spectral efficiency.

Question 6: What are the estimated costs and the areas of investment for implementing the transitional plans for tackling the three scenarios mentioned in Question 5?

Views and Comments of the Respondents

19. Before knowing the actual spectrum re-assignment arrangements, the incumbent 3G operators generally found it difficult to estimate the costs to cater for the possible variations in their frequency assignments. Nevertheless, costs were expected to be expended on the following major areas: (a) upfront and recurrent costs in installing additional base stations; (b) cost in reconfiguring the IRS; (c) cost in retuning and optimising the network; and (d) cost in replacing the remote radio units and repeaters.

The Administration's Response

20. The Administration notes the categories of cost that would have to be incurred by the incumbents to cater for variations in frequency assignments.

Question 7: If an incumbent 3G operator is unable to obtain any of the 3G spectrum or if it manages to obtain less spectrum than what it currently has, to what extent the spectrum that it currently holds in other frequency bands could act as effective substitute for the spectrum foregone?

Views and Comments of the Respondents

21. All the incumbent 3G operators commented that frequency spectrum in the other frequency bands would not have sufficient capacity to cope with the sustained robust growth in mobile data traffic, and hence could not be an effective substitute for the spectrum in the 1.9 – 2.2 GHz band. They did not consider the 4G-LTE services would be able to replace the 3G services, noting that there was still a substantial number of 2G customers long after the roll-out of the 3G services and some customers would prefer staying on with the 3G services. HKT added that the non-availability of 4G services in certain areas, such as MTR lines and stations and other indoor areas, made it not an effective substitute for 3G services. It also pointed out that the non-availability of spectrum in the 850/900 MHz band posed as a disadvantage to HKT. CMHK held an opposite view, that spectrum in the other frequency bands could act as an effective substitute for the spectrum in the 1.9 – 2.2 GHz band.

The Administration's Response

22. The Administration maintains its views in the First Consultation Paper that by the time 2016 a sizable number of 3G customers would have migrated to the 4G-LTE services. This is elaborated on in paragraph 29 of the Second Consultation Paper. It also explains why migration of customers from 3G to 4G services is not the same as that from 2G to 3G services in the past. While the 2G network serves the voice users, the 3G/4G network should be considered as a whole network serving the group of intensive mobile data users. In the dual mode operation, the 4G network can offload the 3G data traffic and the 3G network can supplement the 4G network in coverage and the provision of voice services. The concern of HKT about non-availability of 4G services at the MTR lines and stations has been overtaken by the rapidly changing market developments. All MNOs have recently rolled out their 4G services in these

areas. The CA also notes the reform of the 850/900 MHz frequency band by operators for the provision of 3G services. Therefore, the Administration is of the view that frequency spectrum in the other frequency bands could be an effective substitute for spectrum in the 1.9 – 2.2 GHz band, although it may be constrained by insufficient capacity.

Question 8: How effective would be the application of alternative technologies (e.g. Wi-Fi, femtocell, etc.) help economise on the use of radio spectrum through offloading the mobile data traffic?

Views and Comments of the Respondents

23. The incumbent 3G operators generally pointed out that those alternative technologies (e.g. Wi-Fi, femtocell, etc.) could at most provide supplementary capacity to offload some of the mobile data traffic, but they were subject to limitations such as interference and capacity constraint at heavy data usage points. Coupled with the ever growing demand for mobile data services, the incumbents did not expect the application of alternative technologies to provide much relief to the strained mobile network capacity. On the other hand, CMHK considered that these alternative technologies very effective in economising on the use of radio spectrum.

The Administration's Response

24. The Administration notes that Wi-Fi has already been widely used to offload the mobile data traffic, where applicable. When steeper service charges are applied to the heavy data users in order to cope with the problem of capacity shortage in future, users are expected to make greater efforts to economise on their use of the mobile network resources. Thus while the application of alternative technologies can never replace the use of radio spectrum, they would be able to provide certain relief.

Option 3: A Hybrid between Administratively-Assigned and Market-Based Approach

Question 9: Do you have any comment on the preliminary proposal of the CA to offer each of the incumbent 3G operators the right of first refusal to a frequency assignment of 2 x 10 MHz of 3G spectrum post October 2016 under Option 3?

Views and Comments of the Respondents

25. The incumbent 3G operators held different views on Option 3, and hence their positions on the proposal to offer them the right of first refusal to a frequency assignment of 2 x 10 MHz of spectrum in the 1.9 – 2.2 GHz band post October 2016 were also different. CSL and SmarTone were of the view that Option 3 might be less disruptive than Option 2. CSL pointed out in particular that this hinged importantly on the incumbents being offered the right of first refusal to a contiguous band of 2 x 10 MHz of the concerned spectrum, and also on how the auction under Option 3 would be conducted. HKT regarded Option 3 as fundamentally flawed, and Hutchison considered it in breach of the Government's spectrum policy objectives as stated in the Policy Framework.

26. On the efficiency of assigning 2 x 10 MHz of spectrum in the 1.9 – 2.2 GHz band to the incumbents, HKT commented that it would almost be impossible to provide the current peak data download speed of 42 Mbps due to the need to support voice traffic. This is expected to constrain its flexibility in refarming the 1.9 – 2.2 GHz spectrum in future as 2 x 5 MHz of spectrum would have to be retained for 3G services during the transitional period. HKT further pointed out that its equipment was designed to work with 2 x 20 MHz of spectrum, and that LTE-Advanced services could only be offered with 2 x 20 MHz of spectrum. Hutchison also opined that the incumbents needed more instead of less spectrum, like four adjacent carriers of 2 x 5 MHz each would be required under the multi-carrier HSDPA technology to provide a peak data download speed of 84 Mbps. Therefore, it considered adoption of Option 3 was in breach of the Government's spectrum policy objectives.

The Administration's Response

27. It was on the grounds of spectral efficiency that the CA proposed an assignment of 2 x 10 MHz of spectrum in the 1.9 – 2.2 GHz band to the incumbent 3G operators in the First Consultation Paper. A frequency assignment of 2 x 10 MHz will enable the incumbents to maintain the peak data download speed of 42 Mbps, which was supported by NSN in its submission.

The peak data download speed can be enhanced to 84 Mbps with the MIMO technology.

28. The arguments above by the incumbents that they need more instead of less spectrum reaffirms the merits of Option 3. Under this option, each incumbent may through exercising the right of first refusal obtain part of the spectrum in the 1.9 – 2.2 GHz band, and the remaining part will be pooled together and put to auction. Thus the incumbents may have the opportunity to attain a frequency holding of 2 x 20 MHz by participating in the auction. Contrary to Hutchison's allegation that Option 3 was in breach of the Government's spectrum policy objectives, the fact is Option 3 provides just the avenue for the Government to achieve its spectrum policy objectives, in ensuring technically efficient use of the spectrum to facilitate the introduction of advanced and innovative communications services. On the other hand, Option 1 allows the incumbents to hold at most 2 x 15 MHz of spectrum in the 1.9 – 2.2 GHz band, and there is no room for any of them to attain 2 x 5 MHz more of the spectrum to achieve the maximum spectral efficiency. The benefit of Option 3 was acknowledged by CSL, which opined that Option 3 was in some respects preferable to Option 2 as they would be able to retain 2 x 10 MHz of the spectrum in the 1.9 – 2.2 GHz band and also to obtain further spectrum from the auction.

Question 10: Similar to Question 1, given there is clear indication of competing demand for the 3G spectrum, are there good public policy reasons for the CA to offer RFR Spectrum to the incumbent 3G operators, instead of assigning it through the market-based approach as stipulated in the Policy Framework, when the current 3G frequency assignments expire in October 2016?

Views and Comments of the Respondents

29. The incumbent 3G operators reiterated their position in the reply to Question 1 that the offer of RFR Spectrum to them was in the public interest. In particular, HKT pointed out that it would not be sufficient for the CA to offer right of first refusal to the incumbents for only part of the frequency holding in the 1.9 – 2.2 GHz band. CMHK also took the same view as in the reply to Question 1 that there was no good public policy reason for the CA to offer right of first refusal to the incumbents for even part of the spectrum in the 1.9 – 2.2 GHz band.

The Administration's Response

30. As discussed in paragraphs 22 – 27 of the Second Consultation Paper, the need to maintain customer service continuity constitutes the overriding public policy reason for the Administration to deviate from the full-fledged market-based approach as stipulated in the Policy Framework. However, the SCED does not consider that this justifies the offer of right of first refusal to the incumbents for all their frequency holding in the 1.9 – 2.2 GHz band. Discussion in paragraphs 29 – 39 of the Second Consultation Paper explains how the proposal to offer right of first refusal to the incumbents for two-thirds of their frequency holding in the 1.9 – 2.2 GHz band will contribute to alleviating the concern about customer service continuity, while re-auctioning the remaining one-third of the concerned spectrum will contribute to enhancing the efficiency in spectrum utilisation, encouraging investment and the introduction of innovative services. The Administration has hence proposed to put forward Option 3 for further consultation.

Question 11: Do you have any comment on the preliminary proposal of the CA under Option 3 to devise an arrangement so that all interested parties will have the opportunity to get hold of at least a contiguous band of 2 x 10 MHz of paired 3G spectrum?

Views and Comments of the Respondents

31. CMHK and CSL did not prefer Option 3, but they provided explicit support to the proposed arrangement of enabling all interested parties to get hold of at least a contiguous band of 2 x 10 MHz of spectrum in the 1.9 – 2.2 GHz band. HKT commented that such an arrangement would have technical and cost implications, as it would necessarily involve each of the incumbent 3G operators giving up part of their frequency holding in the 1.9 – 2.2 GHz band, and all the IRS would need to be reconfigured.

The Administration's Response

32. The Administration notes the views of the industry about the importance of getting hold of a contiguous band of 2 x 10 MHz of spectrum in the 1.9 – 2.2 GHz band and also the implication on reconfiguration of the IRS. Therefore, a band plan has been proposed in paragraph 52 of the Second Consultation Paper for views and comments of the industry and interested parties. Under the proposed Plan, all interested parties will be able to obtain at

least a contiguous band of 2 x 10 MHz of spectrum in the 1.9 – 2.2 GHz band if they so wish, and at the same time it will provide an opportunity for the incumbent 3G operators to preserve their existing frequency holding in the band and to build up a contiguous band of up to 2 x 20 MHz.

Question 12: Taking into account the merits of having contiguous spectrum of 2 x 10 MHz paired spectrum and the investment in capital equipment that the incumbent operators have already put in the 3G spectrum, should the CA draw up the band plan as described in paragraph 46?

Views and Comments of the Respondents

33. CMHK and CSL supported the idea of the CA drawing up the band plan, if Option 3 is adopted. CSL reiterated the importance of having contiguous spectrum as the capital costs of supporting non-contiguous spectrum were much higher. On the other hand, HKT regarded this arrangement as intrusive and hence Option 3 should be rejected.

The Administration's Response

34. In view of the considerations given in the Administration's response to views and comments on Question 11, the CA has decided to draw up a band plan for consultation, as depicted in paragraph 52 of the Second Consultation Paper. Contrary to what HKT has argued, the drawing up of a band plan by the CA is not an intrusive arrangement at all. Rather, under Section 32G(1) of the Ordinance, the CA has the statutory duty to "*promote the efficient allocation and use of the radio spectrum as a public resource of Hong Kong*". The CA is confident that the band plan drawn up after consultation with the industry and interested parties will facilitate efficient spectrum utilisation in the long term.

35. In addition, with the four spectrum slots to be put out for re-auction that are band specific, the incumbents can target at their original 2 x 5 MHz of frequency holding under the existing term of assignment and to acquire the adjacent slots, if they want to build up a contiguous band of 2 x 20 MHz spectrum in the 1.9 – 2.2 GHz band. This means that the market mechanism will deliver through auction an optimum arrangement for frequency assignments among the successful bidders, and also to ensure efficiency in spectrum utilisation.

Question 13: What are your views and comments on the proposed arrangement discussed in paragraph 54?

Views and Comments of the Respondents

36. The SCED proposed in the First Consultation Paper that he should announce the reserve price for the Re-auctioned Spectrum when the offer of right of first refusal was made to the incumbents, and that the auction reserve price should be lower than the SUF of the RFR Spectrum. CSL commented that the setting of those prices must be transparent, fair and equitable to both the incumbent 3G operators exercising the right of first refusal to acquire the RFR Spectrum and the parties participating in the auction of the Re-auctioned Spectrum. It further noted that if the SUF of the RFR Spectrum was set too high, the incumbents would have no choice but to surrender the RFR Spectrum. HKT replied that its comments on the methods for setting the SUF of the RFR Spectrum under Option 1 as given in its reply to Question 2 also applied. Yet it reiterated that a zero price for the RFR Spectrum was preferred, and likewise for the auction reserve price of the Re-auctioned Spectrum.

The Administration's Response

37. The SCED has on the basis of the market-based mechanism proposed two methods for setting the SUF of the RFR Spectrum as set out in paragraphs 56 – 60 of the Second Consultation Paper. The two methods provide indications on the intrinsic value of the RFR Spectrum. Coupled with the views of the SCED on the setting of the reserve price for the Re-auctioned Spectrum as given in paragraph 63 of the Paper, the incumbent 3G operators should have sufficient information to form a view on whether to exercise the right of first refusal for the RFR Spectrum. The SCED will therefore follow the established arrangement of announcing the auction reserve price when the Information Memorandum to be issued for the auction of the Re-auctioned Spectrum is published, which will take place after the incumbents have decided whether to exercise the right of first refusal for the RFR Spectrum and the total amount of Re-auctioned Spectrum is known for certain.

38. On the level of the auction reserve price for the Re-auctioned Spectrum relative to the SUF of the RFR Spectrum, it is reasonable for the reserve price to be set lower than the SUF of the RFR Spectrum as it represents the minimum value of the Re-auctioned Spectrum. The competitive bidding process is expected to yield results that reflect the full market value of the Re-auctioned Spectrum. However, under the current proposals of having the SUF

of the RFR Spectrum linked to the re-auction outcome, there is a need to pitch the auction reserve price of the Re-auctioned Spectrum at a level that is significantly higher than the reserve price set for all the spectrum auctions in the past, due to reasons as explained in paragraph 63 of the Second Consultation Paper. The SCED cannot accept the proposal of setting a zero reserve price for the Re-auctioned Spectrum. Also, he cannot accede to the proposal of a zero SUF for the RFR Spectrum, as already explained in the Administration's response to views and comments on Question 2.

Question 14: What are your views and comments on the proposal to benchmark the SUF of Spectrum RFR with the Spectrum Re-auctioned as proposed in paragraphs 55 – 58 above?

Views and Comments of the Respondents

39. This method of benchmarking the SUF of the RFR Spectrum with the Re-auctioned Spectrum was supported by CMHK and a member of the public, but the incumbent 3G operators found this a risky and harsh arrangement as they would need to commit themselves to an unknown level of SUF in deciding whether to exercise the right of first refusal to acquire the RFR Spectrum. In particular, CSL criticised this as untested and exposing the incumbents to unreasonable regulatory and business risks. SmarTone commented that such an arrangement would likely produce distorted auction results and prejudice the incumbents' ability to compete for the Re-auctioned Spectrum.

The Administration's Response

40. The concern of the incumbents is noted. The SCED has proposed other SUF benchmarking methods in the Second Consultation Paper which are premised upon the market-based mechanism for consultation, as detailed in paragraphs 56 – 60 of the paper. The difference of these two methods from the proposal in the First Consultation Paper is that the incumbents would have a better idea about the SUF payable for the RFR Spectrum. Apart from the SUF of the Re-auctioned Spectrum that is to be known after the auction, the incumbents have full knowledge of the two other elements proposed to be adopted to calculate the SUF of the RFR Spectrum, viz. the annual royalty payment to be paid by the incumbents for the right to use the spectrum in the 1.9 – 2.2 GHz band in 2015/16, and the relevant past auction benchmark results.

41. As to SmarTone's concern about distortion to the auction outcome of the Re-auctioned Spectrum, it is also anticipated by the SCED as the SUF as determined by auction for the Re-auctioned Spectrum will have direct implication on the SUF payable by the incumbents for the RFR Spectrum. Therefore, the SCED proposes in paragraph 63 of the Second Consultation Paper to pitch the auction reserve price of the Re-auctioned Spectrum at a level that will be significantly higher than the reserve prices set for all the spectrum auctions in the past to forestall possible bid shading behaviour by the incumbents.

Question 15: What are your views on the proposal to put the unpaired 3G spectrum to reserve?

Views and Comments of the Respondents

42. The incumbents were generally in support of the proposal, except HKT, which suggested re-assignment of this unpaired spectrum to the incumbents along with the paired spectrum. The reason is that it envisaged the carrier aggregation technology defined under LTE-Advanced in the 3GPP standard in 2015/16 would be ready to facilitate aggregation of the 5 MHz unpaired spectrum blocks with the paired spectrum to provide additional capacity on the downlink.

The Administration's Response

43. The CA's responses to the industry's feedback are given in paragraph 68 of the Second Consultation Paper. Basically, the view of the CA is that since the unpaired spectrum in the 1.9 – 2.2 GHz band currently held by the incumbents is not yet a priority band for application in the near future, it maintains its proposal in the First Consultation Paper that the 20 MHz of unpaired spectrum will be put back to reserve.

**OFCA's Assessment on Average Degradation in Data Download Speed
under the Status Quo and Loss of Different Number of
2 x 5 MHz Carriers in the 1.9 – 2.2 GHz Band**

Calculation

Under the status quo, the estimated growth in spectral capacity from 2012 to 2016 for the incumbent 3G operators is calculated in the following table –

Spectrum	No. of Carriers
Total No. of 2 x 5 MHz carriers which are currently in use for 3G mobile data services in 2012 (a) <i>(including spectrum in the 850 MHz, 900 MHz and 1.9 - 2.2 GHz bands)</i>	15
Total No. of 2 x 5 MHz carriers which will be available for deployment of 3G/4G mobile data services by October 2016 (b) <i>(including spectrum in the 850 MHz, 900 MHz, 1800 MHz, 1.9 - 2.2 GHz, 2.3 GHz and 2.5/2.6 GHz¹ bands)</i>	26
Total No. of 2 x 5 MHz carriers which will be available for 3G/4G mobile data services by 2016 [(c) = (a) + (b)]	41
Average No. of 2 x 5 MHz carriers per incumbent 3G operator which are currently in use for 3G mobile data services in 2012 [(d) = (a) / 4]²	3.75
Average No. of 2 x 5 MHz carriers per incumbent 3G operator which will be available for 3G/4G mobile data services by October 2016 [(e) = (c) / 4]²	10.25
Estimated growth in spectral capacity for mobile data services [(f) = (e) / (d)]	2.73 x

2. From the above, it can be seen that the total spectral capacity of the incumbent 3G operators by October 2016 is estimated to be about 2.73 times of that in 2012. Together with network infrastructure upgrade by the network operators that can almost double the network capacity (see paragraph 8 below), the mobile data network capacity of the incumbent 3G operators can grow by a

¹ This includes the 2 x 25 MHz of paired spectrum to be auctioned in March 2013.

² The actual numbers of carriers are different amongst the incumbent 3G operators. Instead of analysing the impact on individual incumbent operators, we use the average number of carriers here to analyse the impact on an average incumbent 3G operator.

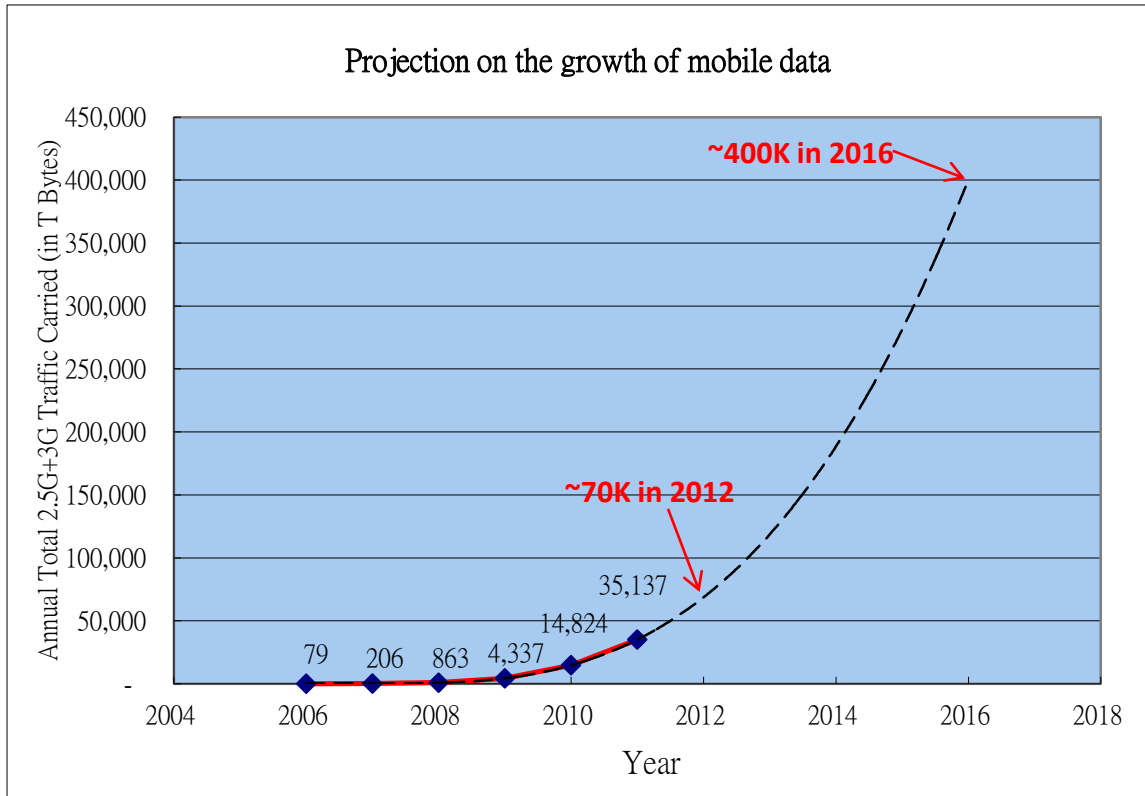
factor of $2.73 \times 2 = 5.46$ times. According to the projection under the assumptions in paragraph 4 below, the mobile data usage in 2016 is projected to be about 6 times of that in 2012. On a linear scale, and assuming other factors remain largely unchanged, this would mean that the network capacity needs to increase 6 times by October 2016 in order to maintain the quality of service as of today. With just a 5.46 times growth in network capacity, it follows that there would be a network capacity shortage of $(6 - 5.46) / 6 = 9\%$ in October 2016 as compared with that in 2012. Assuming a straight-line relationship between network capacity shortage and the average data download speed degradation, this would mean that even the incumbent operators are able to retain all their existing frequency assignments in the 1.9 – 2.2 GHz band post October 2016, there would be **an average drop of about 9% in the data download speed by October 2016 as compared to that in 2012**. This is the base case scenario.

3. Using the methodology in paragraph 2 above, the estimated degradation in average data download speed under the scenarios where an average incumbent 3G operator loses one, two or three carriers are tabulated in the following table –

Scenarios	1 carrier less for an average incumbent	2 carriers less for an average incumbent	3 carriers less for an average incumbent
No. of carriers currently in use in 2012 (a)	3.75	3.75	3.75
Total No. of 3G/4G carriers by 2016 (b)	9.25 (=10.25-1)	8.25 (=10.25-2)	7.25 (=10.25-3)
Estimated growth in spectral capacity [(c) = (b) / (a)]	2.46 x	2.2 x	1.93 x
Estimated growth in network capacity with network upgrade [(d) = (c) x 2]	4.92 x	4.4 x	3.86 x
Estimated percentage drop in average data download speed [(e) = ((d) / 6 - 1) * 100%]	-18%	-27%	-36%

Assumptions

4. The estimated growth in the mobile data traffic is based on OFCA’s historical data on annual mobile data usage from 2006 to 2011/2012, with projection up to 2016 made on the basis of a statistical model. As depicted in the following chart, it is estimated that there would be a 6-fold increase in the total mobile data traffic from 2012 to 2016 –



5. The majority of mobile data usage in 2012 is contributed by 3G services deployed in the 850/900 MHz and 1.9 – 2.2 GHz bands.

6. All the spectrum in the 2.5/2.6 GHz band which will be auctioned in March 2013 will be used for rolling out mobile data services by the incumbent 3G operators.

7. By October 2016, all available paired spectrum in the 850 MHz, 900 MHz, 1800 MHz, 1.9 – 2.2 GHz, and 2.5/2.6 GHz bands *plus* unpaired spectrum in the 2.3 GHz band currently assigned to the incumbent 3G operators will be used by these operators for deployment of 3G or 4G mobile data services with dual-/multi-mode operation capability. For the purpose of the calculation above, it is assumed that the capacity provided by 30 MHz of unpaired spectrum in the 2.3 GHz band is on par with that provided by three 2 x 5 MHz carriers in the 1.9 – 2.2 GHz band.

8. Incumbent 3G operators and/or their customers would be willing to upgrade their network infrastructure and devices (as the case may be) with the latest technology available and expansion/addition of cell sites, which would effectively double the network capacity.