For discussion
on 11 June 2018

Legislative Council Panel on
Information Technology and Broadcasting

Spectrum Trading

PURPOSE

Hong Kong has a spectrum management framework for mobile telecommunications services which is reasonably effective in promoting efficient use of spectrum. Against this background, and taking also into account the findings of a consultancy study on *inter-alia* the costs/risks and benefits analysis and a host of implementation issues pertaining to spectrum trading, we do not see a justifiable case for altering our current spectrum management framework by introducing spectrum trading in Hong Kong in the short and medium term.

2. This paper elucidates to Members on our policy position on spectrum trading as set out above and our underlying considerations.

BACKGROUND

What is Spectrum Trading

3. Spectrum trading is a mechanism whereby a spectrum assignee may, through bilateral negotiations, transfer all or part of the spectrum it holds to another party for the duration of spectrum assignment. One of the benefits of spectrum trading is to provide mobile network operators ("MNOs") with the flexibility to acquire *additional* spectrum in the *secondary* market whenever they see a need to increase network capacity to better serve their customers. Spectrum trading is hence considered as a means to ensure the efficient use of spectrum by assisting MNOs to flexibly and timely adapt to changing technological and market conditions. While spectrum trading is in operation in some

economies[1], such a system is not, and in fact has never been permitted in Hong Kong.

The 2007 Radio Spectrum Policy Framework

4. The subject of spectrum trading was first raised in the context of the promulgation by Government of the Radio Spectrum Policy Framework in April 2007 ("Framework"), to set out our spectrum policy objectives, guiding principles in spectrum management, spectrum rights, supply of spectrum, spectrum for Government services and spectrum pricing. A three-month public consultation was conducted beforehand to invite views from the industry and interested parties on a number of issues relating to spectrum management, including spectrum trading in relation to spectrum supply. The launch of the public consultation on the proposed Framework and the outcome of consultation were reported to the Legislative Council ("LegCo") respectively vide paper CB(1)853/06-07(03) and a LegCo brief issued on 24 April 2007 (file ref: CTB(CR) 7/4/16(06)).

5. Insofar as spectrum trading is concerned, as per our promulgation in the Framework –

> "The policy inclination is to introduce spectrum trading in Hong Kong in the long term, *subject to* a feasibility study and resolution of various implementation issues."

Spectrum Management since 2007

6. Since the coming into effect of the Framework in 2007, in accordance with the policy guidance as set out therein, a *market-based* approach in spectrum management has been adopted for spectrum assignment whenever the Communications Authority ("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. Practically speaking, given the competing demands in existence at all times for spectrum for public mobile telecommunications services since, newly available mobile spectrum has usually been assigned by the CA through *auction*. Spectrum is typically assigned for a term of 15 years. Upon expiry of the 15-year term, spectrum is generally

[1] Examples include the United States, the United Kingdom, Australia, New Zealand and Canada.

re-assigned by the CA through adopting a hybrid arrangement embodying an auction element.

7. Accordingly, between 2007 and 2017, the CA (and the former Telecommunications Authority) successfully conducted a total of seven auctions for mobile spectrum assignment/re-assignments to meet MNOs' needs. As of now, a total of 552 MHz of spectrum available for mobile services in the sub-3 GHz bands[2] has been released and assigned to the MNOs. In assigning new spectrum and re-assigning spectrum upon expiry of initial assignment, the CA in general adopts a *technology-neutral* regulatory approach, under which MNOs may choose to upgrade their networks with more advanced and efficient technologies within the spectrum assignment periods without the need to seek the CA's approval. This enables MNOs to make more efficient use of spectrum and provides them with the flexibility to introduce innovative services timely.

Other Means to Enhance Spectrum Utilisation

8. To enhance the efficient use of spectrum, MNOs may apply to the CA for *spectrum swap* if they can prove, *inter alia*, that the proposed swap will bring about technical benefits (such as reduction of radio interference, improvement in spectral efficiency, or introduction of new or innovative services) and that no monetary exchange is involved between the concerned parties. MNOs are also permitted under our current spectrum management and telecommunications regulatory regime to enter into commercial agreements on various forms of *mobile network sharing* arrangements, including network capacity leasing (such as the mobile virtual network operator arrangement) in order to meet their need for increasing network capacity, as well as antenna-sharing, site-sharing and radio access network ("RAN")-sharing to achieve technical and operational benefits. Indeed, there are cases of network-sharing through commercial agreements between MNOs[3] and permission of spectrum swaps by the CA[4].

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[2] The CA issued a statement in March 2018 promulgating its decision to re-allocate the 3.4 – 3.7 GHz band from fixed satellite service to mobile service, for the provision of public mobile services with effect from April 2020. As a result, an additional 200 MHz of spectrum in the 3.4 – 3.6 GHz band (on top of the current 552 MHz of spectrum in the sub-3 GHz bands) will be made available for the provision of public mobile services. The consultation on the assignment arrangements and the related spectrum utilisation fee is underway.

[3] One example is the commercial arrangement between China Mobile Hong Kong Company Limited ("CMHK") and Hong Kong Telecommunications (HKT) Limited ("HKT") for the former to provide third generation ("3G") mobile services based on leasing of 3G network capacity from

9. As of end January 2018, the mobile subscriber penetration rate in Hong Kong reached 247.6%, which is among the highest in the world. With intense competition in the mobile telecommunications market consisting of four facilities-based MNOs, 29 mobile virtual network operators and other mobile service providers, mobile service charges in Hong Kong are highly competitive and are among the lowest in the region. With a competitive market environment and scarcity of spectrum to meet ever increasing demand for mobile data capacity, there are strong incentives for spectrum assignees to utilise efficiently, during the finite assignment periods, their spectrum holdings. All in all, given the supply and demand situation of radio spectrum and their high utilisation throughout these years, our current spectrum management regime has achieved the objective of promoting the efficient use of spectrum in a totally liberalised and highly competitive market in Hong Kong.

10. While the CA is managing the radio spectrum in accordance with the guiding principles set out in the Framework, we are keeping under review developments in overseas markets, including those where spectrum trading has been introduced, to ensure that our telecommunications services remain among the most efficient services globally and that our position as a telecommunications hub is maintained.

CONSULTANCY STUDY 2017 - 2018

Assessing the Need for Spectrum Trading

11. As mentioned in paragraph 5 above, whether spectrum trading may be introduced in Hong Kong in the long term[5] is subject to a feasibility study[6] and a resolution of various implementation issues, such

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HKT. This arrangement is still in effect today despite CMHK has already acquired its own 3G spectrum in the 1.9-2.2 GHz band after re-assignment of the concerned spectrum in 2016.

[4] The CA has so far approved two spectrum swap applications, one from SmarTone Mobile Communications Limited and CMHK for swapping spectrum in the 1800 MHz band in 2012, and the other from CMHK and HKT for swapping spectrum in the 2600 MHz band in 2016.

[5] Locally, from time to time, there have been enquiries from individual MNOs or members of the LegCo on whether spectrum trading would be introduced in Hong Kong

[6] In 2009, the former Office of the Telecommunications Authority commissioned a consultancy study on the development and implementation of a spectrum trading regime in Hong Kong. Implementation options were suggested by the consultant but some substantial implementation

as those relating to the supply of spectrum for trading, the effectiveness of such a trading regime, the implications on the spectrum management framework, how to deal with the question of trading gains and ways to prevent MNOs from acquiring more spectrum to lessen market competition (i.e. spectrum hold-out or hoarding), etc.

12. In view of the above and in light of the substantial changes in the mobile telecommunications environment since the promulgation of the Framework and particularly in recent years, we consider it appropriate and timely to commission a study to assess the relevant implementation issues relating to spectrum trading. In 2017, we commissioned an independent consultant ("Consultant") to examine the subject with focus on the following issues –

(a) latest overseas experience in respect of spectrum trading;

(b) the demand for and supply of spectrum for trading in Hong Kong based on current market practices and the competitive landscape;

(c) the benefit and cost of introducing a spectrum trading regime in Hong Kong; and

(d) how a spectrum trading regime should be implemented if such a regime is pursued in Hong Kong; and alternative methods to enhance spectrum efficiency in Hong Kong if such a regime is not pursued in Hong Kong.

The Consultant completed the study in May 2018. The executive summary of the consultancy report is at **Annex A**[7]. The key findings are highlighted in the ensuing paragraphs.

Key Findings of the Consultancy Study

(a) Overseas Experience

13. Not all markets have introduced spectrum trading. Spectrum trading may work in economies that have a long or perpetual spectrum

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issues, such as how to deal with the question of windfall and other gains by operators through spectrum trading, were yet to be satisfactorily addressed.

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

assignment regime, which is not applicable to Hong Kong. In most markets where spectrum trading has been introduced, the volume of mobile spectrum trading has been relatively low. That a higher volume of mobile spectrum trading activity exceptionally occurs only in Canada and the United States can be largely attributed to the two countries' regional spectrum licensing regime, which also is not applicable to Hong Kong.

(b) Spectrum Supply and Demand Situation in Hong Kong

14. According to the Consultant, the released sub-3 GHz spectrum is generally well utilised in the Hong Kong market as MNOs have great impetus to fully deploy the spectrum they hold during the finite term of assignment to support network capacity requirements of their subscribers. Looking ahead, there would be sustained demand for additional mobile spectrum in the sub-3 GHz bands. On the other hand, the supply of available spectrum in the same bands in the primary market would remain constrained in the short term. In face of such a constraint, it is unlikely that spectrum holders would be willing to sell their spectrum resources in the secondary market. The potential supply of spectrum in the secondary market, if there were one, remains in question. Given the above, in a spectrum trading regime, the level of trading activity is anticipated to be low in the short term, as would be the benefits so derived.

15. The Consultant further notes that the overall demand for spectrum trading might also be affected by the ongoing spectrum auctions conducted to release new spectrum for mobile services. MNOs or other interested parties might wait for the release of the new spectrum and secure it for a full 15 years' term, rather than entering into commercial negotiations with the incumbent spectrum assignees to trade for the assigned spectrum (which involves additional transaction cost) for the remaining duration of the assignment period.

(c) Cost and Benefit Analysis

16. The Consultant notes that certain benefits arising from spectrum trading which could be realised under a regional licensing or perpetual licensing regime are not applicable to Hong Kong.

17. One major benefit of spectrum trading is to enable a MNO who does not have enough capacity to meet its short term need to acquire the spectrum from the market through commercial deals with other

MNOs. In the Hong Kong setting, as noted by the Consultant, MNOs can implement certain types of mobile network sharing, such as antenna-sharing, site-sharing, RAN-sharing and capacity leasing through commercial arrangement with other MNOs, which can serve as effective alternatives to resolve MNOs' short term need for additional capacity. For longer term need for spectrum capacity, MNOs can bid for additional spectrum by taking part in auctions conducted by the CA regularly when new spectrum becomes available, or when assigned spectrum is returned to the CA upon expiry of term for re-assignment.

18. As regards costs and risks, the Consultant notes from the feedback from several industry stakeholders that costs related to spectrum hoarding and over-concentration of spectrum should be taken seriously. Industry stakeholders also mention the possible difficulties in the treatment of potential windfall profits/losses from spectrum already in the market. The Consultant points out that although potential costs because of loss of harmonisation and increased risk of interference are not highlighted in the industry interviews, they are nonetheless important considerations from a regulatory perspective. While there are safeguards to mitigate the costs and risks, they may not be a satisfactory solution to resolve all the problems, in particular with regards to windfall and other private gains. The Consultant observes that level of trade activity is anticipated to be low in Hong Kong if spectrum trading were introduced, and there is limited justification to support the setting up of a spectrum trading regime in the short term.

19. The Consultant also observes that the implementation timeline required for the spectrum trading regime is an important consideration in the short term. Given the time it would take to set up the new arrangements and the availability of existing regulatory mechanisms (including re-assignment opportunities at forthcoming auctions), the window of opportunity for a spectrum trading regime to have an impact on the Hong Kong market might be limited in the short term.

(d) Alternatives to Spectrum Trading

20. The Consultant notes that whilst spectrum trading may be a useful tool to enhance spectrum flexibility and efficiency, it is not the only solution. In the Consultant's view, there are mechanisms other than spectrum trading that can be used to effectively create a more flexible environment for spectrum assignment/re-assignment and to enhance spectrum efficiency in the Hong Kong market. Drawing on Hong Kong's existing regulatory frameworks, the Consultant has proposed three

enhancements to our current spectrum management mechanism that could help enhance spectrum use in Hong Kong, without implementing spectrum trading, namely –

(i) enhanced mobile network sharing arrangement which involves the combination of existing RAN-sharing and capacity leasing mechanisms;

(ii) periodically adjusted spectrum utilisation fee ("SUF") for administratively assigned spectrum; and

(iii) enhanced spectrum swap which involves inter-band and/or asymmetric bandwidth spectrum swaps.

Consultant's Overall Assessment

21. The Consultant is of the view that Hong Kong's current spectrum management framework for mobile telecommunications services is reasonably effective in promoting the efficient use of spectrum.

22. The Consultant has identified a few benefits of introducing a spectrum trading regime. However, in the case of Hong Kong, the benefits so derived would be insignificant as trading activity is anticipated to be low even if spectrum trading were permitted. On the other hand, the Consultant notes that spectrum trading may give rise to a number of costs and risks, which need to be properly managed and addressed through a range of safeguards. Those safeguards however may not be effective in eliminating all potential costs and risks, in particular windfall profits and other private gains to be gained by trading parties.

23. The Consultant is of the view that in the short term (i.e. within five years), there is limited justification to support the setting up of a spectrum trading regime, having considered the time needed to implement it, and the risks and costs involved.

24. As for the medium term (i.e. five to ten years), fifth generation ("5G") mobile services are expected to be the main driver for mobile spectrum usage and development. The different possible use cases for 5G (e.g. enhanced mobile broadband, Internet of Things applications, etc.) have differing implications on how mobile networks might need to evolve. Thus, there has yet to be a clear case for implementing spectrum trading in Hong Kong in the medium term. In

addition, it is likely that the supply of 5G spectrum in the high frequency bands (above 24.25 GHz) would be large. Although demand is still uncertain at this stage, should the CA be of the view that there are no competing demands for such spectrum in the primary assignment, and pursuant to the Framework, this spectrum may be assigned administratively instead of through auction. In such a scenario, spectrum trading is not relevant.

COMMERCE AND ECONOMIC DEVELOPMENT BUREAU'S POLICY VIEWS

25. We take note of the Consultant's assessment that in the case of Hong Kong, spectrum has been utilised efficiently under the spectrum management regime operating in accordance with the guiding principles as promulgated by the Framework. It is evident that the adoption of the market-based approach in spectrum management and the conduct of auctions from time to time[8] not only create opportunities for incumbent and prospective MNOs to bid for spectrum to meet their needs through a transparent, open and fair system, they also enable the incumbents to review their overall spectrum holdings in deciding on whether, and if so, the extent of their involvement in each bidding exercise. Prior to each auction, the CA may also re-organise the band plans with a view to optimising spectrum efficiency prior to another 15 years of assignment.

26. As affirmed by the Consultant, the adoption of a technology-neutral regulatory approach, the availability of a spectrum swap regime, and the possibility for MNOs to enter into commercial arrangements with each other for mobile network sharing including network capacity leasing have provided the MNOs with the necessary flexibility in deploying the spectrum and enhance spectrum efficiency. This is well supported by the fact that Hong Kong is one of the earliest markets that launched third generation ("3G") and fourth generation ("4G") mobile services in the world.

27. We note the Consultant's view that even if spectrum trading were permitted, trading activity would likely be low in Hong Kong and the benefits so derived would be insignificant. Furthermore, the

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[8] In practical terms, with seven mobile spectrum auctions being held in Hong Kong in the past ten years, incumbent and potential MNOs were given opportunities on average every 17 months or so to acquire spectrum through auctions.

significant amount of time needed to set up a spectrum trading regime and the ready availability of existing regulatory mechanisms would also limit the positive impact of such a regime on the Hong Kong market in the short term.

28. As pointed out by the Consultant, spectrum trading would bring about costs and risks that need to be evaluated against the benefits it brings. There may be concerns that spectrum trading would complicate the existing spectrum management regime which has been operating smoothly in Hong Kong over the years. Also, in Hong Kong where auctions are used predominantly in primary assignments, there may be concerns that a spectrum trading regime (or a secondary market) would not help promote competition further, but would instead increase the risk of anti-competitive behaviour such as speculation or hoarding despite the potential safeguards. In our view this move is not beneficial or conducive to the development of Hong Kong's highly competitive telecommunications market and would quite to the contrary run the risk of defeating the whole purpose of ensuring efficient use of spectrum.

29. Moreover, spectrum is a scarce public resource. Spectrum trading allows MNOs to trade between themselves and such trading in the secondary market is expected to generate windfall/private profits. Such profits, unlike the SUF collected in the primary assignments which is transferred to the General Revenue for the benefit of the Hong Kong community, would only be reaped by individual MNOs as private profits from the trading of this scarce public resource. Compared with spectrum assignment through auction, this may seem to be an unfair arrangement, one which is not in the public interest.

30. In fact, the Consultant points out that MNOs in Hong Kong[9] are in general not keen on the introduction of a spectrum trading regime, except for one which strongly supports this idea. On top of the considerations outlined above, we do not see a justifiable case to pursue spectrum trading based on the submission and advocacy of one single market operator.

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[9] A table showing the distribution of spectrum holdings among the four MNOs by bands is at **Annex B**.

Short and Medium Term Assessment

31. Having considered the above and taking into account overseas experience in spectrum trading, the supply and demand situation of spectrum in Hong Kong, various implementation issues, the costs/risks and benefits analysis and the alternatives available to achieve just as effectively if not more the goal of enabling efficient use of spectrum, we see no justifiable case for introducing spectrum trading in Hong Kong in the short term, i.e. the next five years.

32. As for the medium term (i.e. five to ten years), we note the Consultant's assessment that 5G will likely be the key driver of a new generation of innovative telecommunications services and will have a huge impact on the mobile telecommunications market. Given that the spectrum supply in the high frequency bands suitable for 5G are abundant, it is possible that the CA may in accordance with the guiding principle in the Framework decide to assign the spectrum administratively should it consider that there are no competing demands for such spectrum. In fact, the CA will, following public consultation, make a decision on the assignment arrangement for spectrum in the high frequency bands for mobile services (viz. the 24.25 – 27.5 GHz and 27.5 – 28.35 GHz bands) later this year or early next year. Should the CA decide to assign the spectrum administratively, spectrum trading will not be relevant in such a scenario. As things now stand, we do not see a case for implementing spectrum trading in the medium term either.

WAY FORWARD

33. We and the CA would continue to monitor the technology and market developments as well as the allocation of mobile spectrum for 5G in the coming years and the implications on the spectrum assignment regime for mobile services, with a view to keeping it up to date in the 5G era. We also take note of the Consultant's recommendations on possible enhancements to our existing spectrum management mechanism that could help further facilitate efficient spectrum use in Hong Kong without the need to implement spectrum trading. We will work with the CA on the suggested enhancements in this regard. We will continue to keep in view developments in the longer term.

ADVICE SOUGHT

34. Members are invited to note and give their views on the content of this paper.

Communications and Creative Industries Branch
Commerce and Economic Development Bureau
June 2018

Executive summary

CEDB commissioned a consultancy study undertaken by Analysys Mason Limited (Analysys Mason) and DotEcon Limited (DotEcon) on issues relating to spectrum trading for public mobile telecoms services.

The objectives of the consultancy were to:

- study the latest overseas experience in respect of spectrum trading;
- assess the demand for and supply of spectrum for trading in Hong Kong based on current market practices and the competitive landscape;
- evaluate and analyse the benefits and costs of introducing a spectrum trading regime in Hong Kong; and
- advise how a spectrum trading regime should be introduced if such a regime is pursued in Hong Kong, while also proposing alternative methods to enhance spectrum efficiency in Hong Kong if such a regime is not pursued in Hong Kong.

Latest overseas experience in respect of spectrum trading

Based on comprehensive research into the extent of implementation of spectrum trading in different markets worldwide, we have identified three major scenarios with respect to the implementation (or otherwise) of spectrum trading, namely:

- **Category 1**: A clear spectrum trading regime is implemented through specific legislation (e.g. the UK, USA, Canada, Australia and New Zealand)

- **Category 2**: Spectrum trading is allowed, albeit not through a full-fledged trading regime (e.g. Singapore, Luxembourg and Switzerland)

- **Category 3**: No spectrum trading is allowed (e.g. Japan and Mainland China)

Hong Kong falls into Category 3.

In summary, we have found that not all markets have introduced spectrum trading.

In most case study markets where spectrum trading has been introduced, the use of mobile spectrum trading has been relatively low.

In case study markets with low spectrum trading volumes, trading has typically been used to rejuvenate underutilised spectrum (i.e. in instances where assigned spectrum was not fully used by the licence holder), and to respond to changing technology and service demands.

A higher volume of mobile spectrum trading activity exceptionally occurs only in Canada and the USA, and this can be largely attributed to the two countries' regional spectrum licensing regimes, which is not applicable to Hong Kong.

Our analysis suggests benefits of spectrum trading cited internationally include the following:

- aggregation of regional spectrum holdings
- rejuvenation of under-utilised spectrum
- lowering barriers to expansion
- flexibility to allow spectrum use to evolve with changing market demands
- flexibility to change the use of spectrum in regimes with long or perpetual licences
- reduction of administrative burden on the regulator.

On the other hand, the introduction of spectrum trading may give rise to potential costs/risks, such as:

- spectrum hoarding, including speculative hoarding
- windfall profits and other private profits gained by trading parties
- over-concentration of spectrum
- loss of harmonisation
- increased risk of interference
- distortion of auction dynamics.

The potential costs/risks to spectrum trading implementation need to be properly managed and addressed, through a range of safeguards, and balanced against the costs, in the overall consideration as to whether a spectrum trading regime should be implemented.

Supply of and demand for spectrum for trading in Hong Kong

In considering whether there is a need to introduce spectrum trading with a view to promoting efficient use of spectrum, we have examined the current spectrum management regime in Hong Kong to gain insights on its effectiveness in ensuring optimal spectrum use and to ascertain whether there are alternative tools which could also potentially be adopted or enhanced to achieve similar benefits to that of the introduction of spectrum trading. We have also assessed information on the latest market conditions derived from industry interviews.

Our review indicates that Hong Kong's current spectrum management framework for public mobile telecoms services is reasonably effective in promoting the efficient use of spectrum. Spectrum is assigned for a fixed term and not assigned perpetually, usually through market-based mechanism as in auction in respect of newly available spectrum. Spectrum is generally re-assigned upon expiry of term by adopting a re-assignment arrangement that embodies in it an auction element.

This creates opportunities, from time to time, for those players, including incumbent mobile network operators (MNOs) and new interested parties, who wish to acquire spectrum, to bid for the spectrum. This also creates opportunities, from time to time, for incumbent MNOs to review their overall spectrum holdings in deciding whether to take part in the competitive bidding of spectrum that takes place periodically, based on their commercial considerations. Should they so decide, they can participate in auctions held by the Office of the Communications Authority

(OFCA), the executive arm of the Communications Authority (CA), the independent statutory regulator.

The current regulatory regime also supports operators in various ways to achieve efficient use of spectrum: the technology-neutral principle in spectrum management, the spectrum swap mechanism and mobile network sharing all assist operators to flexibly and timely adapt to changing technological and market conditions.

One of the major benefits of spectrum trading is that, if an MNO does not have enough capacity to meet its short-term need, it may acquire the spectrum from the market through commercial deals with other MNOs.

In the case of Hong Kong, MNOs are already allowed to implement certain types of mobile network sharing, such as antenna sharing, site sharing, radio access network sharing and capacity leasing through commercial arrangement with other MNOs. These sharing arrangements serve as viable alternatives to resolve MNOs' short-term need for additional capacity. For longer-term need for spectrum capacity, as mentioned above, MNOs could bid for additional spectrum by taking part in the auctions to be conducted by the CA regularly when new spectrum is available, or when assigned spectrum is returned to the CA upon expiry of the spectrum assignment periods for re-assignment.

In the industry interviews we conducted, we found mobile spectrum to be in high demand with operators, bearing in mind the Hong Kong market's incessant demand for mobile data services and the need for operators to prepare for the launch of fifth generation (5G) mobile services. Demand for additional spectrum (especially in the sub-3GHz spectrum bands) will likely be sustained in the short term, and it is expected that some of industry's demand for spectrum may translate to potential demand for spectrum trading.

Practically speaking, spectrum utilisation in Hong Kong is currently generally high and MNO market shares remain relatively stable. There is no indication of significant changes in market share that will result in an operator having significantly less usage requirements. Particularly for spectrum in the sub-3GHz spectrum bands, given its availability in the primary market would remain constrained in the short term, it is unlikely that spectrum holders would be willing to sell their spectrum resources in the secondary market. Therefore, even if spectrum trading were permitted, the potential supply of spectrum in the secondary market remains in question.

Against the above, trading activity is anticipated to be low in the short term, and so would the benefits so derived.

Overall demand for spectrum trading may also be affected by the on-going spectrum auctions conducted to release new spectrum for mobile services. The latter is being proactively addressed by the CA, particularly in frequency bands above 3GHz, in preparation for commercial launch of 5G from 2019/2020 onwards. MNOs or other interested parties could potentially wait for the availability of new spectrum, and acquire it for a full 15 years' term, rather than negotiating with

the incumbents to trade for the assigned spectrum (which involves additional transaction costs) for the remaining duration of the assignment period.

In addition, from our interviews with the operators, most of them did not express clear intentions to participate in the secondary market for spectrum. While one operator heavily supported the introduction of a spectrum trading regime, others were less keen, stating fears of increased risks due to anti-competitive activities.

Benefits and costs of introducing a spectrum trading regime in Hong Kong

In terms of overall benefits, certain benefits arising from spectrum trading will not be applicable to Hong Kong as Hong Kong does not have regional licensing or perpetual licensing terms.

Regarding costs and risks of spectrum trading, feedback from stakeholders suggest that costs related to spectrum hoarding and over-concentration of spectrum should be taken seriously. In addition, there may not be a satisfactory solution to resolve the problem of windfall gains and other private gains.

In the short term (five years), the introduction of spectrum trading in Hong Kong appears to be a balancing act among (a) the introduction of more flexibility to the overall spectrum assignment regime in terms of permitting asymmetric trades (including partial trades of spectrum holdings) and increased time flexibility in determining when to acquire or relinquish spectrum and (b) costs and potential risks associated with spectrum trading, and (c) safeguards and further regulatory controls required to forestall/alleviate such costs and risk and the related implementation costs.

To elaborate, at present, there is no critical bottleneck in the Hong Kong market that requires spectrum trading as the only resolution. This is because the current spectrum management framework for public mobile telecoms services already appears to be reasonably effective in promoting the efficient use of spectrum under existing regulatory mechanisms (e.g. assignment/re-assignment opportunity at regular intervals, capacity leasing mechanism). We also note that as spectrum for public mobile telecoms services is relatively well utilised in Hong Kong, the supply of mobile spectrum for trading and thus level of trading activity is anticipated to be low in the short term, as would be the benefits so derived.

The implementation timeline required to set up the spectrum trading regime is an important consideration in the short term. Various jurisdictions have dedicated a significant amount of time to set up spectrum trading regimes. Given the time it takes to set up and the availability of existing regulatory mechanisms (including re-assignment opportunities at forthcoming auctions), the window of opportunity for a spectrum trading regime to have an impact on the Hong Kong market may be limited in the short term.

Hence, considering the above, the limited benefits expected in the short term in Hong Kong may not justify the associated costs for introducing and implementing such a regime. In this regard, there is limited justification to support the setting up of a spectrum trading regime in the short term, having considered the time needed to implement, and the risks, and costs.

In the medium term (five to ten years), 5G is expected to be the main driver for mobile spectrum usage and development. However, 5G standards are still evolving and 5G use cases are not yet entirely clear. The different possible use cases for 5G (e.g. enhanced mobile broadband, IoT) have differing implications on how mobile networks might need to evolve. Additional spectrum management considerations are likely to occur in relation to spectrum access for 5G use cases other than mobile broadband. Whilst the technological advances in mobile networks envisaged for 5G are such that multiple logical networks can be provisioned from one physical network (i.e. through slicing), it is possible that new spectrum demands will emerge (e.g. in relation to possible demand for private 5G networks for industrial IoT use cases). There might also be demand for private in-building 5G networks. There might be a need to consider more flexible approaches to spectrum assignment.

There is a possibility that the additional flexibility brought about by spectrum trading would be useful to cope with 5G development and roll-out. That said, we note that current mechanisms already provide some flexibility to allow use of existing mobile spectrum to evolve with the needs of 5G (e.g. re-farming of technology-neutral spectrum holdings for future 5G technologies). The expiry of existing spectrum assignments within the next ten years also provides opportunities for the CA to reorganise the band plans if necessary before the new term of assignment. There has thus yet to be a clear case for implementing spectrum trading in Hong Kong in the medium term.

In addition, it is likely that the supply of 5G spectrum in the frequency range 24.25–86GHz would be large. Although demand is still uncertain at this stage, should it be the view of the CA that there are no competing demands for 5G spectrum in the primary assignment, pursuant to the Radio Spectrum Policy Framework, this spectrum may be assigned administratively instead of through auction. In such a scenario, spectrum trading is not relevant.

Proposed approach to spectrum trading implementation if pursued, and alternative methods to enhance the spectrum efficiency in Hong Kong if not pursued

If a trading regime were to be pursued in Hong Kong, it is important to build on the existing regulations and practices adopted by the Government to minimise implementation complications resulting from inconsistencies between a new trading regime and the existing spectrum management framework.[1]

This would suggest that each prospective trade shall be reviewed on a case-by-case basis, using a two-tier approval process, to allow each trade to be considered based on its relevant technical merits. This regulatory approval process is the key safeguard to prevent trades that will reduce overall technical and market efficiency. Pre-existing safeguards i.e. network and service roll-out requirements, and clear definition of spectrum lot sizes and technical conditions, also serve to

[1] Depending on the types of trading to be implemented, some changes to existing regulations and/or to the spectrum management framework might be required (e.g. if liberalisation is allowed, it may be necessary to define technical usage conditions for licences to be suitable for trading).

safeguard against other costs related to spectrum hoarding, loss of harmonisation and the risk of interference.

We note that safeguards may not be effective in eliminating all potential costs/risks. This is particularly evident for the risk of windfall gains and other private profits to be gained by trading parties. Regulatory review of trades may remove some of the risk associated with excessive profits being gained by operators. However, this might not comprehensively resolve the issue as approved trades could still be conceived as 'unfairly benefiting' trading parties without stimulating productivity or competition.

Rather than spectrum trading, there are other mechanisms that can be used to effectively create a more flexible environment for spectrum assignment/re-assignment and to enhance spectrum efficiency in the Hong Kong market.

We have drawn on existing regulatory frameworks, and propose the following three enhancements to current spectrum management mechanisms that could help enhance spectrum use in Hong Kong, without implementing spectrum trading, namely:

- Enhanced mobile network sharing arrangement
  - combination of existing RAN-sharing and capacity leasing mechanisms
- Periodically adjusted SUF for administratively assigned spectrum
- Enhanced spectrum swap
  - inter-band and/or asymmetric bandwidth spectrum swaps.

Conclusion

In conclusion, spectrum trading may be a useful tool to enhance spectrum flexibility and efficiency, especially in certain market environments, e.g. those featuring regional licensing or perpetual licensing system. There are however potential costs to spectrum trading implementation that need to be carefully mitigated through a range of safeguards; and there are risks that might not be adequately addressed despite safeguards.

In the case of Hong Kong, it already has a spectrum management system which is reasonably effective in promoting efficient use of spectrum. Insofar as further enhancing the efficient use of spectrum and improving market flexibility are concerned, there are other spectrum management tools that can be used. The other tools could also potentially be enhanced to achieve similar benefits to that of the introduction of spectrum trading, without incurring the associated costs and risks. This suggests there is limited justification for introducing spectrum trading in Hong Kong in the short and medium term.

In the longer term, the potential 5G spectrum-related challenges are likely to be complex and interlinked. Hong Kong should monitor the technology and market developments as well as the allocation of mobile spectrum for 5G in the coming years and the implications on the spectrum assignment regime for mobile services both in primary and potentially in secondary assignments, with a view to keeping it up to date in the 5G era.

Annex B

Distribution of Spectrum Holdings among Mobile Network Operators

Spectrum	CMHK[1]	HKT[2]	Hutchison[3]	SmarTone[4]
850/900 MHz		15.0 MHz	10.0 MHz	10.0 MHz
900 MHz		16.6 MHz	16.6 MHz	16.6 MHz
1800 MHz	26.4 MHz	72.8 MHz	23.2 MHz	26.4 MHz
1.9–2.2 GHz	19.6 MHz	29.6 MHz	29.6 MHz	39.6 MHz
2.3 GHz	30.0 MHz		30.0 MHz	
2.5/2.6 GHz	40.0 MHz	60.0 MHz[5]	20.0 MHz[5]	20.0 MHz
Total	**116.0 MHz**	**194.0 MHz**	**129.4 MHz**	**112.6 MHz**

1 China Mobile Hong Kong Company Limited

2 Hong Kong Telecommunications (HKT) Limited

3 Hutchison Telephone Company Limited

4 SmarTone Mobile Communications Limited

5 Genius Brand Limited currently holds 40 MHz of spectrum in the 2.5/2.6 GHz band. Genius Brand Limited is indirectly owned by HKT and Hutchison, and hence the concerned spectrum is assumed to be equally shared between the two parties.