

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.