DECISION ISSUED BY THE
INFO-COMMUNICATIONS DEVELOPMENT AUTHORITY OF SINGAPORE

FRAMEWORK FOR THE ALLOCATION OF SPECTRUM FOR INTERNATIONAL MOBILE TELECOMMUNICATIONS ("IMT") AND IMT-ADVANCED SERVICES AND FOR THE ENHANCEMENT OF COMPETITION IN THE MOBILE MARKET

18 February 2016

PART I: INTRODUCTION

1. With the projected growth in mobile data consumption[1] driving the demand for spectrum for 4G and future International Mobile Telecommunications-Advanced ("**IMT-Advanced**") systems and services, IDA had earlier estimated that between 1 GHz and 2 GHz of spectrum will be required to deliver mobile services by around 2025, depending on the demand scenarios. Hence, IDA issued a public consultation in April 2014 ("**First Public Consultation**") to review the allocation of spectrum and the possible approaches to facilitate the entry of new players into the mobile market. A second public consultation was subsequently issued in July 2015 ("**Second Public Consultation**") to outline IDA's plans for the upcoming spectrum allocation exercise, including the proposal of a framework to facilitate the entry of a new Mobile Network Operator ("**MNO**"). These consultations are in line with IDA's vision of establishing Singapore as a 'Smart Nation'[2] that is underpinned by high speed, trusted and resilient infocomm infrastructure comprising both fixed and wireless networks.

2. In the Second Public Consultation, amongst other things, IDA sought views on the spectrum identified that could be made available to meet the growing mobile communication needs in the next 3 – 5 years, and proposed a framework to facilitate the entry of a new MNO, given the strong interest from industry players at the close of the First Public Consultation and the potential benefits that may be brought about with greater competition in this market.

3. At the close of the Second Public Consultation, IDA received comments from various respondents[3]:

a) Airbus Defence and Space
b) Consistel Pte Ltd
c) Ericsson Telecommunications Pte Ltd
d) GRID Communications Pte Ltd
e) Liberty Wireless Pte Ltd
f) LKH Precicon Pte Ltd
g) M1 Limited
h) Motorola Solutions
i) MyRepublic Limited
j) Qualcomm Incorporated

[1] Various studies forecast mobile data traffic to experience Compounded Annual Growth Rates ("**CAGR**") of between 40% and 60% over the next few years.
[2] Singapore's vision of a 'Smart Nation' encompasses citizens and people at the core of the transition – to use infocomm to enhance and improve citizens' lives and ensure that the use of infocomm is maximised to its fullest potential for the benefit of Singapore.
[3] The responses to the Second Public Consultation can be found at: http://www.ida.gov.sg/policies-and-regulations/consultation-papers-and-decisions/pending-decisions/Proposed-Allocation-of-Spectrum-for-International-Mobile-Telecommunications-IMT-and-IMT-Advanced-Services-and-Options-to-Enhance-Mobile-Competition

k) Singtel Mobile Singapore Pte Ltd
l) StarHub Mobile Pte Ltd
m) ZTE Corporation

4. IDA thanks all respondents and has given careful consideration to the comments received. Respondents were broadly supportive of the proposal to make available more spectrum for mobile services, although there were mixed responses to the proposed framework to facilitate the entry of a new MNO. This document sets out the key issues raised during the Second Public Consultation, the comments received, and IDA's decision on the final spectrum allocation and new entrant facilitation framework.

PART II: SUMMARY OF RESPONSES AND IDA'S DECISION

A. SPECTRUM TO BE ALLOCATED

5. In the Second Public Consultation, IDA shared its long term spectrum plans and its proposal to allocate 225 MHz of spectrum from the 700 MHz, 900 MHz (including the Extended GSM ("**EGSM**") band) and the 2.3 GHz and 2.5 GHz Time Division Duplex ("**TDD**") bands (the latter two are hereinafter referred to as the "**TDD bands**") for 4G and/or IMT-Advanced systems and services.

6. IDA had also identified the 800 MHz, 1.4 GHz and 3.5 GHz bands in the Second Public Consultation for mobile services. This included the proposed approaches to further study the technical issues related to the re-farming of these bands for mobile services, to harmonise the use of these bands with internationally and regionally agreed spectrum band plans, as well as the proposed means to facilitate the co-existence of the above-mentioned spectrum bands with other services.

Spectrum for allocation in near term

7. All respondents were generally supportive of the proposals to make available spectrum from the 700 MHz, 900 MHz and TDD bands for deployment of 4G and/or IMT-Advanced systems and services in the near term. Specifically, they agreed with the proposal to make available the 700 MHz, 900 MHz and TDD bands for mobile services, but urged IDA to reconsider setting aside part of the EGSM band for the Singapore-Malaysia High Speed Rail ("**HSR**"). There were also suggestions to make available more spectrum from the 2.3 GHz band for allocation, and to allocate the 800 MHz and 3.5 GHz bands in the upcoming spectrum allocation exercise. IDA has carefully reviewed these comments, taking into account all relevant considerations, including the outcome of the World Radio-communication Conference 2015 ("**WRC-15**"), as well as the impending expiry of the existing spectrum rights in the 900 MHz band and the need to re-allocate this band, and has <u>decided to allocate 235 MHz of spectrum from the 700 MHz, 900 MHz and the TDD bands in the upcoming spectrum allocation exercise for 4G and/or IMT-Advanced systems and services</u>. The amount of spectrum to be made available in each spectrum band and the specific frequencies are provided in the table below and elaborated in the rest of this section.

Table 1: Summary of spectrum to be allocated

Spectrum band	Frequency range	Amount	Available from
700 MHz	703 – 748 MHz/ 758 – 803 MHz	2 x 45 MHz (90 MHz)	1 January 2018[4]
900 MHz (including EGSM)	885 – 915 MHz/ 930 – 960 MHz	2 x 30 MHz (60 MHz)	1 April 2017
2.3 GHz TDD	2300 – 2340 MHz	40 MHz (unpaired)	
2.5 GHz TDD	2570 – 2615 MHz	45 MHz (unpaired)	

8. IDA will adopt the following definition for '4G and/or IMT-Advanced systems and services': "*a cellular mobile communications system capable of evolving to achieve the targeted peak data rates of 100 Mbps for high mobility and 1 Gbps for low mobility as defined by ITU-IMT-Advanced; meeting at the minimum the standards and specifications of either LTE (i.e., 3GPP Release 8 or beyond), or WiMax (i.e., IEEE 802.16-2009 or beyond) or standards/specifications recognised as ITU-IMT-Advanced by the ITU*." IDA had proposed the above definition in the Second Public Consultation and received no comments to amend the proposed definition.

9. Consistent with IDA's approach in the 2013 4G spectrum auction, IDA will adopt a case-by-case assessment of any proposed deployment of alternative technologies to those stated in this definition. The above-mentioned spectrum bands may also be used to provide 3G mobile services, provided that the spectrum right holder(s) fulfil the obligation to provide 4G and/or IMT-Advanced mobile systems and services, and obtain IDA's prior written approval for the use of the spectrum to provide 3G mobile services. In granting such approval, IDA reserves the right to impose such conditions as may be appropriate in the circumstances of each case.

700 MHz, 900 MHz and EGSM bands

10. Given that most respondents were supportive of the proposal to make available the 700 MHz and 900 MHz bands (including the EGSM band) for mobile services, IDA will allocate these bands in the upcoming spectrum allocation exercise.

11. In the Second Public Consultation, IDA had proposed to allocate the EGSM band on a short-term spectrum right basis with a First Rights of Refusal ("**FROR**")[5]

[4] The timeline for the availability of the 700 MHz band is dependent on the timeline for the switch off of the analogue broadcasting network, which is expected to complete by end 2017. IDA will finalise the commencement date for the 700 MHz spectrum rights when it issues the documents pertaining to the auction rules or as soon as possible. IDA will also put in place measures to address the uncertainty in the commencement date for the 700 MHz spectrum rights. Refer to subsequent section on 'Spectrum right duration' for further details.

accorded to the existing spectrum right holder or on a long-term spectrum right basis without any FROR accorded, depending on the developments for the EGSM band. Some respondents expressed their concerns with the proposal to accord FROR to only the existing EGSM band spectrum right holder, and shared that the expected completion of the Indonesian MNOs' network migration shortly should obviate the need for FROR. IDA also noted developments in Indonesia on the migration of the Indonesian MNOs' networks to GSM[6], High Speed Packet Access or LTE-based technologies which reasonably point to the availability of the EGSM band (i.e., 885 – 890 MHz / 930 – 935 MHz) before 1 April 2017. Having duly considered the relevant factors and circumstances, IDA has determined that it will allocate the EGSM band (i.e., 885 – 890 MHz / 930 – 935 MHz) on a long-term basis without according FROR to the existing spectrum right holder.

12. As mentioned in the Second Public Consultation, IDA further notes that Singapore and Malaysia are in discussions over the operational requirements for the Singapore-Malaysia HSR. These include the spectrum requirements for a communication system for rail operations (i.e., GSM for Railway or "**GSM-R**") that is likely to reside within the EGSM band, possibly in the 880 – 885 MHz/ 925 – 930 MHz portion, which remains under consideration by the relevant authorities.

13. Hence, while IDA will allocate the aforementioned EGSM band on a long-term basis without according any FROR to the existing spectrum right holder, should unforeseen circumstances delay the availability of the aforementioned EGSM band or if part of the allocated EGSM frequencies is required for the Singapore-Malaysia HSR subsequently, the successful bidder of the EGSM band may be required to shift its operating frequencies within the EGSM band[7] accordingly.

2.3 GHz and 2.5 GHz TDD bands

14. A few respondents suggested making available more spectrum from the 2.3 GHz TDD band and requested clarity on the constraints pertaining to the use of this band. IDA would like to reiterate that the 2.3 GHz TDD band is currently coordinated on a 'half-band' sharing basis with our immediate neighbours. Singapore thus has priority access to the 2300 MHz – 2350 MHz TDD band only. Further, as the 2335

[5] IDA would reiterate that it is generally not inclined towards granting FROR in spectrum allocation exercises, as it strengthens incumbency and distorts the market mechanism which ensures that scarce spectrum resources are allocated to parties that are able to utilise them efficiently. Whilst IDA had considered FROR for the EGSM band due to the unique circumstances of the present case, such considerations may not always be relevant or applicable for other cases.

[6] IDA understands the Indonesia Minister of Communication and Information had issued a regulation pertaining to the restructuring of Indonesia's 800 MHz spectrum band for mobile services, which involves the migration of Indonesian MNOs' Code Division Multiple Access ("**CDMA**") network by 14 December 2016.

[7] 880 – 890 MHz / 925 – 935 MHz

MHz – 2400 MHz TDD band are constrained frequencies[8], IDA had proposed to allocate 30 MHz (i.e., 2300 MHz – 2330 MHz) for mobile services in the Second Public Consultation. Nonetheless, taking into consideration the respondents' comments, and following further studies conducted by IDA which demonstrated that it is possible for mobile services to co-exist with the users residing in some parts of the constrained frequencies[9], IDA has decided to increase the amount of spectrum to be allocated from the 2.3 GHz TDD band to 40 MHz.

15. Regarding the 2.5 GHz TDD band, most respondents suggested setting aside 5 MHz of spectrum on both ends of the 2.5 GHz TDD band as guard bands. IDA will thus maintain a 5 MHz guard band in the upper end of the 2.5 GHz TDD band. IDA is of the view that a guard band at the lower end of the band is not required as IDA has assessed that the unassigned 2 x 10 MHz of Frequency Division Duplex ("**FDD**") spectrum in the 2.5 GHz band[10] is sufficient to minimise potential interference between adjacent FDD and TDD systems. IDA also notes the respondents' suggestion on the possible mitigation measures for co-channel or adjacent channel interference between different TDD systems and will leave it to the MNOs to coordinate with one another (with both local MNOs and with MNOs in neighbouring countries where necessary) to ensure the co-existence of their respective networks.

16. In addition to the above coordination requirements, IDA will also require the successful bidders of the TDD bands to coordinate their mobile network deployments with the adjacent operators of any authorised telecommunication system. Further details are provided in the subsequent section on 'Spectrum coordination'.

Other spectrum bands for allocation in the longer-term

17. For the other spectrum bands that were consulted on or mentioned in the Second Public Consultation, IDA notes the respondents' support for the proposed timeline of 3 – 5 years to re-farm the 800 MHz band and suggestions on the approach to re-farm this band. Respondents also broadly agreed with the proposed plans to make available the 1.4 GHz band for trials while awaiting the outcome of WRC-15, although a respondent highlighted that devices for this band are currently unavailable. Finally, some respondents also suggested making available the 3.5 GHz band for mobile services.

[8] The constrained frequencies are not available for assignment due to potential interference with other networks and systems currently deployed in Singapore.
[9] This will require certain interference mitigation measures (e.g., spectrum coordination) that will be elaborated in the later sections.
[10] 2560 – 2570 MHz / 2680 – 2690 MHz. IDA had reserved this 2 x 10 MHz of FDD spectrum as a guard band to provide for the co-existence of S-band radars and mobile systems operating in the 2.5 GHz band. See 'Decision on Framework for the reallocation of spectrum for 4G telecommunication systems and services' for further information. Available from: https://www.ida.gov.sg/~/media/Files/PCDG/Consultations/20120410_4Gtelecomm/Decision4GSpectrum.pdf

18. IDA will take into consideration the industry's comments and the outcome of the recently concluded WRC-15 discussions as IDA reviews the plans of these spectrum bands and assesses suitable spectrum that could be re-farmed for the provision of mobile broadband services in the longer-term. Specifically, IDA's review activities will entail the following:

a) IDA will require time (i.e., approximately 3 – 5 years) to re-farm the 800 MHz band and assess the appropriate assignments for this band. For instance, given the number of existing users in the 800 MHz band and the complexity of the re-farming process, IDA will need to engage existing Short Range Device and Trunked Radio users to assess the appropriate timeframe for migration, and work with them to minimise the impact to their customers arising from the re-farming exercise.

b) For the 1.4 GHz band[11] ("**L-band**" in short), IDA notes the industry's comments that no device is currently commercially available. IDA will thus monitor market and technology developments, and take into consideration the WRC-15 recommendations before allocating spectrum in this band. As proposed in the Second Public Consultation, IDA will make available spectrum from this band for interested parties to conduct trials, for temporary use[12], and/or offer commercial services[13] while the long-term plan[14] for the L-band is being studied. These trials, temporary use and/or commercial services should be based on wireless broadband technologies (including for example, enterprise LTE ("**eLTE**") or Machine-to-Machine ("**M2M**") services). Trials may be conducted under IDA's Technical[15] or Market Trial[16] frameworks, and commercial services may be offered using spectrum assigned on a non-interference and non-protection basis[17].

[11] Namely 1452 – 1492 MHz
[12] Guidelines for applying for the temporary or occasional use of radio frequencies. Available from: http://www.ida.gov.sg/~/media/Files/PCDG/Licensees/Licensing/Framework%20and%20Guidelines/GuidelinesLicensingSch/WebGuidelinesTempFreqUse.pdf
[13] The type of application depends on industry demand, which will be considered and approved by IDA on a case-by-case basis.
[14] The WRC-15 identified frequencies in the L-band (i.e., 1427 – 1518 MHz) for mobile broadband communications.
[15] Terms and conditions for telecommunication technical trials. Available from: http://www.ida.gov.sg/~/media/Files/PCDG/Licensees/Licensing/Framework%20and%20Guidelines/GuidelinesLicensingSch/TechTrialLic.pdf
[16] Guidelines on submission of application for market trial licence. Available from: http://www.ida.gov.sg/~/media/Files/PCDG/Licensees/Licensing/Framework%20and%20Guidelines/GuidelinesLicensingSch/GuideMTrialLic.pdf
[17] Framework for assignment of frequencies on non-interference and unprotected basis. Available from: http://www.ida.gov.sg/~/media/Files/PCDG/Licensees/SpectrumMgmt/SpectrumAuctAss/NonInterfUnprotBasis/Info%20Paper_8Mar10.pdf

c) For the 3.5 GHz bands, IDA expects to conduct further technical assessments on the co-existence between mobile services and existing users, before deciding on the long-term plan for this band.

19. IDA will conduct separate consultation(s) for any proposed changes to the use of the above-mentioned spectrum bands.

B. SPECTRUM ALLOCATION AND NEW ENTRANT FACILITATION FRAMEWORK

Overview

20. Consistent with previous frameworks on the allocation of spectrum for mobile services, IDA will adopt a market-based approach (i.e., auction) to allocate the identified spectrum bands in Table 1 (hereinafter known as the "**2016 Spectrum Auction**"). In IDA's view, this is a fair, transparent and efficient method to allocate scarce spectrum resources.

21. As proposed in the Second Public Consultation, IDA will also leverage the 2016 Spectrum Auction to facilitate the entry of a new MNO, given the market interest reflected in the First Public Consultation and the potential benefits that may be brought about by a new MNO. IDA will facilitate the entry of one new MNO only as IDA's study showed that the market structure and growth potential of Singapore's mobile market can likely only support one more MNO in the next few years.

22. One group of respondents commented that the mobile market is mature and competitive. There are a variety of quality mobile services and the incumbent MNOs proactively invest in their mobile networks. These respondents said that there is a lack of evidence on the purported benefits of new entry. They also said that decreased revenues in the mobile sector arising from greater competition will not encourage service innovation and investments, citing a number of consolidations in Europe as an example. On the other hand, another group of respondents was of the view that new MNO entry would be the catalyst for competitive and innovative mobile services.

23. On balance, given the strong interest from potential new players, IDA is of the view that there may be scope for greater competition and service innovation in the market. Furthermore, with consumers' increasing reliance on mobile broadband for connectivity, and the technology and service evolutions in the industry (such as Internet of Things ("**IoT**") and M2M communications), there may be attractive and viable business opportunities and market segments for a new MNO.

24. In this regard, IDA has observed that the entry of new players in other jurisdictions has brought about lower priced and/or more innovative mobile plans for the benefit of consumers. For example, some jurisdictions with new MNO entry have experienced decreases in average mobile price plans by up to 40%, and the introduction of new service offerings such as simplified pricing packages, innovative bundles and specialised plans for targeted customer segments. Further, IDA has observed that the entry of a new MNO may also incentivise the MNOs to invest in their mobile networks to maintain their competitive advantage.[18]

25. IDA also notes that globally, some mobile markets have been supporting a 4-MNO structure, such as in Spain and Sweden. In Hong Kong, there are also four MNOs operating in the market after a merger in 2014 reduced the number of MNOs from five to four. While IDA notes the respondents' comments about a number of consolidations in the European mobile market recently, notably in Germany and Ireland, it should be noted that the European Commission ("**EC**") had put in place conditions as part of these mergers that would still encourage a 4-MNO market structure in their respective markets. The mergers in the aforementioned countries typically include conditions for the merged entity to divest or make available spectrum to a new MNO, and/or strengthening regulations to facilitate the entry of Mobile Virtual Network Operators ("**MVNOs**"). In explaining its decisions, the EC emphasised that these conditions would ensure that competition would be preserved such that consumers would be able to enjoy the associated benefits.

26. In relation to these mergers and the recent developments pertaining to consolidations in Europe, IDA also notes that the concerns on lessening of competition were shared by most European regulators.[19]

27. On the concerns that new MNO entry will impact mobile network investments, IDA found no clear or direct correlation between new MNO entry and a fall in mobile network investments by incumbent MNOs in other jurisdictions. While some countries had experienced a fall in mobile network investments following the entry of a new MNO, such fluctuations could have been influenced by macro-economic conditions and/or the state of the MNO's mobile network, rather than a direct result of the new entry. In this regard, IDA further notes that other regulators had

[18] For example IDA observed that Bouygues went on to deploy France's first LTE-Advanced ("**LTE-A**") network in 2014 despite the entry of Free Mobile and the competitive pressure it exerted on the market. Orange has also announced its plans to invest €15 billion in its networks to maintain its competitive advantage over the next few years.

[19] For instance, in a recent article in the Financial Times dated 31 January 2016 that made reference to the planned Hutchinson 3 UK and O2 merger, Ms Sharon White, the CEO of the UK regulator, Ofcom, stated that "Competition, not consolidation, has driven investment." She further noted an Ofcom study that showed that average mobile prices were lower by 10 – 20 % in markets with four operators and a disruptive player than in those with only three established networks. Similarly, in a speech after the withdrawal of the merger of Telenor and TeliaSonera in Denmark, Ms Margrethe Vestager, EC Competition Commissioner, shared that "we could not see how the benefits for consumers would outweigh the expected price increases induced by the loss of competition".

expressed views that competition was instrumental to mobile network investments, and there are examples[20] of increased investment levels following the entry of a new MNO. Therefore, IDA is of the view that the entry of a new MNO is likely to increase the total mobile network investments in the market as a whole, and spur incumbent MNOs to continue to invest in upcoming technologies such as 5G in order to remain competitive in the dynamic mobile sector, where end users demand access to quality, reliable, high-speed and advanced mobile broadband services.

28. In summary, given the potential benefits with the entry of a new MNO and the strong interest from industry players, it would not be reasonable for IDA to foreclose market entry.

Spectrum Auction Structure

29. IDA will structure the 2016 Spectrum Auction in two stages: (i) a New Entrant Spectrum Auction ("**NESA**"), which is only open to qualified[21] bidders who are currently not MNOs; and (ii) a General Spectrum Auction ("**GSA**") which is open to the incumbent MNOs and the successful bidder from the NESA. IDA has given careful consideration to the comments by the industry, and has set out its decision in the following sections.

NESA Framework

30. In the Second Public Consultation, IDA proposed to set aside 60 MHz of spectrum that comprised 2 x 10 MHz of 700 MHz band, 2 x 10 MHz of 900 MHz band and 20 MHz of 2.3 GHz TDD band for one new MNO.

31. Under the NESA framework, amongst other things, a qualified potential new entrant bidder must be an incorporated company[22]; must not have rolled out or own any nationwide mobile system or network in Singapore; and must not be an associate[23] of any incumbent MNO and/or of another qualified potential new entrant bidder.

[20] In a speech in June 2015, the EC Competition Commissioner stated that "…overall level of telecoms investment in France grew, and remains at higher levels than at the moment of Free's entry". IDA also notes that, on 17 March 2015, Orange announced a €15 billion plan to enhance networks across its group, including its telecommunication operations.

[21] Potential new MNOs who are interested in participating in the NESA are required to participate in a pre-qualification exercise before they are allowed to participate in the NESA. Further details are provided in the subsequent sections.

[22] For the avoidance of doubt, a consortium or overseas company seeking to participate in the NESA must incorporate a company under the Singapore Companies Act (Cap. 50) in order to do so.

[23] For the 2016 Spectrum Auction, IDA will adopt the following definition of "associate" in determining whether a new entrant bidder is an associate of an incumbent MNO and/or of another qualified potential new entrant bidder: A person, A, is an associate of another person, B, if —
(a) A is a relative of B;
(b) A is a related corporation of B;
("related corporation" has the same meaning as in Section 4(1) of the Companies Act)

32. IDA assessed that a new MNO would require access to sufficient low and high frequency spectrum to offer competitive data capacity and service coverage to compete in the mobile market. At the same time, IDA was cognisant that the new MNO might not have the financial resources to participate and compete on a level playing ground in the same spectrum auction with the incumbent MNOs to obtain the spectrum required, given the capital investment required to deploy a new nationwide mobile network and the revenue uncertainty as it competes for customers in a mature market. As a result, the new MNO and incumbent MNOs would value the same spectrum composition differently. Further, the spectrum set-aside would not be the first time IDA has set aside spectrum to facilitate the entry of a new MNO. Similar measures were adopted for the 2013 4G spectrum auction, but IDA notes that there was no interest from industry players then.

33. There were mixed responses to the above proposal. Some respondents submitted that the proposed spectrum set-aside package was "generous" and opined that 2 x 10 MHz of sub-1 GHz spectrum would be sufficient for the new MNO to deploy a nationwide mobile network. There were also concerns that the spectrum set-aside in the 900 MHz band might impact the incumbent MNOs' ability to meet IDA's 3G Quality of Service ("**QoS**") requirements, and there were suggestions for IDA to set aside spectrum from the 800 MHz band instead. There were also suggestions to disallow the new MNO from participating in the GSA. On the other

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(c) A is a corporation whose directors are accustomed or under an obligation, whether formal or informal, to act in accordance with the directions, instructions or wishes of B or, where B is a corporation, of the directors of B;
("corporation" has the same meaning as in Section 4(1) of the Companies Act)
(d) B is a corporation whose directors are accustomed or under an obligation, whether formal or informal, to act in accordance with the directions, instructions or wishes of A or, where A is a corporation, of the directors of A;
(e) A is a person who is accustomed or under an obligation, whether formal or informal, to act in accordance with the directions, instructions or wishes of B or, where B is a corporation, of the directors of B;
(f) B is a person who is accustomed or under an obligation, whether formal or informal, to act in accordance with the directions, instructions or wishes of A or, where A is a corporation, of the directors of A;
(g) A is a corporation in which B, alone or together with other associates of B as described in paragraphs (b) to (f), is in a position to control not less than 12% of the voting power in A;
(h) B is a corporation in which A, alone or together with other associates of A as described in paragraphs (b) to (f), is in a position to control not less than 12% of the voting power in B;
(i) A is a person with whom B has an agreement or arrangement, whether oral or in writing and whether express or implied, to act together with respect to the acquisition, holding or disposal of shares, units or other equity interests in, or with respect to the exercise of their voting power in relation to, a designated telecommunication licensee, a designated business trust or a designated trust;
(j) A is a person with whom B has an agreement or arrangement, whether oral or in writing and whether express or implied, to act together with respect to the provision of telecommunication services;
(k) A is a person with whom B has an agreement or arrangement, whether oral or in writing and whether express or implied, to trade or lease or otherwise transfer the right to use spectrum; or
(l) A is related to B in such other manner as prescribed by any regulations made under section 74 of the Telecommunications Act (Cap. 323).

hand, a few respondents were supportive of the proposal and even suggested IDA to set aside at least 20 MHz more spectrum (either from the sub-1 GHz or above-1 GHz band) for the new MNO, so as to facilitate the new MNO to offer comparable high speed mobile services as the incumbent MNOs.

34. IDA has reviewed the proposed spectrum set-aside package in view of the industry comments received, and will set aside 60 MHz of spectrum that comprises 2 x 10 MHz of 900 MHz band and 40 MHz of 2.3 GHz TDD band for one new MNO in the NESA. IDA's reasons are set out as follows:

a) No mandatory wholesale roaming access: IDA maintains its position not to mandate the incumbent MNOs to provide wholesale access to the new MNO under the upcoming spectrum allocation exercise. This is because establishing wholesale roaming arrangements often involve substantial and lengthy negotiations, which may delay the new MNO's service deployment process. Further, such wholesale roaming access may increase the new MNO's dependency on the incumbent MNOs' network, reducing the incentive for the new MNO to deploy its network expeditiously and limiting the benefits that could have been brought about by more facilities-based competition.

b) Sub-1 GHz spectrum: IDA will set aside 2 x 10 MHz of spectrum from the 900 MHz band as this amount has been assessed to be appropriate to support the roll out of a nationwide mobile network. Some respondents had similarly commented that 2 x 10 MHz of sub-1 GHz spectrum was sufficient for the provision of a nationwide mobile network. IDA did not consider the 800 MHz band for the spectrum set-aside package as it is not ready for allocation for mobile services as explained in the earlier sections. While IDA could have set aside the 700 MHz band for the new MNO instead, the uncertainty[24] over the commencement date of spectrum right for the 700 MHz band meant that the new MNO will have to rely on its high frequency spectrum holdings (see below) or some form of roaming arrangement with the incumbent MNOs to achieve a network coverage and capability that is equivalent to deploying in the 700 MHz band in the interim period. Relying solely on high frequency spectrum to roll out a nationwide network will increase the capital investment[25] and time required significantly, thereby reducing the viability of the new MNO. Negotiating interim roaming or wholesale arrangements with incumbent MNOs may also be protracted. Therefore, it would be more appropriate to

[24] The availability of the 700 MHz band for mobile services is dependent on the switch off of the analogue broadcasting network, which is expected to complete by end 2017.

[25] IDA understands that the roll out of a mobile network that relies primarily on high frequency spectrum is expected to require around several times the capital investment to roll out a mobile network using low frequency spectrum in an urban setting.

set aside sufficient amount of spectrum in the 900 MHz band and let the new MNO decide if it would like to obtain more low frequency spectrum in the 700 MHz band in the GSA, rather than reserving it in the NESA.

c) Above 1 GHz spectrum: IDA has decided to increase the amount of spectrum set-aside in the 2.3 GHz TDD band from 20 MHz to 40 MHz. High frequency spectrum such as the 2.3 GHz TDD band is typically employed as a capacity layer by MNOs globally to provide faster mobile network speeds. The increased spectrum set-aside in the TDD bands will enable the new MNO to provide comparable mobile network speeds to compete effectively with the incumbent MNOs. Specifically, the new MNO will be able to aggregate the 40 MHz of 2.3 GHz TDD spectrum to achieve a theoretical peak throughput of up to 220 Mbps using existing antenna technologies. It will also have the option of aggregating its 900 MHz and 2.3 GHz TDD spectrum to provide a theoretical peak throughput of up to 295 Mbps, with more advanced technical solutions[26]. These arrangements will enable the new MNO to compete on a level playing field with incumbent MNOs, and differentiate itself through innovative services and pricing offers.

35. IDA disagrees with the submissions that the spectrum set-aside in the 900 MHz band will cause significant impact to the incumbent MNOs' 3G QoS. The 900 MHz band is currently allocated to the incumbent MNOs, who are utilising them for the provision of 2G, 3G or 4G mobile services. With the cessation of 2G services from 1 April 2017[27], the spectrum set-aside is akin to the re-farming of the spectrum currently assigned for 2G services in favour of 4G and/or IMT-Advanced services. In addition, with an increasing number of subscribers migrating to 4G services, IDA has assessed that the incumbent MNOs will only require 2 x 5 MHz of 900 MHz spectrum each for the provision of 3G services and to meet the relevant QoS standards.[28] In view of the above, the spectrum set-aside package is unlikely to cause significant disruptions to the incumbent MNOs' operations in respect of their provision of 3G services. Further, IDA will implement certain measures[29] in the GSA to ensure the incumbent MNOs' continued access to the 900 MHz band to avoid disruptions to existing 3G services.[30] Therefore, a more balanced and reasonable approach would

[26] Achieved through multiple-input-multiple-output antennas, carrier aggregation, etc.
[27] MNOs to close 2G networks from 1 April 2017. Available from: https://www.ida.gov.sg/About-Us/Newsroom/Media-Releases/2015/MNOs-to-close-2G-networks-from-1-April-2017
[28] The incumbent MNOs also have access to approximately 45 MHz of spectrum from the 2.1 GHz band for the provision of 3G services.
[29] Refer to section on 'Spectrum caps' for further information.
[30] The measures are an exceptional arrangement based on the facts of the present case, and shall not be construed as giving rise to any expectation by the industry that IDA will adopt the same or similar measures in the future to ensure that the MNOs' services are not adversely disrupted as a result of any spectrum right expiry. In addition, the MNOs shall not rely on the above to claim or assert any form of legitimate expectation against IDA, whether procedural or substantive in nature, in respect of any action that IDA may or may not take in the exercise of its discretion. As commercial entities, the

be to maintain the spectrum set-aside of 2 x 10 MHz from the 900 MHz band, and incorporate mechanisms into the GSA to ensure the incumbent MNOs have continued access to a reasonable amount of the 900 MHz spectrum to provide quality mobile services (see section on 'Spectrum caps' below).

36. With the spectrum set-aside in the 900 MHz band, IDA recognises that the incumbent MNOs may be required to re-tune their mobile networks, depending on the final assignment of the spectrum lots. In this regard, IDA will allow the MNOs (i.e., both incumbent MNOs and the new MNO, if any) to submit a joint proposal on the specific frequency assignments during the 'Assignment Stage' of the GSA (see section on 'Spectrum Auction Parameters for GSA' below). To facilitate the above transition, IDA will require the successful bidders of the 900 MHz band to extend all necessary cooperation, flexibility and assistance, especially in the first two months after 1 April 2017, in order to ensure the orderly migration of services.[31]

37. On some respondents' submissions that more spectrum should be set aside for the new MNO, IDA would highlight again that the spectrum set-aside package now comprises a combination of low and high frequency spectrum, which aggregation should allow the new MNO to offer comparable mobile services to the incumbent MNOs from a throughput perspective. The new MNO may also participate in the GSA if it wishes to obtain further spectrum, and will be subject to similar auction rules[32] as the incumbent MNOs. However, the new MNO will not be allowed to bid for the 900 MHz band in the GSA as it would have reached the spectrum caps placed on all players to ensure reasonable access to spectrum in this band for the provision of quality mobile services (see section on 'Spectrum Auction Parameters for GSA' below).

38. With respect to the comments that the proposed spectrum set-aside package was excessive by international standards, IDA would like to highlight that while some of the overseas regulators had set-aside a smaller amount of spectrum for a new MNO, they had also imposed regulatory obligations on the incumbent MNOs to provide national roaming to the new MNO. For example, the incumbent MNOs in France were required to provide 2G roaming services to Free Mobile as part of their licence conditions. Similarly, and as part of the conditions for the merger of Hutchinson 3 Austria and Orange Austria (the merged entity collectively known as "**H3G Austria**"), H3G Austria was required to provide roaming service to the new MNO that entered the Austrian mobile market through Austria's 2013 spectrum auction. In this regard, as earlier explained, IDA will not impose regulatory obligations on the incumbent MNOs to provide wholesale roaming to the new MNO

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onus is solely on the MNOs to be fully aware of the expiry dates of their respective spectrum rights, and to make such plans and take such steps as are required to ensure the continuity of their mobile services prior to the applicable expiry dates.

[31] For the avoidance of doubt, this is an exceptional arrangement based on the facts of the present case. For more information, please refer to footnote 30.

[32] This would include, amongst others, the spectrum caps.

under the upcoming spectrum allocation exercise. Furthermore, it should also be noted that the market conditions for which the set-aside spectrum amount was decided in the various countries were different. For example, Free Mobile in France likely did not require as much spectrum when it bid for the fourth mobile licence in 2009[33] given that 2G and 3G were the prevalent technologies and mobile data consumption was low. Therefore, it would not be appropriate to directly compare IDA's facilitation framework for a new MNO with the other countries as the conditions and circumstances for the spectrum set-asides were different (further details are provided in **ANNEX A**). As such, IDA considers that the spectrum set-aside package of 60 MHz is sufficient and reasonable for the new MNO in today's mobile market.

39. With the spectrum set-aside from the 900 MHz and 2.3 GHz TDD bands, the remaining spectrum lots in the 700 MHz, 900 MHz and the 2.5 GHz TDD bands will be allocated in the GSA. If there is no new MNO following the conclusion of the NESA, the set aside spectrum will be allocated in the GSA, which will be available for bidding by the incumbent MNOs only.

Reserve price for spectrum set-aside package

40. IDA had proposed an indicative reserve price of S$40 million as the starting price for the NESA, based on the proposed 60MHz of spectrum set-aside package in the Second Public Consultation. There were mixed responses to the proposed indicative reserve price. While a few respondents were supportive of the proposed reserve price, some other respondents submitted that it amounted to a 'subsidy' and was excessively discounted by international standards. There were also suggestions to peg the clearing price of the spectrum set-aside package at a specific discount to the clearing prices of the respective spectrum lots in the GSA, or to set the clearing prices of the respective spectrum lots in the GSA at a premium to the clearing price of the spectrum set-aside package.

41. IDA has reviewed the reserve price for the spectrum set-aside package and has decided to revise it from S$40 million to S$35 million[34] to take into account the changes to the composition of the spectrum set-aside package. As explained in the Second Public Consultation, IDA had arrived at the reserve price for the spectrum set-aside package after considering, among other things, the capital investments required to roll out a new nationwide mobile network. IDA considers that the difference in the reserve price for the NESA and for a similar spectrum package in the GSA is not unreasonably excessive considering that the objective of this facilitation measure is to lower the entry barriers for the new MNO to participate in

[33] Arcep accepts Free Mobile's application. Available from: http://www.arcep.fr/index.php?id=8571&no_cache=1&L=1&tx_gsactualite_pi1%5Buid%5D=1234&cHash=673a886685546b63b1c60de48694ba5e

[34] The reserve price excludes Goods and Services Tax, which shall be separately borne by the successful bidder.

the auction to bid for the spectrum set-aside package. IDA would like to highlight that other jurisdictions had adopted similar approaches for their spectrum auctions in response to the additional regulatory obligations that were imposed on their MNOs for being awarded certain spectrum lots. For example, the reserve price for spectrum lots that came with a specific service coverage obligation for Norway's 800 MHz auction in 2013 were 60% lower than similar lots without the obligation. In the UK, the reserve price for spectrum lots with specific service coverage obligation was around 44% lower than spectrum lots without similar obligations. These international examples demonstrate that IDA is not unique in adopting a lower reserve price for spectrum lots, depending on the policy objectives to be achieved.

42. IDA also disagrees with the suggestions to cross-peg the clearing prices of either the NESA or GSA at a pre-determined premium or discount across the two auctions. Such approaches defeat the objective and nullify the benefits of the auction process to encourage an efficient allocation of spectrum resources.

43. IDA would also like to emphasise that the reserve price for the NESA is not a 'subsidy', as alluded to by some respondents in the Second Public Consultation. In this regard, IDA would highlight that the reserve price is only a starting bid price for the NESA, and the clearing price will ultimately depend on the outcome of the NESA.

Auction format for NESA

44. IDA had proposed to adopt either a simple ascending round auction or a single-round second price sealed bid auction for the NESA in the Second Public Consultation. While the respondents did not raise concerns with either, one respondent indicated its preference for the ascending round format while another suggested IDA to adopt a tender approach to award the 4th MNO licence as this would enable IDA to select the most capable candidate among the potential new entrants.

45. Having considered the comments, IDA will adopt an ascending round auction for the NESA to facilitate price discovery. As mentioned earlier, IDA has adopted an auction approach as it is the most objective, efficient and transparent means of allocating scarce spectrum resources. In particular, given the possibility of competing new entrant bidders, it would be more appropriate to adopt an ascending round auction, rather than a sealed bid auction, to ensure the auction process is rigorous in ensuring the spectrum is allocated in an efficient manner to the bidder that values it the most.

Pre-qualification and performance bond

46. Several respondents emphasised the importance of the pre-qualification exercise to ensure only serious and capable players are allowed to participate in the spectrum auction. There were also specific suggestions for IDA to impose a

performance bond on the new MNO to ensure it is committed to deploy a mobile network.

47. IDA agrees that prospective bidders should be pre-qualified before they are permitted to participate in the NESA. This is consistent with the approach that IDA has taken for previous auctions. For example, in the 2013 4G spectrum auction, prospective bidders were required to declare, amongst other things, their financial capital structure, technical capabilities and their proposed services. They were also required to submit a banker's guarantee, as part of their 'Expression of Interest' to participate in the auction, for an amount that was equivalent to the reserve prices for their initial bid. Separately, under the Facilities-Based Operator ("**FBO**") licence framework, every new FBO licensee is also required to submit a performance bond amounting to 5% of its budgeted capital expenditure as part of its FBO licence application. These served as checks to ensure that the prospective bidders are serious and possess the necessary capabilities to deploy the relevant network(s) to provide telecommunication services.

48. To ensure that the above interests continue to be met, IDA will impose pre-qualification requirements on prospective bidders[35] to, *inter alia*, provide the relevant evidence of their technical capabilities and their financial position. This will include documentary evidence of the bidders' experience in telecom network deployments, understanding of the local environment for network deployment and offering of services, and commitments from investors or lenders certifying the amount of funding that will be provided to support the new MNO's spectrum bidding and network deployment. IDA will also consider and review certain other relevant factors. On a non-exhaustive basis, these will include reviewing the prospective bidder's business plans and planned service offerings (in particular, what are its planned innovative service offerings and how would it bring greater value to consumers), track record of operational performance and compliance with regulations, and subjecting it to a 'fit and proper' test, such as the background, reputation and standing of the prospective bidder, checking for any criminal records of the prospective bidder, whether the prospective bidder has been refused a licence, whether there are public interest concerns, etc. Further details of the pre-qualification criteria can be found in the auction documents that will be issued at a later date.

49. Consistent with previous spectrum auctions, IDA will require prospective bidders to submit a banker's guarantee that is equivalent to the reserve price of the spectrum set-aside package as part of their 'Expression of Interest' for the NESA. The successful bidder will also be required to submit an additional banker's guarantee that, together with the submitted banker's guarantee as part of the successful bidder's 'Expression of Interest', guarantees at least 75% of the winning

[35] References to prospective bidders shall include their officers, their shareholders and their associates.

bid of the NESA.[36] Details of these payment requirements will be stipulated in the auction documents.

50. IDA will also impose a performance bond on the new MNO that is equivalent to 5% of the new MNO's expected capital expenditure or S$20 million, whichever is higher, upon the grant of its FBO licence or amendments to its existing FBO licence, as the case may be.[37] The new MNO will be required to submit the performance bond in the form of a banker's guarantee in accordance with the requirements stipulated in the auction documents. This performance bond will be tied to milestones pertaining to the new MNO's network rollout that have been committed by the new MNO and approved by IDA. IDA will have the right to draw on the banker's guarantee if the new MNO fails to meet any of the rollout milestones, unless there are reasons provided to IDA's satisfaction. Separately, the new MNO is reminded that IDA is empowered to take appropriate enforcement action against it, including but not limited to the imposition of financial penalties on the new MNO should it fail to meet any of its regulatory obligations, including compliance with licence and spectrum right conditions, as the case may be, above and beyond the requirements of the performance bond.

Services to be provided by the new MNO

51. As indicated in the Second Public Consultation, IDA notes that the definition of 4G and/or IMT-Advanced systems and services may be interpreted to mean that MNOs may be able to use the allocated spectrum bands to provide data-only mobile services. Following further assessments, and in view that there is still significant voice and SMS service demand by consumers, IDA will require the new MNO to also provide voice (including emergency call services) and SMS services. IDA will adopt a technology neutral approach for this requirement, and will leave it to the new MNO to decide on the best approach to provide such services (i.e., by LTE, any other technologies, or via wholesale arrangements).

52. While IDA will not prohibit the new MNO from providing wholesale services (see subsequent section on 'Wholesale obligations'), IDA requires the new MNO to utilise the spectrum rights it acquires to deploy its own nationwide mobile network for the purpose of providing retail mobile broadband services directly to its own end users (i.e., individual and/or corporate customers).

[36] For clarity, in the event that the winning bid is an amount equivalent to the reserve price of the spectrum set-aside package, the successful bidder of the NESA will not be required to submit any additional banker's guarantee.

[37] IDA will determine the amount for the performance bond based on the expected capital expenditure for the roll out of a nationwide mobile network as indicated in the new MNO's 'Expression of Interest' document.

Spectrum Auction Parameters for GSA

Auction format for GSA

53. IDA had proposed to adopt the 'Clock Plus' auction format for the GSA to provide a more efficient auction outcome by facilitating price discovery and reducing aggregation risks between categories of spectrum bands. The 'Clock Plus' auction format is also simpler to understand from the perspective of the bidders, compared to the 'Combinatorial Clock Ascending' auction format. The respondents who commented on this auction format had not raised concerns on the format, aside from suggestions on some aspects of the auction rules. Therefore, IDA will adopt the 'Clock Plus' auction format for the GSA.

54. IDA will issue the specific details and rules of the 'Clock Plus' auction format in due course, but an overview of the format and the key auction parameters are described below.

55. As indicated in the Second Public Consultation, the 'Clock Plus' auction will consist of three main stages:

a) Initial offer stage: Qualified bidders will be required to submit an initial offer in respect of the quantity of spectrum lots they demand in each spectrum band (700 MHz, 900 MHz, and the TDD bands), subject to the relevant spectrum caps.[38] In any spectrum band, should the quantity demanded by all qualified bidders exceeds the quantity of spectrum lots available in that spectrum band, the auction will proceed to the 'Quantity stage' for all spectrum bands; otherwise each qualified bidder will be allocated the quantity demanded at the reserve price and proceed to the 'Assignment stage'.

b) Quantity stage: At the start of this stage of the auction, there will be a price 'clock' for each relevant category of spectrum lots. In each round, qualified bidders will specify demand for quantities of lots within categories, subject to the relevant spectrum caps. There is a single common price for all lots within a category, and this price 'ticks' up over successive rounds until there is no longer any excess demand. This stage of the auction is completed when there is no longer excess demand in every category of spectrum lots. Thereafter, successful qualified bidders will go on to the 'Assignment stage'.

[38] For the avoidance of doubt, the initial offer shall be accompanied by a banker's guarantee that is equivalent to the sum of the respective reserve prices of the spectrum lots the qualified bidder submits in its initial offer.

c) Assignment stage: This stage of the auction will determine the actual frequency bands to be assigned to each successful bidder. IDA is prepared to allow and accept joint proposals from successful bidders on the specific assignments of the frequency bands for this stage of the 2016 Spectrum Auction. In assessing the joint proposals, IDA will consider factors, including but not limited to, the impact of the assignment to existing services and the contiguity of the spectrum assignments. In the case where bidders fail to submit joint proposals by the stipulated date, IDA will implement a single-round, sealed-bid auction to determine the specific assignments based on the successful bidders' willingness to pay for each possible assignment listed by IDA. The successful bidder from the NESA will also be required to participate in this stage for the assignment of its 900 MHz band, in addition to any other spectrum lots it may have won in the quantity stage of the GSA.

Spectrum lot sizes

56. As there were no objections to the proposed spectrum lot sizes, IDA will maintain the spectrum lot sizes of 2 x 5 MHz for the 700 MHz and 900 MHz bands, and 5 MHz for the TDD bands. The spectrum bands and the corresponding amount of spectrum lots that will be allocated in the GSA are summarised in the table below.

Table 2: List of spectrum bands and the number of lots to be allocated in GSA

Spectrum band	Frequency range[39]	Number of lots with new MNO	Number of lots if there is no new MNO
700 MHz	703 – 748 MHz/ 758 – 803 MHz	9 lots (total 2 x 45 MHz)	
900 MHz	885 – 915 MHz/ 930 – 960 MHz	4 lots (total 2 x 20 MHz)	6 lots (total 2 x 30 MHz)
2.3 GHz TDD	2300 – 2340 MHz	Not applicable	8 lots (total 40 MHz)
2.5 GHz TDD	2570 – 2615 MHz	9 lots (total 45 MHz)	9 lots (total 45 MHz)

Spectrum right duration

57. IDA had proposed spectrum right durations that range from 12 to 16 years for the spectrum bands listed in the table above. While one respondent was supportive of the proposed spectrum right durations, others suggested that IDA adopt a spectrum right duration of at least 15 years to provide investment certainty and to be consistent with international practices.

[39] The frequency range includes the spectrum that will be set aside for the new MNO.

58. Having given careful consideration to these views, IDA will adopt a spectrum right duration of 15 years for the 700 MHz band, and 16 years for the 900 MHz and TDD bands. A shorter spectrum right duration has been provided for the 700 MHz band given the later commencement date of this band. While IDA has indicated that the 700 MHz spectrum right will commence from 1 January 2018, this may be further delayed by the progress of the switch off of the analogue broadcasting network (in short analogue switch off or "**ASO**"). In this regard, IDA aims to adjust the commencement and end dates of the 700 MHz band spectrum rights accordingly to maintain the spectrum rights duration of 15 years regardless of the delay. A summary of the spectrum right durations, commencement and end dates is provided in the table below.

Table 3: Summary of spectrum right durations

Spectrum bands	Commencement date	End date	Duration
700 MHz[40]	1 January 2018	31 December 2032	15 years
900 MHz	1 April 2017	31 March 2033	16 years
2.3 GHz TDD			
2.5 GHz TDD			

59. IDA has assessed these spectrum right durations to be appropriate, and also consistent with the duration of spectrum rights that were auctioned previously (e.g., 4G spectrum auction in 2013), as well as with some overseas jurisdictions. IDA is of the view that the 15- to 16-year period provides sufficient investment certainty to the industry, while catering for technological changes that may require the need to re-farm or re-allocate the spectrum bands for new uses in the future. While IDA had previously set a longer duration of 20 years for the 3G spectrum rights in 2001, the 3G spectrum rights were issued at a time when the technology trends and equipment availability for 3G were less certain. In comparison, there is greater certainty over the technological pathways and equipment availability for the spectrum bands that will be allocated in the 2016 Spectrum Auction.

Spectrum caps

60. The respondents emphasised the importance of the spectrum caps to prevent spectrum hoarding and to ensure MNOs are able to obtain sufficient spectrum for the provision of quality mobile services. Specifically, they urged IDA to consider the spectrum that is available to the mobile sector in totality and to consider spectrum caps that take into account other spectrum bands that have already been allocated to the incumbent MNOs. Suggestions on the possible spectrum caps were also provided.

[40] As explained above, the availability of the 700 MHz band is dependent on the timeline for ASO, which is expected to complete by end 2017.

61. IDA notes the concerns of the industry and has given careful consideration to the suggestions. IDA's policy objective of introducing spectrum caps in an auction is to prevent the monopolisation of scarce spectrum resources such that they can be used efficiently. The spectrum caps are intended to facilitate an outcome where the MNOs may reasonably obtain sufficient spectrum to deliver viable mobile services, and that the market structure of no less than 3 players remains. Therefore, IDA intends to adopt the following preliminary spectrum caps for the GSA provided in Table 4 below. IDA will also set aside 2 x 5 MHz from the 900 MHz band for each of the incumbent MNOs in the GSA to ensure their continued access to the 900 MHz band for the provision of 3G mobile services.[41] The finalised spectrum caps and other related measures will be provided in the auction documents.

Table 4: Preliminary spectrum caps for the GSA, which will apply to incumbent MNOs and the new MNO (if any)

<table>
<tr><th></th><th>700 MHz</th><th>900 MHz</th><th>2.3 GHz TDD</th><th>2.5 GHz TDD</th><th>All bands</th></tr>
<tr><td>Total amount of spectrum[42]</td><td>2 x 45 MHz (9 lots)</td><td>2 x 30 MHz (6 lots)</td><td>40 MHz (8 lots)</td><td>45 MHz (9 lots)</td><td>235 MHz</td></tr>
<tr><td>Caps with new MNO[43]</td><td rowspan="2">2 x 20 MHz (4 lots)</td><td>2 x 10 MHz (2 lots)</td><td colspan="2">Nil</td><td>85 MHz</td></tr>
<tr><td>Caps without new MNO</td><td>2 x 15 MHz (3 lots)</td><td colspan="2">45 MHz (9 lots)</td><td>105 MHz</td></tr>
</table>

Reserve Price and Relevant Fees

62. IDA had proposed the following indicative reserve prices in the Second Public Consultation: S$20 million for a 2 x 5 MHz lot in the 700 MHz and 900 MHz bands, and S$5 million for a 5 MHz lot in the TDD bands. To arrive at these reserve prices, IDA considered the intrinsic value[44] of the relevant spectrum bands and the international benchmarks of reserve and clearing bid prices for similar bands in recently concluded spectrum auctions. IDA also took into account the clearing prices for the spectrum allocated in Singapore's 2013 4G spectrum auction.

[41] For the avoidance of doubt, this is an exceptional arrangement based on the facts of the present case. For more information, please refer to footnote 30.
[42] The amount of spectrum includes the spectrum that will be set aside for the new MNO (if any).
[43] For the avoidance of doubt, the respective spectrum caps for the GSA will also apply to the new MNO, if it decides to participate in the GSA. In this case, the new MNO's spectrum holdings acquired from the NESA will count towards the GSA spectrum caps.
[44] Intrinsic value refers to the economic value of the spectrum arising from technical factors such as its propagation characteristics, applications and the harmonisation of spectrum internationally, as well as commercial factors such as the expected market demand and market share for each MNO. For this spectrum allocation exercise, IDA considered a 4-MNO market as part of the commercial factors for the economic valuation of the spectrum.

63. IDA notes that not all respondents commented on the proposed reserve prices. One respondent suggested lowering the reserve price of the TDD bands to below S$1 million per 5 MHz lot. IDA has reviewed the reserve prices and will adopt the following reserve prices for the GSA: S$20 million for a 2 x 5 MHz lot in the 700 MHz and 900 MHz bands, and S$3 million for a 5 MHz lot in the TDD bands, excluding Goods and Services Tax which shall be separately borne by successful bidders in accordance with the relevant tax requirements[45]. Specifically, IDA has decided to revise the reserve price for the TDD bands from S$5 million to S$3 million per 5 MHz lot after reviewing the reserve and average clearing prices of recent TDD spectrum auctions conducted globally. IDA is of the view that the revised reserve price for the TDD bands is a reasonable estimate of its economic value, given the growing use of the TDD bands among MNOs globally and their maturing device ecosystem. The revised reserve price will better facilitate price discovery during the bidding process. In this regard, with respect to one of the respondent's submission that a reserve price of below S$1 million for the TDD bands would be aligned with international practices, IDA would like to highlight that some of the examples cited are no longer relevant as these auctions were conducted more than four years ago when there was little industry interest in TDD networks then. These examples thus do not provide an accurate or current representation of the economic value of the TDD bands.

64. Consistent with previous spectrum auctions, IDA will require the successful bidders to pay the relevant auction fees upfront. However, IDA recognises that the spectrum rights for the 700 MHz band will not commence until 2018 at the earliest. IDA is thus prepared to allow the successful bidders to have the option of deferring the payment of the auction fees for the 700 MHz band to a date no later than six months before the commencement of the 700 MHz spectrum rights. Given that IDA has preliminarily fixed the commencement date of the 700 MHz band spectrum rights to be 1 January 2018 (albeit subject to adjustment as mentioned in the earlier sections), this means that successful bidders will be required to make payment for the spectrum auction fees for the 700 MHz band by no later than 30 June 2017.[46] The deferment will be subject to the successful bidder providing a banker's guarantee for at least 75% of the auction fee due for the 700 MHz spectrum rights based on the stipulated timeframe provided in the auction documents. Further details of the payment schedule will be made available in the auction documents that will be published at a later date.

65. In addition to the upfront auction fees that are dependent on the clearing prices of the respective auctions, the successful bidders will also be required to pay

[45] Prospective bidders shall comply with the relevant tax treatment and requirements prescribed by the Inland Revenue Authority of Singapore ("**IRAS**") in relation to all payments to be made for the upcoming spectrum auction exercise.

[46] This means that that the winning bidders are allowed to defer the payment of the relevant auction fees to no later than 30 June 2017.

the annual spectrum management fees and one-time application and processing fees as set out in the Telecommunications (Radio-communication) Regulations. Further details of all relevant fees will be listed in the auction documents that will be issued at a later date.

Applicable Regulatory Obligations

66. Successful bidders, including the new MNO, who are awarded spectrum rights pursuant to the rules of the 2016 Spectrum Auction will be required to comply with IDA's relevant regulatory frameworks and requirements within the stipulated timeline, where applicable. This includes, but is not limited to, the provisions set out in the Telecommunications Act ("**TA**"), Telecommunications (Radio-communication) Regulations, the Code of Practice for Competition in the Provision of Telecommunication Services 2012 (the Telecom Competition Code ("**TCC**") in short), the Code of Practice for Info-communication Facilities in Buildings 2013 ("**COPIF**"), and the conditions as set out in the respective licences and spectrum rights. Successful bidders, including the new MNO, will also be required to implement consumer protection measures specified by IDA, including but not limited to, providing consumers with a Premium Rate Services barring service and data roaming bill caps, when they commence service.[47]

67. In the Second Public Consultation, IDA stated that the new MNO will be required to comply with its network rollout deadlines, and that IDA will impose the requirements of the relevant regulatory frameworks (e.g., QoS and network resilience, etc.) on the new MNO in phases. Some respondents emphasised the importance of subjecting the new MNO to similar regulatory requirements so as to ensure a level playing field for the MNOs. Others, on the other hand, put forth suggestions on the timeline to implement the respective regulatory requirements such as the timeline and assessment for service coverage.

68. IDA has reviewed all the responses received and has decided to impose the relevant regulatory requirements on the new MNO in phases. This is a practical and reasonable approach, as it will clearly not be possible for the new MNO to comply with the full set of regulatory requirements from the onset when it is still deploying its network and not yet offering services. The new MNO will also require reasonable time to roll out its mobile network before it can meet the relevant requirements. For the avoidance of doubt, the new MNO will be required to meet these regulatory requirements by way of deploying its own nationwide mobile network, and not by relying on other means such as wholesale access, spectrum trading or spectrum sharing. Specific details of the respective regulatory requirements for the MNOs (including the new MNO) are provided in the sections below. Please note that nothing herein shall affect the exercise of IDA's regulatory powers, including IDA's

[47] Further details on these consumer protection measures will be made available in the information package for prospective new MNOs.

ability to review, add to or change its regulatory frameworks from time to time as may be appropriate in the circumstances.

Timeline for nationwide coverage

69. To ensure that the allocated spectrum is used effectively and efficiently to provide mobile services, IDA will require the relevant spectrum right holders to deploy nationwide 4G and/or IMT-Advanced systems and services using the spectrum allocated in the 2016 Spectrum Auction in a timely manner. Therefore, IDA will stipulate the following timelines for the deployment of nationwide 4G and/or IMT-Advanced systems and services for the new MNO.

Table 5: Nationwide service coverage timelines applicable to new MNO

Coverage requirements	Timeline
Nationwide outdoor service coverage	By 30 September 2018 (i.e., 18 months after the commencement of the 900 MHz and 2.3 GHz TDD spectrum rights)
Road tunnels and in-building service coverage	By 30 September 2019 (i.e., 30 months after the commencement of the 900 MHz and 2.3 GHz TDD spectrum rights)
Underground MRT stations/ lines service coverage	By 30 September 2021 (i.e., 54 months after the commencement of the 900 MHz and 2.3 GHz TDD spectrum rights)

70. IDA is of the view that the timelines provided in Table 5 are reasonable, taking into account the operational challenges in network roll out. Specifically, IDA has accorded a longer timeline for the underground MRT stations/ lines in view of the greater operational challenges in deploying mobile networks in such infrastructure. IDA also notes that the densification of the MRT network will likely increase the complexity and time required to deploy mobile networks in all underground MRT stations/ lines.

71. IDA will require the incumbent MNOs who are awarded 700 MHz and/or TDD spectrum in the GSA to use these spectrum bands to augment their existing networks to provide nationwide 4G and/or IMT-Advanced services by 31 December 2018 (i.e., 12 months from the expected commencement of the 700 MHz spectrum rights). However, should there be any delays to the availability of the 700 MHz band, IDA may be prepared to provide extension(s) to the aforementioned deadline on a case-by-case basis by making adjustments to the deadline to take into account the length of the delay. IDA is of the view that this would be a practical approach as the spectrum bands to be allocated will complement the incumbent MNOs' existing spectrum holdings in areas with intensive data requirements. At the same time, this would also ensure that the incumbent MNOs who are awarded the relevant spectrum rights will use the spectrum in an effective manner.

Spectrum trading

72. A few respondents urged IDA to restrict the new MNO from spectrum trading in view of concerns over potential spectrum speculation. IDA notes the concerns of the industry about possible spectrum speculation by the new MNO. In relation to this, IDA would like to assure the industry that there are existing measures in place to safeguard against spectrum speculation. Successful bidders must use the spectrum bands to deploy their networks in accordance with the deployment requirements described above. Specifically, spectrum right holders are not allowed to engage in any spectrum trading (especially before fulfilling the nationwide rollout obligation), unless they have obtained IDA's prior written approval to do so. This regulatory requirement applies to all spectrum right holders, including the incumbent MNOs.

Co-existence of mobile services and existing systems

73. While the 700 MHz band will be made available for mobile services following the targeted completion of ASO by end 2017, further time will be required to facilitate the migration of other isolated systems currently operating in the 700 MHz band on a localised basis. Successful bidders of the 700 MHz band will thus be required to have their mobile systems and services co-exist with these isolated systems until the complete migration[48] of these systems. Further details of the time period and site information will be made available to the prospective bidders for the GSA at a later date.

Spectrum coordination

74. IDA will require successful bidders of the 2016 Spectrum Auction to take the necessary steps to ensure the use of the allocated spectrum for the purpose of 4G and/or IMT-Advanced systems or services does not interfere with other existing networks and systems, and vice versa. To this end, successful bidders will be required to coordinate with one another, operators of other networks and systems, or MNOs from Singapore's neighbouring countries. For example, the successful bidders of the 2.5 GHz TDD spectrum will be required to coordinate with Broadcast Satellite Services in Indonesia. IDA will also require the new MNO to coordinate with existing user(s) operating in the adjacent frequency bands.

75. In this regard, IDA understands the challenges faced by the MNOs to coordinate the mobile network parameters. IDA will thus facilitate border coordination discussions[49] between the local MNOs and their neighbouring

[48] Expected to be in 2019.

[49] The Border Communications Coordination Meeting ("**BCCM**") is a platform for both Singapore's and Indonesia's regulators and MNOs to coordinate on cellular and broadcast satellite related matters. The HetNet and Spillage Coordination Sub-Working Group ("**HSC-SWG**") is another platform for

counterparts. To the extent that IDA leaves such coordination to the MNOs, IDA may, on a case-by-case basis, require the MNOs to comply with certain mitigation measures for coordination when interference is deemed to be caused by mobile network deployments in Singapore. A list of the possible interference mitigation measures is provided in **ANNEX B**.

Coverage beyond shoreline

76. Consistent with the coverage requirements imposed on other nationwide mobile services, IDA will similarly require successful bidders to provide service coverage up to 15 km from the shoreline. However, IDA will consider any cross-border interference risks and any minimum QoS requirements before enforcing this coverage requirement. For the avoidance of doubt, where MNOs are unable to meet this coverage requirement for certain areas from the shoreline because of technical requirements imposed by IDA, particularly those to minimise interference with Singapore's neighbouring countries, IDA will generally not enforce this requirement in relation to the affected areas.

Quality of service

77. IDA notes a suggestion from a respondent to impose the 4G QoS standards on the MNOs only after they have deployed their nationwide mobile network using the 700 MHz band. IDA will consider this suggestion when finalising the 4G QoS framework. While IDA has not put in place a 4G QoS framework, it has been monitoring the incumbent MNOs' 4G network performance since Q4 2014.[50] Given the growing reliance on mobile services and with mobile networks being a key infrastructure underpinning Singapore's Smart Nation vision, IDA cannot overemphasise the importance of MNOs providing reliable and high quality mobile services. Accordingly, IDA will require the successful bidders of the 2016 Spectrum Auction to comply with the relevant QoS standards where applicable. In the meantime, before IDA finalises the 4G QoS standards, potential bidders can refer to the '3G Public Cellular Mobile Telephone Service QoS Standards'[51] for an overview of the possible QoS performance indicators that IDA may adopt for the 4G QoS framework. IDA will inform the successful bidders when it issues the 4G QoS framework.

Singapore's, Malaysia's and Brunei Darussalam's regulators and MNOs to coordinate mobile networks at the border areas.

[50] IDA survey on 4G service coverage. Available from: https://www.ida.gov.sg/About-Us/Newsroom/Media-Releases/2015/IDA-Survey-Shows-4G-Service-Coverage-Available-at-Most-Outdoor-Areas

[51] Available from: https://www.ida.gov.sg/~/media/Files/PCDG/Licensees/StandardsQoS/QualityofService/MobileQoSFramework3Gnew.pdf

Network and service resilience

78. Similar to the approach for QoS, IDA will apply the relevant network resilience frameworks on the successful bidders of the 2016 Spectrum Auction. Specifically, IDA will impose the requirements of the respective network resilience frameworks on the new MNO in phases as follows (refer to **ANNEX C** for an overview of the respective frameworks):

a) Outage Reporting Code: To be effected once the new MNO commences commercial service;

b) Resiliency Code: To be effected after the new MNO achieves a 5% market share[52] in the mobile market; and

c) Mobile Audit Framework: IDA will provide the new MNO with specific details of the requirements prior to the 2016 Spectrum Auction and will monitor the new MNO's network design once it commences commercial service. The actual requirements of the framework will come into effect no earlier than 1 October 2019.

79. The aforementioned resilience requirements will continue to apply to the incumbent MNOs from the commencement date of the respective spectrum rights, given that they have already deployed nationwide mobile networks.

Wholesale obligations

80. As mentioned in the Second Public Consultation, IDA will require successful bidders (i.e., both the new and incumbent MNOs) to negotiate in good faith to provide wholesale network access to MVNOs upon request. As the intent of the new entrant facilitation framework is to ensure that the new MNO will utilise the spectrum rights it acquires to deploy its own nationwide mobile network, the new MNO will be prohibited from providing wholesale services to any of the incumbent MNOs unless it has obtained IDA's prior written approval to provide such services. These obligations will be imposed on the successful bidders as a condition of granting the spectrum right. For the avoidance of doubt, the new MNO is not prohibited from obtaining wholesale services from the incumbent MNOs during the initial rollout phase should it wish to do so, provided there is mutual agreement between the new MNO and the incumbent MNO(s).

[52] The market share of the new MNO will be calculated as follows: $\frac{number\ of\ new\ MNO's\ mobile\ subscribers}{total\ number\ of\ mobile\ subscribers\ in\ Singapore}$

Interconnection matters

81. IDA notes the comments of the respondents pertaining to interconnection and access to spaces for the provision of mobile service coverage. In this regard, IDA would like to remind the industry that the TCC sets out the interconnection and access regulatory framework that licensees are required to comply with. Specifically, Section 5 of the TCC requires IDA's licensees to co-operate with one another to promote competition in Singapore. This includes, amongst other things, being required to interconnect with other licensees, to submit all interconnection agreements to IDA, and to co-operate in good faith and in a commercially reasonable manner to implement their interconnection agreements. Licensees are encouraged to commercially negotiate their interconnection agreements as far as possible. For interconnection with dominant licensees, a licensee may, at its option, do so pursuant to the terms of: (i) an IDA-approved Reference Interconnection Offer; (ii) any existing interconnection agreement between the dominant licensee and any other similarly situated licensee; or (iii) an individualised interconnection agreement. In relation to option (iii), licensees may request IDA to resolve the dispute if they fail to voluntarily reach an individualised interconnection agreement within 90 days of the submission of a written request to negotiate an individualised interconnection agreement.

82. Regarding the access to spaces for the provision of mobile service coverage, IDA would like to highlight that the COPIF, *inter alia*, specifies the space and facilities that a developer or owner of a building shall generally provide for the deployment of mobile service. It also provides the requirements to be observed by IDA's licensees that deploy their equipment within the space or facilities provided pursuant to the COPIF. Specifically, Section 16.6 of the COPIF stipulates the principles for the sharing of mobile deployment space (i.e., to share on an equal basis unless agreed otherwise). IDA will continue to monitor the developments of the industry and will facilitate access by the MNOs if required. IDA will also take these developments into consideration for the subsequent review of the COPIF.

Other matters

Charges for non-building access point ("NBAP")

83. IDA notes the suggestions by a respondent that NetLink Trust's rooftop connection should be classified as non-residential instead of NBAP as provided in Schedule 3 of NetLink Trust's Interconnection Offer. IDA reviews the charges of NetLink Trust's services on a regular basis and is of the view that the existing NBAP charges remain relevant, and will take the comments into consideration when it reviews the charges.

Common Antenna Systems ("CAS")

84. IDA notes a respondent's suggestion to regulate the pricing principles of CAS. CAS are initiatives by the incumbent MNOs to facilitate mobile service deployment in locations where the MNOs have assessed to be more feasible or cost effective to do so. In this regard, IDA recognises that there may be merit for the new MNO to have access to the CAS and will require the incumbent MNOs to negotiate in good faith to provide the new MNO with access to CAS. In the event that the MNOs are unable to voluntarily reach a sharing agreement, the MNOs may request IDA to intervene to resolve the dispute.

Number portability

85. Number portability refers to the ability for subscribers to retain their existing numbers, including 1800 (toll-free) and 1900 (premium) service numbers, when they change their service providers or geographical locations. With respect to the comments by a few respondents that the new MNO must offer the full suite of mobile services (i.e., voice, SMS and data) to enjoy number portability, as mentioned above at paragraph 51, the new MNO will indeed be required to do so.

Prohibition against anti-competitive behaviour, etc.

86. IDA reminds industry players that it takes a serious view towards any anti-competitive or collusive behaviour. Specifically, Sections 8 and 9 of the TCC prohibit any licensee from engaging in any anti-competitive behaviour, unfair methods of competition or collusive activity, etc. This includes not entering into agreements to co-ordinate separate bids for assets, resources or rights auctioned by IDA, or for any input into the licensees' services or equipment or for the provision by the licensee of any service or telecommunication equipment, regardless of the price levels to which the licensees agree. IDA will not hesitate to take appropriate enforcement action in the event it is determined that the licensee has contravened the TCC.

C. NEGOTIATION PRINCIPLES FOR MVNOS

87. In the Second Public Consultation, IDA proposed to publish negotiation principles to facilitate the entry of "thick" MVNOs[53] given the interest from industry players, and the potential benefits "thick" MVNOs can bring to the mobile market. IDA would also like to clarify that a "thick" MVNO generally refers to an MVNO which has substantial control over its operations, data and services launched, including certain elements of network routing.

[53] Unless IDA indicates otherwise, references to MVNOs in this decision shall refer to "thick" MVNOs.

88. There were mixed responses to the above-mentioned proposal. While one respondent expressed its objections to the proposal, other respondents were supportive of the measure and emphasised the importance that MVNO agreements should be commercially negotiated. Suggestions were also provided to improve the proposed negotiation principles, including but not limited to a 'retail minus' model for wholesale access and to be more specific on non-discriminatory practices by the host MNO.

89. IDA has reviewed the responses, and will maintain its two-pronged approach of requiring spectrum right holders to negotiate in good faith with MVNOs (as explained in paragraph 80) and the publication of negotiation principles to facilitate the entry of MVNOs. For the negotiation principles, IDA will adopt the broad principles proposed in the Second Public Consultation and include an additional principle on QoS and service coverage as set out below (refer to **ANNEX D** for the fuller set of negotiation principles).

90. In summary:

a) IDA will maintain the proposed principle that wholesale prices should be no higher than the Host MNO's retail prices (including the existence of any promotional rates). IDA is of the view that this is a more reasonable and balanced approach than seeking to derive a reference 'retail minus' rate to apply to all, as the business model and structure of each MNO is likely to differ from one another. Therefore, it would be more appropriate for IDA to take reference to the prevailing retail prices as a starting point in the event IDA is requested to mediate in any disputes.

b) Regarding the additional principle on QoS and service coverage, IDA recognises that there is merit to make explicit that non-discriminatory traffic management practices also extend to these parameters.

c) On the suggestion for IDA to consider third-party arbitration for negotiation disputes or third-party assessors for QoS measurements, IDA will consider the possibility of accepting such third-party intervention as long as the concerned parties are agreeable to such an arrangement.

91. Regarding comments that the negotiation principles may not be sufficiently adequate or comprehensive, IDA would like to highlight that the negotiation principles broadly cover the services that the MNO can reasonably be expected to provide, the traffic and service management practices (including those highlighted above), wholesale prices, terms regarding the termination of services, etc. Specifically on the concern of exclusivity, IDA is generally not in favour of wholesale arrangements that prevent MVNOs from obtaining wholesale services from more than one MNO. Such exclusive arrangements may indirectly restrict competition.

Furthermore, there are benefits to being able to obtain wholesale services from multiple MNOs, including better service resilience and quality services through a heterogeneous network configuration. Aside from leveraging these negotiation principles, IDA also notes that there are standard contractual clauses which the MVNOs may incorporate into the wholesale agreement to safeguard their interests. Therefore, IDA is of the view that the collective measures mentioned above should reasonably address the concerns of the industry. IDA will also review the negotiation principles on a regular basis, and will consult the industry on any proposed changes to the negotiation principles.

92. While IDA will publish the negotiation principles to facilitate MVNO entry, IDA will generally leave it to the MVNOs to commercially negotiate any wholesale agreements with the MNOs. In cases of disputes, IDA may mediate between the MNO and the MVNO using the negotiation principles as the point of reference. As mentioned in the earlier section, the requirement to negotiate in good faith with MVNOs and the negotiation principles will apply to all MNOs, including the new MNO which emerges from the 2016 Spectrum Auction.

D. INDICATIVE TIMELINE FOR 2016 SPECTRUM AUCTION

93. The indicative timeline for the events leading up to the 2016 Spectrum Auction is provided in the table below. A more detailed timeline will be issued together with the auction documents at a later date.

Table 6: Indicative timeline for 2016 Spectrum Auction

Milestone	Indicative timeline
Collection of Information Package for Prospective New Entrants	10 business days from the issuance of this decision
Issuance of draft Information Memorandum and Auction Rules	March/ April 2016
Industry clarification sessions (if any)	March/ April 2016
Issuance of final Information Memorandum and Auction Rules	April/ May 2016
Submission of Binding Expression of Interest by potential new entrants	Mid 2016
Conduct of NESA (if applicable)	3Q 2016
Submission of Initial Offer and Banker's Guarantee for GSA	3Q/ 4Q 2016
Announcement of whether GSA will proceed	
Information Session and Notification of Auction Details	
Conduct of GSA (if applicable)	

PART III: SUMMARY OF IDA'S DECISION

94. IDA has decided to allocate 235 MHz of spectrum in the 2016 Spectrum Auction. Details of the spectrum bands are provided in the following table:

Table 7: Overview of spectrum to be allocated

Spectrum band	Frequency range	Amount[54]	Availability
700 MHz[55]	703 – 748 MHz/ 758 – 803 MHz	2 x 45 MHz	1 January 2018
900 MHz (including EGSM)	885 – 915 MHz/ 930 – 960 MHz	2 x 30 MHz	1 April 2017
2.3 GHz TDD	2300 – 2340 MHz	40 MHz	
2.5 GHz TDD	2570 – 2615 MHz	45 MHz	

95. IDA will structure the 2016 Spectrum Auction in two stages: (i) the NESA, which is only open to qualified[56] bidders who are currently not MNOs and not an associate of any incumbent MNO and/or of another qualified potential new entrant bidder; and (ii) the GSA which is open to the incumbent MNOs and the successful bidder from the NESA. Specifically, 60 MHz of the spectrum to be allocated will be set aside for one new MNO in the NESA. IDA will adopt an ascending round auction format and a 'Clock Plus' auction format for the NESA and GSA respectively. In the event that there are no qualified prospective bidders for the NESA, IDA will allocate the spectrum that has been set aside for the NESA through the GSA based on the relevant spectrum lot sizes and reserve prices for each spectrum band. An overview of the key auction parameters are provided below.

Table 8: Overview of key spectrum auction parameters

Spectrum band	Lot size	Spectrum right duration	Reserve price
700 MHz	2 x 5 MHz	15 years	S$20 million per lot
900 MHz (including EGSM)		16 years	
2.3 GHz TDD	5 MHz		S$3 million per lot
2.5 GHz TDD			
New MNO spectrum set-aside package	2 x 10 MHz in 900 MHz band; 40 MHz in 2.3 GHz TDD band		S$35 million for the entire spectrum set-aside package

[54] The amount includes the spectrum that will be set aside for the new MNO.
[55] The availability of the 700 MHz band is subject to the completion of ASO, and may become available later than 1 January 2018 should there be any changes to the ASO timeline.
[56] Potential new MNOs who are interested in participating in the NESA are required to participate in a pre-qualification exercise before they are allowed to participate in the NESA.

96. The successful bidders of the 2016 Spectrum Auction will have to comply with regulatory obligations pursuant to the 2016 Spectrum Auction and the relevant regulatory frameworks governing mobile networks and services. While IDA will not impose regulatory obligations on the incumbent MNOs to provide roaming access to the new MNO under the upcoming spectrum allocation exercise, the incumbent MNOs will be required to provide interconnection and mobile number portability to the new MNO within a reasonable timeframe. They will also be required to negotiate in good faith with the new MNO to provide access to CAS and to share mobile deployment space where applicable.

97. An overview of the key regulatory obligations that are applicable to both the new and incumbent MNOs is provided in the table below:

Table 9: Overview of key regulatory obligations

Regulatory obligations	New MNO	Incumbent MNOs
Nationwide rollout timelines (4G and/or IMT-Advanced service coverage)	• Nationwide outdoor service coverage by 30 September 2018 • Road tunnel and in-building service coverage by 30 September 2019 • Underground MRT stations/ lines coverage by 30 September 2021	Successful bidders of the 700 MHz and/or TDD bands are required to use these spectrum bands to augment their existing networks to provide nationwide 4G and/or IMT-Advanced services by 31 December 2018
Network and service resilience, and consumer protection	• Outage Reporting Code to be effected once the new MNO commences service • Resiliency Code to be effected after the new MNO attains a 5% market share • Requirements of Mobile Audit Framework to come into effect no earlier than 1 October 2019 • Specific consumer protection measures to be effected once the new MNO commences service	Existing frameworks continue to apply
Negotiation with MVNOs	All MNOs will be required to negotiate in good faith with MVNOs who request for wholesale access	
QoS	Successful bidders will be required to comply with the relevant 4G QoS standards when issued. In the meantime, potential bidders can refer to the '3G Public Cellular Mobile Telephone Service QoS Standards' for an overview of the possible QoS performance indicators that IDA may adopt for the 4G QoS framework	

98. Aside from the above regulatory obligations, IDA will publish a list of negotiating principles to aid negotiations between MVNOs and MNOs, and IDA may mediate between the MNOs and MVNOs using the negotiation principles as a point of reference.

99. The specific details pertaining to the 2016 Spectrum Auction will be provided in the auction documents that IDA will issue subsequently. In addition to these auction documents, IDA will prepare an information package for prospective new MNOs, which may be collected from IDA's premises 10 business days after the issuance of this decision. Prospective new MNOs who would like to collect the information package are invited to do so by writing to IDA_ILO@ida.gov.sg with the email header "Information package for prospective new MNOs".

ANNEX A

OVERVIEW OF SPECTRUM SET-ASIDE IN SELECTED JURISDICTIONS

Country	Spectrum set-aside	Remarks
France (2009)	2 x 5 MHz of 2100 MHz	• Incumbent MNOs were required to provide 2G roaming service to new MNO as part of the 3G licence condition
Netherlands (2012)	2 x 10 MHz of 800 MHz 2 x 5 MHz of 900 MHz	• The winning bidder, Tele2, was a Mobile Virtual Network Operator ("**MVNO**") with wholesale access arrangements with the incumbent MNOs. It had acquired 20 MHz of 2.6 GHz spectrum during the 2010 spectrum auction • New entrants were subject to a cap of 2 x 10 MHz of low frequency spectrum during the spectrum auction
Czech Republic (2013)	2 x 10 MHz of 800 MHz 2 x 15.8 MHz of 1800 MHz	• MNOs who were awarded at least 2 x 5 MHz of 800 MHz were required to provide national roaming to the new MNO
Austria (2013)	2 x 10 MHz of 800 MHz 2 x 10 MHz of 2.6 GHz	• Austria's regulator set aside 2 x 10 MHz of 800 MHz band for one new MNO • As part of the merger conditions, H3G Austria was required to divest 2 x 10 MHz of 2.6 GHz band to the new MNO and provide roaming access for up to 6 years
Ireland (2014)	2 x 5 MHz of 900 MHz 2 x 20 MHz of 1800/ 2100 MHz	• The merged entity of Hutchinson 3G Ireland and O2 Ireland was required to provide the MVNO(s) that entered Ireland's mobile market through the merger conditions the option of acquiring the spectrum set-aside • The option to acquire the spectrum set-aside will be valid for a period of 10 years, starting from 1 January 2016

ANNEX B

INTERFERENCE MITIGATION MEASURES

Given the inherent characteristics of radio frequency ("**RF**") spectrum, it is important that any deployed telecommunication networks and systems do not interfere with other such networks and systems operating within and/or beyond Singapore. Therefore, to ensure better coordination on the use of RF spectrum, it is pivotal that MNOs coordinate their network parameters when operating in the same spectrum bands. Some of the possible interference mitigation measures that IDA may require the MNOs to adopt include, but are not limited to:

a) Antenna tilt (i.e., electrical and mechanical tilt);
b) Panning the antenna;
c) Lowering the effective radiated power to within a stipulated maximum allowable range; and/or
d) Applying RF filters, where appropriate.

ANNEX C

OVERVIEW OF NETWORK RESILIENCE FRAMEWORKS

An overview of the relevant network resilience frameworks is as follows:

Outage Reporting Code

Introduced in 2008 and revised in 2014, the Outage Reporting Code sets out the requirements and procedures for telecommunication service licensees to report and disseminate information on difficulties involving their services.

Code of Practice for Telecommunication Service Resiliency ("Resiliency Code")

Introduced in 1998, the objective of the Resiliency Code is to ensure that telecommunication service providers, who provide key services to a large number of end users, adopt proactive measures to invest in and improve the resiliency of their telecommunication networks, and the relevant measures to restore services as quickly as possible in the event that service difficulties occur. Services covered by the Resiliency Code include fixed-line, mobile and international telephone services, Internet access services and interconnection services. The Resiliency Code also specifies a penalty framework for contraventions.

Mobile Audit Framework

Implemented in December 2014, the Mobile Audit Framework covers areas such as network design, technical processes, business continuity planning, and infrastructure and facilities, relevant to the operations of a mobile network. As part of the framework, the Mobile Network Operators are required to regularly review the resiliency of their networks biennially, so as to ensure that they meet or exceed best practice requirements.

ANNEX D

NEGOTIATION PRINCIPLES FOR WHOLESALE ACCESS

Negotiation Terms	Details[57]

Scope of service	• Host Mobile Network Operator ("**MNO**") should minimally offer wholesale voice, SMS and 4G data in any combination as requested by the Requesting Party ("**RP**")
	• Host MNO should not impose unreasonable restrictions on:
	  ○ the use of the wholesale inputs by the RP;
	  ○ the RP's retail service offerings; and
	  ○ the RP's retail prices

No unreasonable discrimination	• Host MNO should not engage in unreasonable discriminatory traffic management practices in all respects • Host MNO should provide quality of service and coverage to the RP's customers that are comparable to those the Host MNO provides to its own customers, unless agreed otherwise
Commercial terms	• Host MNO and the RP should negotiate in good faith and use best efforts to complete negotiations within a reasonable time frame • Wholesale prices imposed by the Host MNO should be reasonable, and should not be higher than the retail prices (including the existence of any promotional rates) charged by the Host MNO for similar services or a combination of services. Should the retail prices charged by the Host MNO change, the wholesale prices for the similar services or combination of services payable by the RP should be reasonably adjusted, unless agreed otherwise • A reasonable period of notice should be provided to either party before the termination or suspension of any wholesale agreement ○ For any termination or suspension of the wholesale services, the Host MNO should work with the RP to minimise the impact to the end users of the RP • Host MNO should not impose terms to impede the RP from terminating an existing agreement after giving reasonable notice and/or for seeking to migrate out from the existing Host MNO to another Host MNO

[57] IDA may review, and amend where it considers appropriate, these negotiation principles from time to time.