CONSULTATION PAPER ISSUED BY THE INFO-COMMUNICATIONS DEVELOPMENT AUTHORITY OF SINGAPORE

SECOND CONSULTATION ON PROPOSED 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

7 July 2015

PART I: INTRODUCTION AND OVERVIEW

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 ("**Public Consultation**") to review the allocation of spectrum to ensure the relevant and optimal use of scarce spectrum resources. This is in line with IDA's vision of establishing Singapore as a 'Smart Nation'[2] underpinned by a high speed, trusted and resilient infocomm infrastructure, comprising fixed and wireless networks. IDA had thus identified several spectrum bands that may be allocated for 4G and IMT-Advanced services, in line with international trends and regional spectrum harmonisation efforts.

2. In the Public Consultation, IDA also sought views on possible approaches to facilitate the entry of new players into the mobile market. While some spectrum was set aside for a new Mobile Network Operator ("**MNO**") in IDA's 4G spectrum auction in 2013, there were no applicants for this set-aside spectrum. Nonetheless, IDA remains open to facilitating the entry of new players into the mobile market to enhance competition and the vibrancy of the market, if there is industry interest.

3. In summary, the Public Consultation aimed to: (i) seek views on additional spectrum bands to be allocated for 4G and IMT-Advanced services; (ii) gauge industry interest on the potential for new entrants in the mobile market; (iii) seek views on policy options to facilitate greater competition in the mobile market; and (iv) understand policy considerations to facilitate the deployment of HetNet. These efforts in ensuring optimal use of spectrum and enhancing competition aim to create a more vibrant wireless and mobile landscape in Singapore.

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

a) Asia Broadcast Satellite
b) Cable and Satellite Broadcasting Association of Asia
c) Consistel (Singapore) Pte Ltd
d) Dynamic Spectrum Alliance Limited

[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 can be found on: 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

e) Ericsson Telecommunications Pte Ltd
f) GRID Communications Pte Ltd
g) Inmarsat
h) Liberty Wireless Pte Ltd and Alan Chan
i) M1 Limited
j) Motorola Solutions
k) MyRepublic Limited
l) Phoenix Communications Pte Ltd
m) Qualcomm Incorporated
n) SES
o) Singapore White Spaces Pilot Group
p) Singtel Mobile Singapore Pte Ltd
q) StarHub Mobile Pte Ltd
r) SuperInternet Access Pte Ltd
s) Viacom International Media Networks
t) The Walt Disney Company (Southeast Asia) Pte Ltd

5. IDA thanks all respondents and has given careful consideration to the comments received. This document sets out the key issues raised in the Public Consultation, IDA's responses and decisions on these issues, and additional issues which IDA would like to consult the industry on.

PART II: SPECTRUM BANDS TO BE ALLOCATED

6. In the Public Consultation, IDA sought the industry's views on a range of allocation and technical matters related to the spectrum bands that may be suitable for 4G and IMT-Advanced services (refer to Table 1 below). These included the use of the spectrum bands, allocation timeframe, and technical issues such as radio-frequency interference and co-existence techniques.

Table 1: Overview of possible spectrum bands for mobile services

	Spectrum band	Current assignments	Amount of spectrum available	Available from
Sub-1GHz bands[4]	700 MHz	Terrestrial broadcasting (the digital dividend[5])	90 MHz	After Analogue Switch Off ("**ASO**")[6], including ASO for neighbouring jurisdictions at the border areas. ASEAN has indicated a target year of 2020 for ASO.
	800 MHz	Trunked radio, Short Range Devices ("**SRDs**")	To be determined	To be determined
	900 MHz - also known as Public Cellular Mobile Telecommunication Services ("**PCMTS**") spectrum	2G, 3G, 4G	60 MHz, including 2 x 5 MHz currently allocated in the Extended GSM ("**EGSM**") band	April 2017
>1GHz bands[7]	1.4 GHz	Digital audio broadcasting	40 MHz	To be determined
	1.9/2.1 GHz	3G (4G allowed)	135 MHz, including Time Division Duplex bands	January 2022
	2.3 GHz	Available for trials (previously	30 MHz	Currently available for trial use[8]

[4] Lower frequency spectrum allows for mobile networks to achieve better building penetration and greater service coverage.

[5] The digital dividend is the amount of spectrum made available by the transition of terrestrial television broadcasting from analogue to digital.

[6] This is also known as the digital switch over.

[7] Deploying mobile networks using higher frequency spectrum can provide a higher average throughput for each consumer, although the mobile networks will have poorer penetration and coverage.

	Spectrum band	Current assignments	Amount of spectrum available	Available from
		assigned for Wireless Broadband Access ("**WBA**") /4G)		
	2.5 GHz	Partially assigned for WBA/4G; partially available for trials	45 MHz	
	3.5 GHz	Fixed Satellite Services (downlink)	200 MHz	To be determined

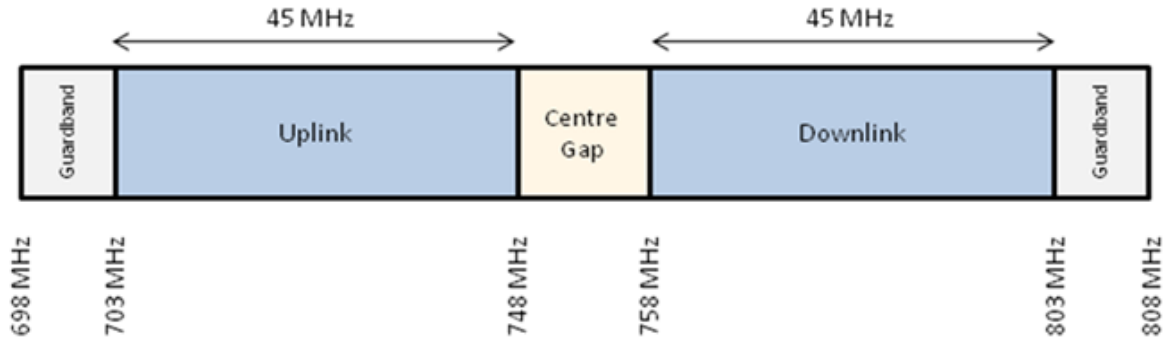
7. In summary, most respondents were supportive of allocating the 700 MHz, 900 MHz, and the 2.3 GHz and 2.5 GHz Time Division Duplex ("**TDD**") bands (the latter two are hereinafter referred to as the "**TDD bands**") for mobile services, and encouraged IDA to allocate these bands as early as possible. However, responses were mixed towards whether to couple the 900 MHz with the 700 MHz and/or other bands, or as a standalone band for allocation, given the different dates in which the respective spectrum bands could be made available and the uncertainty over the availability of the 700 MHz band. This section provides an overview of IDA's assessment of the issues raised, and IDA's preliminary decision on the spectrum bands which will be allocated in the upcoming allocation exercise.

700 MHz

8. The respondents generally encouraged the release of the full Asia-Pacific Telecommunity ("**APT**") 700 MHz band (refer to Figure 1) for mobile services, and to allocate the 700 MHz band when there would be greater certainty on its availability. However, one respondent recommended reserving 2 x 5 MHz at the lower end of the 700 MHz band for Government usage for emergency communications, which could concurrently serve as an additional buffer between TV channels below 694 MHz and commercial mobile systems in the 700 MHz band.

[8] On 23 January 2015, IDA issued an information paper on the "Short Term Allocation Framework for the Time Division Duplex (TDD) bands". In short, IDA allowed technical or market trials using the 2.3 GHz and 2.5 GHz TDD bands until 30 September 2015 or the day before the long-term spectrum rights start, whichever is later.

Figure 1: APT 700 MHz band plan



9. The 700 MHz band is the ASEAN region's digital dividend from ASO for broadcasting. Hence, this digital dividend is dependent on the ASO plans of the regional countries, and there is a need for Singapore to coordinate with our neighbouring countries on the suitable timeframe for the availability of this band. To this end, Singapore and our neighbouring countries target to make available the full 700 MHz band (i.e., 2 x 45 MHz) for mobile broadband services from 2018 at the earliest. While there remains uncertainty over the ASO timeline, given that the digital switch over process in our region is still in progress, IDA will continue to work towards the timeline of 2018 to allocate the 700 MHz band in view of the industry's business planning and investment purposes. In the event of a delay in the ASO timeline, IDA proposes to build in mechanisms in the spectrum allocation framework to allow the delay of the commencement date of the 700 MHz spectrum right, and correspondingly, the expiry date and the spectrum right payment due date, so as to maintain the same spectrum right duration. Hence, IDA is of the view that the 2 x 45 MHz of spectrum in the 700 MHz band can be allocated together with other suitable bands in the next spectrum allocation exercise, even though the respective spectrum rights may have different commencement dates.

10. On the suggestion to reserve part of the 700 MHz band for emergency communications, IDA has considered but does not propose to do so as there are other available frequencies for such purposes. Furthermore, this is an important and valuable band for the industry to deploy nationwide commercial mobile services given the good propagation characteristics of the band and the potential economies of scale brought about by the possibility of the 700 MHz band being a globally harmonised band[9] for mobile services.

11. Some respondents also raised concerns on whether there would be sufficient spectrum for dynamic spectrum access for TV White Space ("**TVWS**") deployment in Singapore, and requested IDA to provide certainty on the availability of the 700 MHz

[9] Aside from the Asia Pacific region, the South American nations have also adopted the APT 700 band plan. The 700 MHz band is also Europe's second digital dividend. Germany recently completed its 700 MHz band auction in June 2015 while France is targeting to auction this band in the second half of 2015 at the earliest.

spectrum for TVWS purposes until 2020. In IDA's Decision on the Regulatory Framework for TVWS Operations in the Very High Frequency ("**VHF**")/Ultra High Frequency ("**UHF**") Bands[10] that was issued on 16 June 2014, IDA had specified the TVWS channels in the 700 MHz band which would be made available before and after ASO. This included withdrawing some UHF channels in the 700 MHz band, while making available other VHF/UHF channels below the 700 MHz band after ASO for TVWS deployment. Therefore, there will not be significant changes to the amount of spectrum available for TVWS operations and IDA is of the view that making available the 700 MHz band for mobile services will not be an impediment to the development of the TVWS ecosystem.

Question 1: IDA would like to seek views and comments on the proposed allocation of the 700 MHz band together with other suitable bands for mobile services in the next spectrum allocation exercise; and the mechanism to allow the delay of the commencement date of the 700 MHz spectrum right, and correspondingly, the expiry date as well as the spectrum right payment due date, in the event of a delay in the ASO.

800 MHz

12. In the Public Consultation, IDA indicated that it was considering several options to re-farm the 800 MHz band (refer to Figure 2 below).

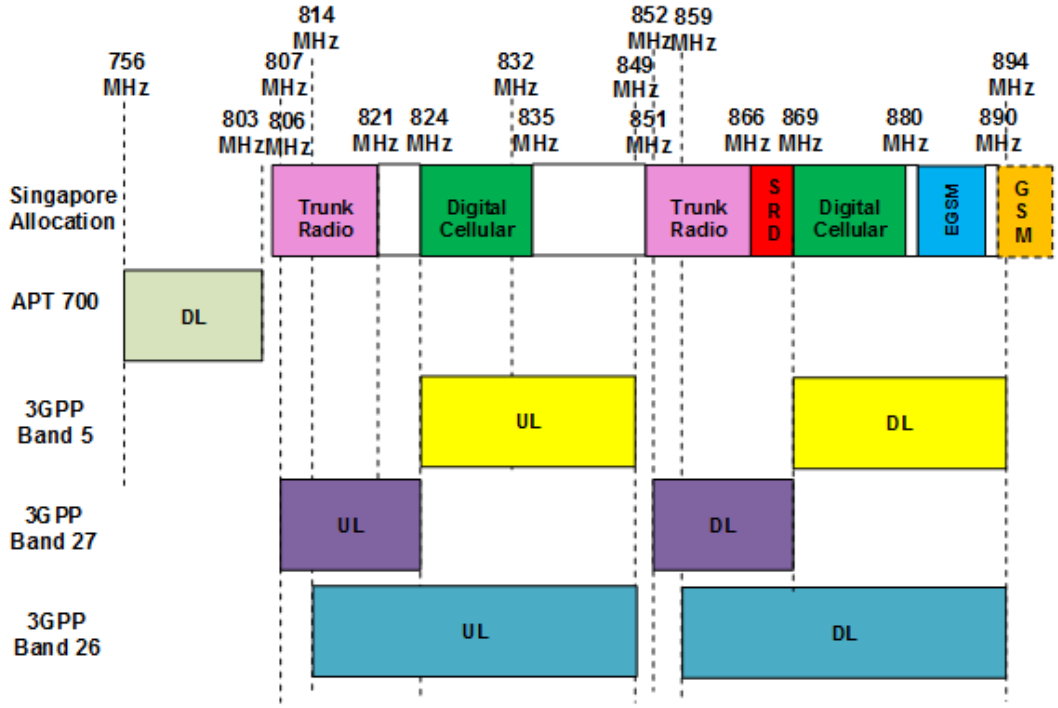
13. Briefly, responses to the possible 800 MHz band plans were varied, with some respondents urging IDA to allocate as much spectrum as possible for mobile services, some supporting the existing Trunked Radio and SRD assignments, and others proposing a middle-ground solution to re-farm parts of the Trunked Radio band for mobile services. The respondents also proposed various band plans, such as the 3rd Generation Partnership Project ("**3GPP**") bands 5, 20, 26, 27, and a combination of the band plans.

14. Some respondents highlighted that mobile services would interfere with Trunked Radio and SRD services, and advised IDA to migrate these current users to other frequencies if IDA intends to re-farm these frequencies for mobile services. The alternative would be to include a guard band of between 1 – 3 MHz between adjacent mobile and Trunked Radio bands, and a 1 MHz guard band between adjacent mobile and SRD bands. In addition, several respondents suggested reserving some spectrum in the 800 MHz band for Public Protection and Disaster Relief ("**PPDR**").

[10] Regulatory Framework for TV White Space Operations in the VHF/UHF Bands: http://www.ida.gov.sg/~/media/Files/PCDG/Consultations/20130617_whitespace/ExplanatoryMemo.pdf

15. The respondents also provided their views on the merits and drawbacks associated with each possible band plan. Respondents with a preference for 3GPP band 5 highlighted the difficulties with the migration of existing Trunked Radio and SRD users to other frequencies, while those who supported a combination of 3GPP bands 5 and 27 recognised this combination would make the largest amount of spectrum available for mobile services within the 800 MHz band. On the other hand, 3GPP band 20 would have minimal interference to mobile services in the EGSM band, and would eliminate the need for a guard band between 3GPP band 20 and the EGSM band.

Figure 2: Possible options for 800 MHz band

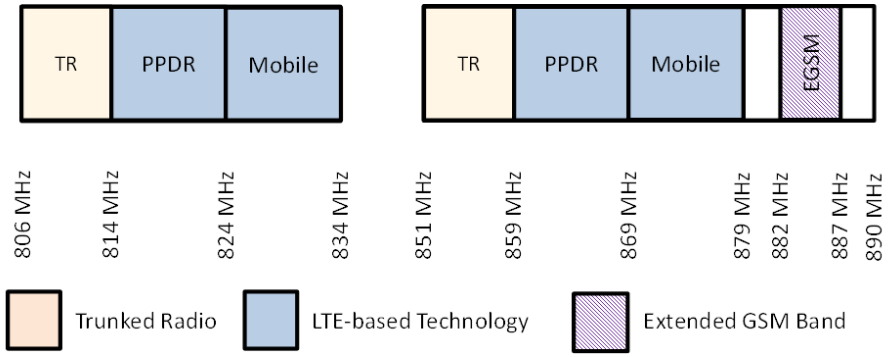


16. IDA notes the respondents' views, and has conducted a technical study on the co-existence of the different services within the 800 MHz band. Findings from the study showed that narrow band technologies such as Trunked Radio will cause interference to adjacent wide band mobile technologies such as Long Term Evolution ("**LTE**"), and guard bands of at least 1 MHz are required to minimise interference between the two services. LTE technology is also unable to co-exist in the same channels as SRD. Hence, to make spectrum available for mobile services and possibly PPDR based on LTE-based technologies in the 800 MHz band, IDA is exploring the possibility of adopting 3GPP band 26, or a combination of 3GPP bands 27 and 5 (excluding the EGSM band), for the 800 MHz band. Either of these options may mean that SRD users will have to be migrated to the 900 MHz band[11], where

[11] This may involve the re-tuning of existing equipment, or investing in chipset/equipment which are able to operate in the 900 MHz band.

there are plans to expand the SRD frequencies so as to accommodate more SRD users in the future. At the same time, frequencies allocated for Trunked Radio in the 800 MHz band may have to be reduced. Trunked Radio operators will thus have to invest in more spectrally efficient Trunked Radio technologies, with the capability to deliver Trunked Radio services using less spectrum. IDA is cognisant of the need to minimise disruption and impact to existing SRD and Trunked Radio users, and thus is considering a phased approach to re-farm the 800 MHz band over the next 3 – 5 years, based on the 3GPP band 26. Under this band plan, 2 x 8 MHz or less may be assigned for Trunked Radio services, at least 2 x 10 MHz for PPDR and 2 x 10 MHz for mobile services, as illustrated in Figure 3 below.

Figure 3: Proposed combination band plan for 800 MHz band (excluding the EGSM portion)



17. Adopting this 3GPP band 26 for the 800 MHz band plan will allow for a more optimal use of the 800 MHz band, by accommodating Trunked Radio, PPDR and mobile services. This band plan will also allow for the deployment of wide band technologies such as LTE, which will minimise cross-border interference issues as LTE technology is adaptive in nature and is designed to dynamically allocate resources to avoid interference based on channel conditions. Nonetheless, in the longer term, adopting the combination of 3GPP band 27 and band 5 may be preferable in optimising the use of the 800 MHz band for the deployment of wide band technologies and minimising interference issues, especially if Trunked Radio users are able to deploy wide band technologies like LTE.

18. IDA is currently engaging existing SRD and Trunked Radio users to assess the appropriate timeframe for the transition, and work with them to minimise the impact arising from this re-farming exercise. IDA will also continue to monitor or participate in discussions related to the 800 MHz band plan at regional and international forums such as the World Radiocommunication Conference ("**WRC**") 2015. Hence, the 800 MHz band will not be allocated at the next spectrum allocation exercise for mobile services, as IDA will require time to re-farm the band and assess the appropriate assignments[12] for the band.

[12] To assess if the frequencies for mobile services within this band should be assigned for mobile uses, PPDR, or a combination of both.

Question 2: IDA would like to seek views and comments on:

a) ***The proposed 800 MHz band plan based on the 3GPP band 26, or a combination of 3GPP band 27 and band 5 (excluding the EGSM band), including views on the possible phased approach and timeline to migrate existing users of the band; and***

b) ***The impact to existing users (i.e., Trunked radio and SRD) of the 800 MHz band plan based on the 3GPP band 26, or a combination of 3GPP band 27 and band 5 (excluding the EGSM band).***

900 MHz

19. The 900 MHz band is currently allocated by way of the PCMTS spectrum rights and allowed to be used for the provision of 2G, 3G and 4G services. The PCMTS spectrum rights will expire on 31 March 2017. This included the rights for the use of a portion of the EGSM band which resides in the 800 MHz band. The EGSM band spans 880 – 890 MHz / 925 – 935 MHz, but only 2 x 5 MHz of this band at 882 – 887 MHz / 927 – 932 MHz is currently allocated under the PCMTS spectrum rights. Most respondents supported the allocation of the 900 MHz band for mobile services. Given the international trends for the continued usage of the 900 MHz band for 3G and/or 4G mobile services, IDA will allocate the 900 MHz band to be used for mobile services, with the spectrum rights starting from 1 April 2017 (at the earliest), in the next spectrum allocation exercise.

20. In the Public Consultation, IDA indicated that the EGSM band, which depending on IDA's decision on the re-farming of the 800 MHz band, might be made available for long term allocation as part of the 800 MHz band. Most respondents recommended allocating the EGSM band together with the rest of the 900 MHz band, but one respondent recommended decoupling the EGSM band from the 900 MHz band so that it could be aligned with the 3GPP band 26.

21. In the 2008 PCMTS spectrum auction, IDA had initially allocated a 2 x 5 MHz lot at 885 – 890 MHz / 930 – 935 MHz from the EGSM band for the industry's use. However, due to cross-border interference arising from different mobile technologies being deployed in the EGSM band in Singapore and Indonesia[13], IDA had approved the EGSM spectrum right holder's subsequent request to shift its frequencies in the EGSM band to 882 – 887 MHz / 927 – 932 MHz. Hence, only 2 x 5 MHz of the EGSM band is usable in Singapore for mobile services.

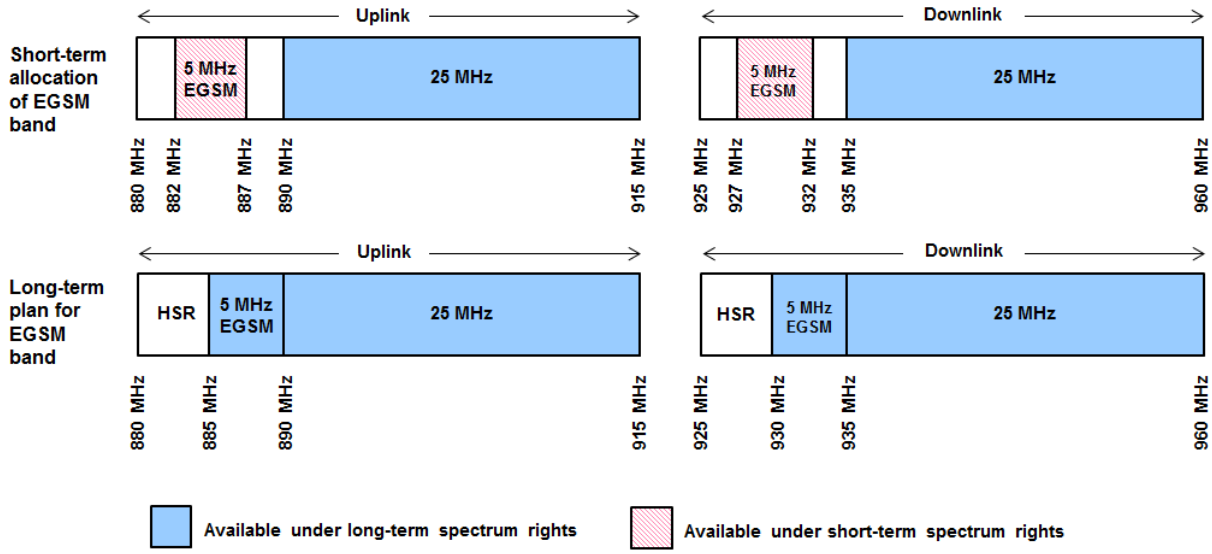
[13] In Indonesia, the Indonesian MNOs have deployed Code Division Multiple Access ("**CDMA**") mobile technology in the EGSM band. The co-channel co-existence of CDMA and IMT-based networks (which is deployed by Singapore MNOs) is not technically feasible.

22. IDA understands that the Indonesian MNOs are planning to migrate their networks in the EGSM band to GSM, High Speed Packet Access ("**HSPA**") or LTE-based technologies which will minimise the cross-border interference between mobile networks in Singapore and Indonesia. Once this migration is completed, the full 2 x 10 MHz of the EGSM band can potentially be used for mobile services in Singapore for the long-term. However, Singapore and Malaysia have been in discussions regarding the High Speed Rail ("**HSR**") and its operational requirements, which include the spectrum requirements for a communication system for rail operations. Given that GSM for Railway ("**GSM-R**"), which operates in the EGSM band, is being considered as one of the possible solutions, and that the HSR will commence operations sometime after 2020[14], IDA will have to reserve 2 x 5 MHz of the EGSM band for HSR use for the long-term. This will mean that only 2 x 5 MHz of the EGSM band can be made available for mobile services in Singapore for the long term, specifically the 885-890 MHz / 930-935 MHz pair band.

23. In the interim period before the Indonesia MNOs complete their migration of their networks in the EGSM band, and before the commencement of the HSR operations, the 2 x 5 MHz of EGSM spectrum currently used in Singapore for PCMTS may continue to be used for mobile services. Hence, IDA is prepared to allocate this 2 x 5 MHz of spectrum from the EGSM band for mobile services on a short-term basis for a 3 to 5 year period (i.e., from 2017 to 2020 or 2022, depending on the commencement date of the HSR operations)[15] in the next spectrum allocation exercise. Prior to the finalisation of the allocation rules for the next spectrum allocation exercise, if there is certainty that the Indonesian MNOs can complete their network migration in the EGSM band before 2017 which will then free up 2 x 5 MHz of the EGSM band for long-term allocation for mobile use in Singapore, IDA may decide to allocate the 2 x 5 MHz lot in the EGSM band[16] on a long-term basis instead. In this scenario, IDA will not need to allocate any frequencies from the EGSM band on a short-term basis.

[14] It was announced on 5 May 2015 that the target completion of HSR, which was originally set for 2020, will be re-assessed due to the scale and complexity of the project.
[15] This is for the 882 – 887 MHz / 927 – 932 MHz pair band. IDA will firm up the duration of this short-term spectrum right when the spectrum allocation rules are released.
[16] This will be for the 885-890 MHz / 930-935 MHz pair band.

Figure 4: Spectrum available for mobile services in the 900 MHz band



24. Therefore, based on current developments, IDA will make available 2 x 25 MHz in the 900 MHz band (i.e., 890 – 915 MHz/ 935 – 960 MHz) for allocation under long-term spectrum rights for mobile services, and 2 x 5 MHz in the EGSM band (i.e., 882 – 887 MHz / 927 – 932 MHz) for allocation under a short-term spectrum right for mobile services (refer to Figure 4 above). The spectrum rights for these lots will commence on 1 April 2017 (at the earliest).

25. Given the proposal to allocate the 2 x 5 MHz of spectrum in the EGSM band under a short-term spectrum right, IDA is considering allocating this short-term spectrum right on a First Rights of Refusal ("**FROR**") basis to the existing spectrum right holder in this 2 x 5 MHz band at an IDA specified reserve price. IDA views that this would be a more practical approach to allow the existing spectrum right holder to continue the use of this band and minimise impact to its end users, rather than to migrate its end users out of the band just to allow another operator to deploy for only a short period of time. If this EGSM band is available after the expiration of the short-term EGSM spectrum right, due to delays in the commencement of the HSR operations and where the Indonesian MNOs have not migrated their networks in the EGSM band, IDA may extend the short-term spectrum right to the spectrum right holder at the winning bid price for the long-term spectrum rights in the 900 MHz band, pro-rated to the duration of the extension. If the existing spectrum right holder for the EGSM band decides not to exercise its FROR, the short-term spectrum rights for this EGSM band will then be made available to all other qualified participants to bid for in the spectrum allocation exercise. However, as stated above, if there is certainty before IDA commences the spectrum allocation exercise that the 885-890 MHz / 930-935 MHz pair band will be ready for use from 2017, IDA will not proceed with the FROR and will make available 2 x 5 MHz of spectrum in the EGSM band to

all qualified participants to bid for in the spectrum allocation exercise for longer term use.

26. IDA would like to emphasise that IDA is generally not inclined towards granting FROR in spectrum allocation exercises, as it strengthens incumbency and distorts the market mechanism in ensuring that the scarce spectrum resources are allocated to parties that are best able to make use of them[17]. Hence, while IDA is prepared to accord FROR to the existing EGSM spectrum right holder as proposed above, IDA will not allocate the long-term spectrum rights in the 900 MHz band on a FROR basis.

Question 3: IDA would like to seek views and comments on the allocation of the short-term spectrum rights for the EGSM band, including the approach to extend the short-term spectrum right.

*1.4 GHz ("**L-band**")*

27. The L-band, 1452-1492 MHz, is currently allocated for Digital Audio Broadcasting ("**DAB**") in Singapore, but most of the band is largely un-utilised.

28. Most respondents recommended re-farming and re-allocating the L-band for mobile services in the future, although one respondent indicated that it did not observe a viable mobile ecosystem in the L-band today. Several respondents highlighted the use of the L-band as a mobile supplemental downlink ("**SDL**")[18] in Europe, with the expansion of the L-band for IMT services expected to be discussed at the WRC 2015. They thus recommended IDA to harmonise Singapore's L-band allocation with WRC 2015's decision, and to consult the industry again when the L-band becomes available for allocation.

29. In relation to this, IDA recognises that the International Telecommunication Union ("**ITU**") is studying the possibility and suitability of expansion of the L-band[19] for the deployment of Frequency Division Duplex ("**FDD**") or TDD technologies in the future, and is considering the L-band as well as the extended L-band as potential candidate bands for mobile broadband under WRC-15 Agenda Item 1.1. Nonetheless, the European Commission recently opened up the L-band for mobile

[17] See also IDA's decision on FROR in the "Framework for the Reallocation of Spectrum for 4G Telecommunication Systems and Services": http://www.ida.gov.sg/~/media/Files/PCDG/Consultations/20120410_4Gtelecomm/Decision4GSpectrum.pdf

[18] A mobile SDL is a mobile system in which the mobile network uses unpaired spectrum in the downlink to provide additional downlink capacity to supplement the capacity of the mobile network.

[19] 1427 – 1452 MHz and 1492 – 1518 MHz

downlink services[20]. Given these ongoing developments, while it would be premature to allocate the L-band on a long term basis at this juncture, it is likely that the various jurisdictions will be re-farming this band for mobile services in the future.

30. Therefore, IDA considers that it would be suitable to re-allocate the L-band for wireless broadband, which may include SDL, in Singapore eventually, given the international developments on the use of this band. IDA thus proposes to make available spectrum, namely 1452 – 1492 MHz, in the L-band in the interim period for interested parties to conduct trials, for temporary use[21], and/or offer commercial services[22], based on wireless broadband technologies (including for enterprise LTE ("**eLTE**") or Machine-to-Machine ("**M2M**") services). Trials may be conducted under IDA's Technical[23] or Market Trial[24] frameworks, and commercial services may be offered using spectrum assigned on a non-interference and unprotected basis[25]. IDA will also continue to monitor the developments of the new band plan for this band at international forums, including the 3GPP, APT and ITU.

Question 4: IDA would like to seek views and comments on:

- ***a) The proposed re-allocation of the L-band for wireless broadband in Singapore in the longer term; and***
- ***b) The allocation of the L-band for trial, temporary use and/or commercial services in the interim period.***

*1.9/2.1 GHz ("**3G Bands**")*

31. Given that the respondents agreed with IDA's proposal to allow the deployment of 4G and IMT-Advanced systems and services in the 3G Bands, and generally supported the position that spectrum usage should be technology neutral to allow the deployment of more spectrally efficient technologies, IDA had issued the

[20] European Commission, 2015. Commission Decision opens up a new frequency band for advanced mobile services. Available from: https://ec.europa.eu/digital-agenda/en/news/commission-decision-opens-new-frequency-band-advanced-mobile-services.

[21] 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

[22] The type of application depends on industry demand, which will be considered and approved by IDA on a case-by-case basis.

[23] 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

[24] 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

[25] 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

"Decision on the Deployment of 4G and IMT-Advanced Systems and Services using Existing 3G Spectrum Rights"[26] on 12 December 2014.

TDD Bands

32. IDA notes that there has been increasing interest in the use of the TDD bands as a capacity layer and as part of HetNet in Singapore. Respondents to the Public Consultation commented that the global interest in the TDD bands was growing and driving the development of the TDD ecosystem. The respondents also urged IDA to make the TDD bands available on a long term basis.

33. Given the technology developments, international trends and the industry interest in the use of the TDD bands, IDA will allocate these bands for mobile services with the long term spectrum rights starting from 1 April 2017. IDA had earlier indicated in the Public Consultation that 50 MHz in the 2.3 GHz band and 50 MHz in the 2.5 GHz band were available for allocation. However, after further assessment, the amount of spectrum which will be made available for mobile services in the upcoming spectrum allocation exercise is as follows:

a) 2.3 GHz band: This band is currently coordinated on a 'half-band' sharing basis with neighbouring jurisdictions, where Singapore has priority access to the 2300 MHz – 2350 MHz band. Further, given that 2335 MHz – 2400 MHz are constrained frequencies[27] and that there are existing users in the remaining frequencies, only 30 MHz (i.e., 2300 MHz – 2330 MHz) will be made available for mobile services in the next spectrum allocation exercise.

b) 2.5 GHz band: Most respondents proposed a 5 MHz guard band between the FDD networks (operating in the 2500 – 2560 MHz band paired with the 2620 – 2680 MHz band) and TDD networks (operating in the 2570 – 2620 MHz band). These proposals are in line with recommendations by the European Commission[28] to minimise potential interference between FDD and TDD systems operating in adjacent bands in the same geographical area. The above proposed guard band, coupled with an

[26] Decision on Deployment of 4G and IMT-Advanced Systems and Services using Existing 3G Spectrum Rights. Available from: http://www.ida.gov.sg/~/media/Files/PCDG/Consultations/20140422_ProposedAllocationSpectrumIMT/Deployment_4G_IMT_Advanced_Sys_and_Svsusing_3G_SpectrumRights.pdf

[27] The constrained frequencies are not available for assignment due to potential interference with other networks currently deployed in Singapore.

[28] European Commission, 2008. Commission decision of 13 June 2008 on the harmonisation of the 2500–2690MHz frequency band for terrestrial systems capable of providing electronic communication services in the Community. Available from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:163:0037:0041:EN:PDF

unassigned 2 x 10 MHz of FDD spectrum in the 2.5 GHz band[29], may obviate the need for guard bands on the lower end of the 2.5 GHz TDD band. Taking the above into consideration, IDA proposes to set aside 5 MHz as a guard band in the upper end of the 2.5 GHz TDD band[30] and make available 45 MHz of spectrum (i.e., 2570 MHz – 2615 MHz) for mobile services in the next spectrum allocation exercise.

34. Notwithstanding IDA's proposal to make the above specified spectrum in the TDD bands available for mobile services, IDA is still studying the extent of coexistence that is possible between different TDD systems, as well as, between TDD and FDD systems, deployed in the same geographical area utilising adjacent frequency bands and in different geographical areas utilising the same frequency bands. Possible measures to address interference between the different systems include adoption of Block Edge Mask[31] and synchronisation[32] of the frequency, phase and time components of the networks[33].

35. In the Public Consultation, IDA had also indicated that a significant separation distance between TDD networks operating in the same band may be required to mitigate co-channel interference, and sought views on the use of the TDD bands for in-building only or for both outdoor and in-building deployment. Respondents were generally not in favour of limiting the use of the TDD bands for in-building deployment and for small cells only. One respondent suggested allowing outdoor small cells deployment in shielded urban environments and in-building deployment of small cells for the 2.5 GHz TDD band. Most respondents also indicated their preference for the TDD bands to be on a full-band sharing basis with neighbouring countries. Hence, while the 2.5 GHz band will remain on a full-band sharing basis with Malaysia, MNOs that are allocated the long term spectrum rights for these TDD frequencies will be required to coordinate with operators from our neighbouring countries (i.e., Malaysia and Indonesia) to address potential co-channel interference issues. MNOs will be allowed to decide the types of TDD deployments (i.e., whether to deploy in-door, outdoor, or in shielded urban environments) as long as they are able to coordinate with neighbouring countries' operators to address interference issues.

[29] 2560 – 2570 MHz paired with 2680 – 2690 MHz.
[30] 2615 – 2620 MHz.
[31] A Block Edge Mask is a spectrum mask that is defined, as a function of frequency, relative to the edge of a block of spectrum that is licensed to an operator. On one side of this frequency boundary is the in-block power limit and on the other side is the out-of-block spectrum mask. Refer to ECC Report 131 on the derivation of a Block Edge Mask for further details: http://www.erodocdb.dk/docs/doc98/official/pdf/ECCRep131.pdf
[32] TDD synchronisation may include establishing inter-operator agreements covering synchronisation components such as common reference clock, compatible frame structures and alignment of Uplink ("**UL**")/Downlink ("**DL**") ratio.
[33] ECC Report 216, "Practical guidance for TDD networks synchronisation", August 2014: http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP216.PDF

36. Related to these TDD bands, IDA issued an Information Paper on the "Short Term Allocation Framework for the TDD bands"[34] on 23 January 2015, making the TDD bands available for allocation on a short-term basis through IDA's Market Trial or Technical Trial frameworks. This will allow interested operators to assess the commercial feasibility of TD-LTE services or to trial HetNet technologies in Singapore. The TDD bands will be available for short term allocation for trials until 30 September 2015, or until the start of the long term spectrum rights for the TDD bands, whichever is later. IDA will continue to study the technical issues related to co-existence for TDD systems, including tapping on the feedback and results of operators conducting TDD network trials under the "Short Term Allocation Framework for the TDD bands".

Question 5: IDA would like to seek views and comments on:

- ***a) The proposed approach for local operators to coordinate with neighbouring countries' operators to address potential co-channel interference in the use of the 2.5 GHz band;***
- ***b) The use of the proposed 5 MHz guard band in the 2.5 GHz band to prevent interference between TDD and FDD systems operating in adjacent bands, versus the imposition of suitable mitigation measures to prevent interference; and***
- ***c) The possible adoption and/or suitable restriction levels for Block Edge Mask, synchronisation of TDD networks and any other suitable mitigation measures to prevent co-channel or adjacent channel interference between different TDD systems or between TDD and FDD systems.***

3.5 GHz

37. In the Public Consultation, IDA sought indications of industry interest in the allocation of long term spectrum rights in the 3.5 GHz band for IMT systems, the use of the 3.5 GHz band solely for deployment of in-building mobile systems, possible impact to end-users of Fixed Satellite Services ("**FSS**") and TV Receive-Only ("**TVRO**") services (the existing users in the 3.5 GHz band) if mobile services are deployed in the 3.5 GHz band, and views on possible co-existence issues between TDD mobile systems and FSS or TVRO systems.

38. There were mixed responses to the proposal to allocate long term rights in the 3.5 GHz band for mobile systems or solely for in-building mobile deployments. Some respondents recommended assigning the 3.5 GHz band for mobile services in

[34] Information Paper: Short-Term Assignment of Unassigned Spectrum in the 2.3 GHz and 2.5 GHz TDD Spectrum bands. Available from: http://www.ida.gov.sg/~/media/Files/PCDG/Licensees/SpectrumMgmt/SpectrumAuctAss/ShortTermTDD/ShortTermTDDInfoPaper.pdf

the future given the interest in this band for small cell deployment and LTE-Advanced ("**LTE-A**") carrier aggregation, and not to restrict the use to in-building deployment only. On the other hand, some respondents cautioned against allocating this band for mobile services given that there were existing FSS users in this band. Despite their diverging views, the respondents acknowledged that the deployment of mobile services in the 3.5 GHz band would cause potential interference to FSS and TVRO services. Further studies will thus be required to assess the potential impact of deploying mobile services in the 3.5 GHz band to FSS and TVRO services.

39. IDA notes the feedback and is of the view that the 3.5 GHz band is not suitable for re-farming and re-allocation for mobile services at this juncture, given the possible interference to existing users. Hence, IDA will continue to monitor the international trends and technology developments for the 3.5 GHz band, as well as explore the possibilities for co-existence of mobile technologies and FSS/TVRO systems in this band. IDA will conduct a separate consultation for any proposed changes to the use of this band.

Other technical issues

40. As IDA will not be allocating the 800 MHz band in the upcoming spectrum allocation exercise, IDA will not be addressing the issue of guard bands between sub-1 GHz bands at this juncture. Nonetheless, should the 800 MHz band be allocated for mobile services in the future, IDA will require operators operating in adjacent bands to co-ordinate with each other, and will take reference from international practices in prescribing any guard band requirements.

Spectrum for allocation – proposed uses, spectrum right durations, allocation method, and other obligations

41. In summary, IDA will be allocating 225 MHz of spectrum from the 700 MHz, 900 MHz (including the EGSM band) and the TDD bands for mobile services based on 4G or IMT-Advanced systems, as summarised in Table 2 below. To provide clarity on the types of systems and services that can be deployed using these spectrum bands, IDA proposes to adopt the definition of 4G and IMT-Advanced systems and services which was used in the 4G spectrum auction conducted in 2013: "*a cellular mobile communications system capable of evolving to achieve the targeted peak data rates of 100 Mbits/s for high mobility and 1 Gbit/s 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.*". Similar to the approach taken in the 4G spectrum auction in 2013, IDA will maintain a case-by-case assessment approach for any proposed

deployment of alternative technologies to those stated in this definition. These spectrum bands may also be used to provide 3G mobile services, as long as the spectrum right holders fulfil the obligation to provide 4G or IMT-Advanced mobile systems and services as well as obtain IDA's approval to deploy 3G mobile services.

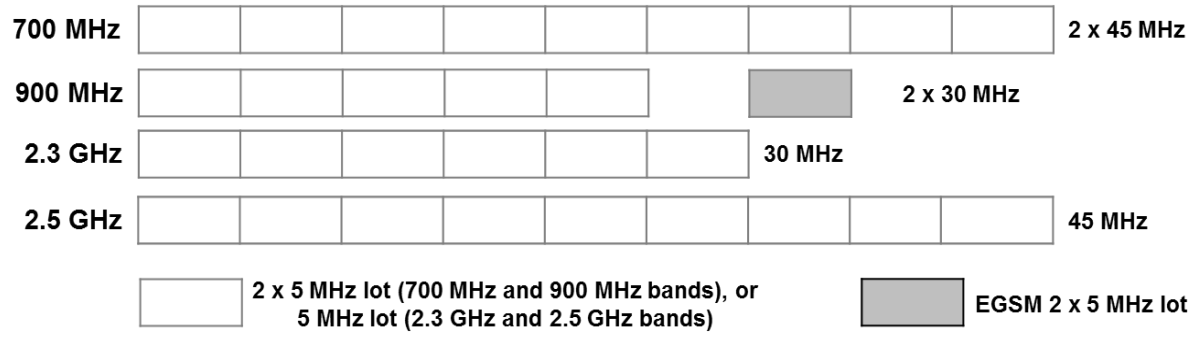
42. IDA notes that under this definition of 4G and IMT-Advanced systems and services, the MNOs may be able to use the spectrum bands to provide data-only mobile services. IDA will allow MNOs the flexibility to do so, provided that MNOs providing data-only services must inform end users of the scope of such services (e.g., the lack of voice or SMS features).

Table 2: List of spectrum bands to be allocated in the next auction

		700 MHz	900 MHz	2.3 GHz TDD	2.5 GHz TDD
To be allocated for long-term spectrum rights	Frequencies	703-748 MHz/ 758-803 MHz	890-915 MHz/ 935-960 MHz	2300-2330 MHz	2570-2615 MHz
	Amount of spectrum	90 MHz (2 x 45 MHz)	50 MHz (2 x 25 MHz)	30 MHz	45 MHz
To be allocated for short-term spectrum rights	Frequencies	-	882-887 MHz/ 927-932 MHz	-	-
	Amount of spectrum	-	10 MHz (EGSM band: 2 x 5 MHz)	-	-

43. IDA proposes for the spectrum in the 700 MHz and 900 MHz bands to be allocated based on lot sizes of 2 x 5 MHz FDD lots, while that in the 2.3 GHz and 2.5 GHz TDD bands will be based on 5 MHz lots. The diagram below illustrates the number of lots that will be allocated in each band.

Figure 5: Spectrum lots to be allocated in each band



44. IDA had also sought views on whether the different spectrum bands should be allocated as standalone bands, or together in the same spectrum allocation exercise. While the respondents generally agreed that the 700 MHz and 900 MHz bands should be allocated as soon as possible, there were mixed responses towards the allocation approach (i.e., either standalone or coupled with other bands).

45. IDA notes the concerns that the allocation of the 900 MHz band and TDD bands may be delayed if they are coupled with the 700 MHz band. However, IDA would like to highlight that the spectrum allocation framework can allow for the simultaneous allocation of these bands while providing for the respective spectrum rights to commence at different dates, as described earlier. This was the approach adopted by IDA for the 4G spectrum auction in 2013, where the 1800 MHz and 2.5 GHz FDD bands were allocated in the same auction but had spectrum rights that commenced on different dates[35]. Hence, IDA will be allocating the 700 MHz, 900 MHz, and the 2.3 GHz and 2.5 GHz TDD bands as listed above, together in the next spectrum allocation exercise.

46. IDA is proposing spectrum right durations ranging from 12 to 16 years for these spectrum bands, similar to the spectrum rights allocated in the 4G spectrum auction in 2013. The proposed durations are intended to provide sufficient investment certainty for the mobile operators, while catering for technological changes that may require the need to re-farm or allocate the spectrum bands for new uses.

47. As in previous spectrum allocation frameworks for mobile services, IDA will use a market-based approach to allocate the spectrum, i.e., an auction, as this is a fair, transparent and efficient method to allocate a scarce resource. IDA proposes to adopt a 'Clock Plus' auction format for the general spectrum auction, after the new entrant auction as explained in Part III below. This 'Clock Plus' auction format was adopted in the 4G spectrum auction in 2013, and consisted 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, 2.3 GHz, and 2.5 GHz bands), subject to the relevant spectrum caps. Should the quantity demanded by all qualified bidders exceed the overall quantity of spectrum lots available, the auction will proceed to the 'Quantity stage'; 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 instead of individual lots, 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

[35] The spectrum rights for the 1800 MHz band will commence on 1 April 2017 and that for the 2.5 GHz FDD band commenced on 1 July 2015.

excess demand. Once this stage of the auction is completed, successful qualified bidders will go on to the 'Assignment stage'.

c) Assignment stage: This stage of the auction will determine the actual frequency bands to be assigned to each qualified bidder, and IDA may consider allowing for joint proposals from qualified bidders on the specific assignments of the frequency bands. Otherwise, or in the case where there is no joint proposal, IDA may implement a single-round, sealed-bid auction to determine the specific assignments based on the qualified bidders' willingness to pay for each possible assignment listed by IDA.

This 'Clock Plus' auction format can potentially lead to a more efficient auction outcome by facilitating price discovery and reducing aggregation risks between categories of spectrum bands, while being simpler to implement during the auction process.

48. IDA will determine the spectrum caps to be imposed for the general spectrum auction, depending on the finalisation of the spectrum set-aside package as elaborated in Part III below. In considering the appropriate spectrum caps, IDA will take into account the reasonable amount of spectrum for MNOs to provide mobile services, balanced with the need to prevent monopolisation of spectrum or spectrum hoarding.

49. IDA is also considering imposing regulatory obligations to ensure the optimal use of the spectrum, e.g., stipulating a deadline to use the spectrum or other roll out obligations, failing which IDA reserves the right to resume the spectrum right(s) without compensation. Such obligations as well as other general regulatory obligations tied to the use of these spectrum bands will be issued together with the finalised auction format and rules.

Question 6: IDA welcomes views and comments on the proposed allocation of the spectrum bands in the next allocation exercise, including on the proposed uses and spectrum right durations of the spectrum bands, the proposed 'Clock Plus' auction format, as well as the appropriate spectrum caps and regulatory obligations to ensure the optimal use of the spectrum.

Reserve prices for spectrum to be allocated at the next auction

50. To arrive at the reserve prices for the allocation of the 700 MHz, 900 MHz, 2.3 GHz and 2.5 GHz bands in the general spectrum auction, IDA considered the intrinsic value[36] of the relevant spectrum bands and the international benchmarks of

[36] Intrinsic value refers to the economic value of the spectrum arising from technical factors such as its propagation characteristics, applications and the harmonisation of the spectrum internationally, as

reserve and final bid prices for similar bands. IDA also took into account the prices achieved for the spectrum allocated in the 4G spectrum auction in 2013. While IDA does not seek to maximise auction revenues, it is important to set the reserve prices at levels that reasonably reflect the potential economic value of the spectrum. This is to ensure that the auction mechanism can efficiently achieve its key objective of efficient allocation of scarce spectrum resources, where winning bidders will seek to maximise the use of the spectrum.

51. Therefore, based on IDA's assessment, the indicative reserve price of each spectrum lot for the general spectrum auction is: SGD$20 million for a 2 x 5 MHz FDD lot in the 700 MHz and 900 MHz bands, and SGD$5 million for a 5 MHz TDD lot in the 2.3 GHz and 2.5 GHz bands. For the EGSM short-term spectrum right, the FROR will be offered at the price based on the reserve price for the long-term spectrum right for the 900 MHz band, pro-rated to the relevant duration.

52. In view of the interest from the industry to participate in the auction of these spectrum bands, IDA will also conduct clarification session for interested bidders to clarify any questions they may have regarding this consultation. Interested bidders are invited to indicate their interest in attending the clarification session by writing to IDA_ILO@ida.gov.sg with the email header "Clarification on spectrum allocation framework" by 10 July 2015.

well as commercial factors such as the expected market demand and market share for each MNO. For this spectrum allocation exercise, IDA considered a four-MNO market as part of the commercial factors for the economic valuation of the spectrum.

PART III: PROPOSED FRAMEWORK TO FACILITATE NEW ENTRY

53. In the Public Consultation, IDA sought views on the policy options to facilitate greater competition in the mobile market, whether by way of encouraging new MNO or Mobile Virtual Network Operator ("**MVNO**")[37] to enter the market. IDA was also interested to hear views on the potential business models and viability for such new entrant(s), and possible regulatory mechanisms to encourage such new entry.

54. There were mixed responses towards the policy options to facilitate new entry. Respondents who expressed interest to enter the market highlighted the need to facilitate their entry and provided suggestions for facilitation measures that IDA can take. They also shared the potential market opportunities, their business ideas and proposed service offerings should they enter the market. On the other hand, the incumbent MNOs advocated a light-touch regulatory approach on the basis that the Singapore mobile market was competitive, and there were already MVNOs operating in the market today without regulatory intervention. The incumbent MNOs submitted that IDA should first identify market failures to justify the need for intervention to facilitate new entry. They also highlighted that any regulatory intervention imposed on them to offer roaming or wholesale access to new entrants would be unfair and would dis-incentivise future network investments, given that the three of them were already subject to stringent Quality of Service ("**QoS**") standards and network resilience requirements.

55. IDA notes the incumbent MNOs' comments on the competitiveness of the mobile market. There are a variety of mobile plans and service offerings available in the market today, and IDA recognises the incumbent MNOs' network upgrades to provide improved or advanced mobile services to consumers.

56. Nonetheless, 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. Further, with consumers' increasing reliance on mobile broadband, and the technology and service evolutions in the industry (e.g., the emergence of Internet of Things ("**IoT**") and M2M communications[38]), there may be attractive and viable business opportunities and market segments for new players to enter either as an MNO or MVNO. The introduction of new mobile service providers and innovative service offerings will inject greater vibrancy into the mobile landscape, in line with our vision of building Singapore into a Smart Nation.

57. The entry of new players is expected to bring about lower priced and/or more innovative mobile plans for the benefit of consumers. For example, some

[37] An MVNO is a mobile service provider which does not own any spectrum rights but purchases airtime and services from MNO(s) on a wholesale basis to sell under its own brand.
[38] The number of M2M connections is estimated to grow at a CAGR of between 25% – 45% over the next few years (Cisco, GSMA Intelligence).

jurisdictions with new MVNO or MNO entry have experienced drops in average prices of mobile plans by up to 40%, and the introduction of new service offerings, such as simplified pricing packages, innovative bundles or loyalty tie-ins, and specialised plans for targeted customer segments. An economic study by IDA also found that a new MNO may potentially bring about net benefits over the long term that is driven by price decreases, as well as non-price improvements in service and pricing innovation.

58. On the comments that facilitating new MNO entry will dis-incentivise network investments of the incumbent MNOs, IDA found no clear or direct correlation between new entry and a fall in mobile network investments by incumbent MNOs in other jurisdictions. While some countries have experienced a fall in mobile network investments following the entry of a new entrant, IDA has observed that such fluctuations in investment levels could have been influenced by macro-economic conditions, rather than a direct result of the new entrant. IDA also notes that there are examples of incumbent MNOs increasing their investment levels following the entry of a new MNO[39].

59. IDA has also assessed that the entry of a new MNO in Singapore is potentially viable, given the dynamic mobile market environment and the strong interest from potential new players. Globally, some mobile markets have been supporting a 4-MNO play, such as in France and Spain, which both saw new MNO launching services in their markets in 2012 and 2006 respectively. In Hong Kong, there are also four MNOs operating in the market after a recent merger reduced the number of MNOs from five to four. On the other hand, IDA also notes that some countries with four or more MNOs have experienced market consolidations. For example, the mobile markets in Germany, Norway and Ireland have experienced mergers in recent years, and are now a 3-MNO market. The potential mergers between O2 and Three in the UK, and Telenor and TeliaSonera in Denmark, may also lead to a 3-MNO market. Nonetheless, in some of the countries which may end up with three MNOs or which have three MNOs presently, IDA has observed that the telecom regulators are keen to maintain or encourage a 4-MNO market, such as in the UK[40] and South Korea[41].

60. In view of the strong interest from potential new entrants and the consumer benefits that may be brought about from greater competition and vibrancy in the

[39] For example, Bouygues went on to deploy France's first LTE-A network in 2014 despite the entry of Free Mobile and the competitive pressure it exerted on the market.

[40] The regulator, OFCOM, recently proposed to reserve some spectrum to be allocated at an unspecified later date, in view of the recent merger activities that may potentially reduce the number of MNOs in UK from four to three: http://stakeholders.ofcom.org.uk/binaries/consultations/2.3-3.4-ghz-auction-design/statement/statement.pdf

[41] The Ministry of Science, ICT and Future Planning has recently proposed to facilitate the entry of a new MNO by offering it priority in frequency allocation: http://www.koreaherald.com/view.php?ud=20150528000969

mobile market, IDA thus proposes to structure the next spectrum allocation exercise to facilitate the entry of a new MNO, as the present tranche of spectrum bands to be offered includes low-frequency spectrum for a new entrant to roll out its network more quickly and cost-effectively. At this juncture, IDA believes that the appropriate and balanced policy approach to bring about the benefits and sustainable competitive effects of new entry is to facilitate one new MNO to enter the market. Based on IDA's study, the entry of two or more new MNOs could result in: (a) a fragmentation of spectrum holdings among the new MNOs, which is not conducive to providing high-speed mobile broadband services to meet the increasing consumer demand for bandwidth hungry content and applications; and (b) a smaller market share for each player, which is unlikely to be viable for the new MNOs in the next few years, given the current size of the Singapore market.

61. Nonetheless, with the growth of the IoT economy and M2M communications, as well as the possibility of new technological developments in the future, IDA does not preclude the possibility of more MNO players entering the market in the future. IDA will monitor market developments before opening up the market further.

62. IDA's proposed framework to facilitate the entry of a new MNO is detailed in the next section below. To highlight, the proposed measures focus on lowering the entry barriers for a new MNO, and upon entry, the new MNO is expected to deploy its network quickly to compete in the market. IDA believes that this is a balanced and proportionate approach in facilitating the entry of a new MNO, while preserving incentives for the market players to invest and compete to bring about sustained benefits for consumers. Hence, beyond facilitating the new MNO entry, IDA will leave it to market forces and allow competition in the mobile market to take its course.

63. While IDA's facilitation measures will target a new MNO entry, IDA also intends to ease entry conditions for MVNOs, recognising that such players, in particular "thick" MVNOs[42], can bring about innovative or niche service offerings to benefit targeted customer segments.

Proposed facilitative framework

64. For a new MNO, the critical first step in entering the market is the acquisition of sufficient spectrum to roll out its network. Given the challenges in acquiring sufficient spectrum in an auction with the incumbent MNOs and the expected capital investments required to deploy a nationwide network, there are various types of measures which can be taken to facilitate the entry of a new MNO, including

[42] A "thick/full" MVNO has complete control over its operations, data and services launched, including certain elements of the core mobile network such as the Home Location Register ("**HLR**").

incentives and regulatory obligations. As highlighted above, IDA is cognisant of the importance of implementing a fair and reasonable framework that will be proportional, and does not overly distort the incentives for both the incumbents and the new MNO in competing and deploying or upgrading their networks. From the responses to the Public Consultation and IDA's assessment of practices from other jurisdictions, IDA proposes the following measures to facilitate the entry of a new MNO:

Spectrum set-aside for new MNO

65. The new MNO will require sufficient spectrum to offer competitive data capacity and service coverage to compete in the market. At the same time, IDA recognises that the new MNO may 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, bearing in mind the capital investment required to deploy a new nationwide mobile network. Therefore, IDA proposes to set aside 2 x 10 MHz in the 700 MHz band, 2 x 10 MHz in the 900 MHz and 20 MHz in the 2.3 GHz band (out of the 225 MHz currently proposed for allocation), in a separate auction where only qualified[43] potential new MNOs are eligible to bid. Under this spectrum auction framework, a potential new entrant bidder must not have rolled out any nationwide mobile system or network, and it must not be an associate of any incumbent MNO[44]. It would not be the first time IDA

[43] Potential new MNOs will be required to participate in a pre-qualification phase by declaring and substantiating, amongst others, their capital structure, financial proposal, technical capabilities and proposed deployment plans before they are able to participate in the spectrum auction.

[44] For this spectrum auction exercise, similar to the 2013 4G spectrum auction, IDA is likely to adopt the following in determining whether a new entrant bidder is an associate of an incumbent MNO: 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;

(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;

(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 provision of telecommunication services;

has considered setting aside spectrum to facilitate the entry of a new MNO. Similar measures were adopted for the 2013 4G spectrum auction, but there was no interest from the industry then. Globally, spectrum set-aside has also been employed by some countries for new MNOs to enter the market. For example, the Netherlands set aside 2 x 10 MHz and 2 x 5 MHz from the 800 MHz and 900 MHz bands in a multi-band auction held in 2012. Likewise, the Czech Republic set aside 2 x 10 MHz and 2 x 15.8 MHz in its 800 MHz and 1800 MHz auctions respectively.

66. The proposed spectrum set-aside has a combination of low and high frequency spectrum. Low frequency spectrum has better propagation characteristics which will enable the new MNO to achieve greater service coverage, while high frequency spectrum will provide the data capacity to meet the intensive mobile data requirements of consumers. Similar suggestions were put forth by the industry, with one respondent requesting for at least 20 MHz and 100 MHz of sub-1 GHz and above 1 GHz spectrum respectively. However, IDA has assessed that as a start, the proposed spectrum set-aside amount is sufficient for the new MNO to compete in the market, taking into consideration the spectrum available for allocation to the industry. For example, the MNOs will require at least 40 MHz of spectrum to offer 300 Mbps LTE-A services[45] using existing antenna technologies. Therefore, the proposed spectrum set-aside amount would be sufficient for the new MNO to start its network deployment, as the new MNO will be able to aggregate spectrum from the 900 MHz and 2.3 GHz TDD band in the interim, and complement this with the 700 MHz band in the future. The new MNO may also participate in the general spectrum auction that is open to the incumbent MNOs if it wishes to obtain spectrum beyond the set-aside amount.

67. In arriving at the proposed spectrum set-aside, IDA considered several possible options, including setting aside spectrum from the 700 MHz and 2.3 GHz TDD bands only, or setting aside parts of the 800 MHz spectrum instead of the 900 MHz spectrum as suggested by respondents interested in entering the market. However, as assessed earlier, the 800 MHz band is not ready for allocation for mobile services at this juncture. In addition, the uncertainty over the commencement date of the 700 MHz band will impact the new MNO's ability to roll out its network to commence services quickly. With only access to spectrum in the 700 MHz band and 2.3 GHz band, the new MNO will have to roam on an incumbent MNO's network should it decide to commence services during the period before the 700 MHz band becomes available. To facilitate such roaming access, IDA considered measures such as imposing regulatory obligations on the incumbent MNOs to provide roaming access to the new MNO. While these measures may facilitate access to roaming,

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(j) 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
(k) A is related to B in such other manner as prescribed by any regulations made under section 74 of the Telecommunications Act (Cap. 323).

[45] This may be currently achieved through the use of Carrier Aggregation.

IDA is cognisant that they may increase the new MNO's dependency on the incumbent MNOs' network in the interim, reducing the incentive for the new MNO to deploy its network expeditiously to bring about more sustainable competition in the mobile market.

68. Therefore, a more balanced and reasonable approach would be to include the 900 MHz band in the spectrum set-aside. With the inclusion of the 900 MHz band, the new MNO will be able to commence services from April 2017 at the earliest, without having to wait for the 700 MHz band to be available. The availability of low frequency spectrum for the initial setup is important as it will reduce the capital investment and time required by the new MNO to deploy a nationwide network given its better propagation characteristics. At the same time, IDA is of the view that this will obviate the need to impose regulatory obligations on the incumbent MNOs to provide roaming access to the new MNO. Nonetheless, if it wishes to, the new MNO may commercially negotiate roaming access with any of the incumbent MNOs.

69. From an implementation perspective, depending on the final spectrum set-aside for the new MNO and the 900 MHz spectrum bands that the incumbent MNOs can bid for, IDA recognises that the incumbent MNOs may have to migrate their subscribers out of their existing spectrum holdings in the 900 MHz band. In this regard, IDA understands that the incumbent MNOs are using part of their existing 900 MHz spectrum holdings to offer 2G and 3G mobile services. Given that the incumbent MNOs have decided to cease their 2G networks by 1 April 2017[46], this will free up parts of the 900 MHz band. IDA also notes that there is an increasing number of 3G subscribers migrating to 4G services, which will in turn reduce the demand for spectrum to be used for 3G networks. Hence, IDA is of the view that setting aside 2 x 10 MHz of the 900 MHz band for a new MNO is unlikely to cause significant disruptions to the incumbent MNOs' operations, as it is likely that they will be re-planning their network operations in the 900 MHz band. Moreover, the proposed spectrum set-aside amount would leave up to 2 x 15 MHz of 900 MHz spectrum available for the incumbent MNOs to bid for in the general spectrum auction, where the incumbent MNOs will still be able to bid for at least 2 x 5 MHz of spectrum each.

70. As explained earlier, IDA does not intend to accord FROR to the existing spectrum right holders of the 900 MHz band (with the exception of the EGSM spectrum provided it is allocated on a short-term spectrum right basis). Nonetheless, in planning for the spectrum to be set aside in the 900 MHz band for the new MNO auction, IDA will assess the appropriate specific frequency ranges to set aside for the new MNO to minimise disruption to the incumbent MNOs' networks. With the spectrum auction expected to take place in 2016, the incumbent MNOs would have

[46] IDA, 2015. 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

certainty of their long-term spectrum holdings in the 900 MHz band, if any, by the end of the auction, and are reminded to use the time to plan and arrange their affairs, manage their resources to fulfil their regulatory obligations, and put in place the necessary plans and measures to carry out any necessary network migration without causing disruption to their subscribers.

71. With the proposed spectrum set-aside, the remaining spectrum lots in the 700 MHz, 900 MHz and the TDD bands will be allocated in the general spectrum auction that is open to all incumbent MNOs, including the new MNO if any. If there is no new MNO following the spectrum set-aside auction for the new MNO, the set-aside spectrum will be allocated in the general spectrum auction for the incumbent MNOs only. IDA will assess the suitable spectrum caps to be imposed on the incumbent MNOs and the new MNO in the general spectrum auction, depending on the final spectrum available in the general spectrum auction.

Reserve price and auction format for spectrum set-aside

72. Bearing in the mind the capital investments required to deploy a new nationwide mobile network, IDA is prepared to set a lower reserve price for the spectrum set-aside to lower the high entry barriers. The indicative reserve price is S$40 million for the entire spectrum set-aside block.

73. In terms of the auction format for the spectrum set-aside, IDA is considering a simple ascending round auction, or a single-round second price sealed bid auction. While the ascending round auction format will aid price discovery and is suitable where the valuation of the spectrum is uncertain to the bidders, it may take a longer time to complete. On the other hand, the single-round second price sealed bid auction, where the winning bidder will be the one that submits the highest bid but will pay the second-highest bid submitted, is simple and fast to implement although it eliminates the opportunity for price discovery.

Regulatory obligations on incumbent MNOs

74. IDA has assessed that the proposed facilitation measures set out above are sufficient to ease the entry barriers for the new MNO. As highlighted earlier, IDA recognises that any regulatory intervention has to be proportional, and should not dis-incentivise incumbent MNOs or the new MNO from investing in their network deployments. The new MNO must be able to sustain its business and compete on its own standing, after the initial facilitation measures as proposed above. This can then truly bring about a more effective and sustainable competitive impact with the introduction of the new MNO into the market.

75. Hence, other than the above proposed facilitation measures, IDA does not intend to impose additional measures suggested by some respondents, such as to impose new obligations on site access or Radio Access Network ("**RAN**") sharing on the incumbent MNOs. There are already regulatory frameworks in place, such as the Code of Practice for Info-communication Facilities in Buildings 2013 ("**COPIF 2013**") which, amongst other things, governs the provision of building access and space for mobile deployments and the sharing of infrastructure in locations where there is limited deployment space. IDA will review these regulatory frameworks to ensure that they remain adequate and relevant for the industry's deployment of mobile networks.

76. However, IDA will require the incumbent MNOs to provide interconnection and mobile number portability within a reasonable timeframe to the new MNO upon request, and at reasonable terms. They will also be required to negotiate in good faith with the new MNO to provide access to common antenna systems. These requirements are necessary for a new MNO's network deployment and provision of mobile services, given the technical necessity for networks to be interconnected, the deployment challenges in locations where there are restrictions on space that can be used for antenna systems, and the expectations and demands of consumers in retaining their mobile numbers. For the avoidance of doubt, the incumbent MNOs are also required to comply with regulatory obligations to ensure the optimal use of the spectrum they acquire, as well as the relevant regulatory frameworks governing mobile networks and services, such as the QoS standards, the Telecom Resiliency Code, an audit framework related to mobile networks and the relevant Facilities-Based Operator licence requirements.

Regulatory obligations on the new MNO

77. To ensure that the new MNO deploys its network expeditiously to make efficient use of its spectrum, it will be required to comply with rollout deadlines of 18 months for nationwide coverage (except underground MRT stations/lines and road tunnels), and 60 months for underground MRT stations/lines and road tunnel coverage, from the start of the 900 MHz spectrum right if the proposed spectrum set-aside above is adopted. IDA is of the view that with the availability of the 900 MHz band for the new MNO, it should be able to deploy its network to achieve nationwide coverage (except underground MRT stations/lines and road tunnels) in 18 months, given the good propagation characteristics of low frequency spectrum. The new MNO may start undertaking works to deploy its network even before the commencement of the 900 MHz spectrum right on 1 April 2017. On the other hand, IDA recognises that there are more operational challenges involved in deploying mobile networks in underground MRT stations/lines and road tunnels, and hence a longer timeframe is proposed for the new MNO to achieve such coverage.

78. In addition, the new MNO will have to comply with the relevant regulatory frameworks governing mobile networks and services, such as the QoS standards, the Telecom Service Resiliency Code, an audit framework related to mobile networks and the relevant Facilities-Based Operator licence requirements. For the QoS requirements, IDA proposes to impose the relevant requirements on the new MNO in phases after the nation-wide rollout obligation deadlines. For the requirements of the Telecom Service Resiliency Code and audit framework, IDA also proposes to impose these requirements a few years after the nation-wide rollout deadlines, or based on the size of the subscriber-base of the new MNO. IDA will further study and finalise the implementation of these requirements on the new MNO.

Question 7: IDA would like to seek views and comments on the proposed facilitation framework for the new MNO, including on the set-aside spectrum, the reserve price for the set-aside spectrum, the auction format, and the regulatory obligations on the new MNO.

Easing entry conditions for MVNOs

79. While IDA had, as part of the 2013 4G spectrum auction, required the incumbent MNOs to negotiate in good faith to provide wholesale access to MVNOs, IDA views that there is merit to further facilitate the entry of MVNOs, in particular "thick" MVNOs, given the interest from the industry. IDA believes that "thick" MVNOs, having more control over their operations, customer databases and services to be offered, can bring about innovative or niche services to benefit consumers on a larger scale and can compete in a more sustainable manner, compared to "thin" MVNOs. Thus, in addition to imposing the good faith negotiation requirement as a condition for the upcoming auction (similar to the 2013 4G spectrum auction), IDA proposes to aid such negotiations for "thick" MVNOs with the publication of negotiation principles. In cases of dispute, IDA may mediate between the MNO and the "thick" MVNO using the negotiation principles as the point of reference. The requirement to negotiate in good faith with MVNOs and the proposed negotiating principles will apply to all MNOs, including the new MNO which emerges from the upcoming spectrum auction. IDA may review and amend these negotiation principles from time to time. An overview of the key negotiation principles for "thick" MVNOs are as follows (refer to the **Annex A** for details on the list of such negotiation principles):

a) **Technical and commercial SLA**. MNOs should provide wholesale services which minimally should include mobile traffic (i.e., voice, SMS and data). The MNOs should not unreasonably discriminate against the MVNOs' mobile traffic, and should not impose terms which impede the

MVNOs from terminating an existing agreement by the giving of reasonable notice and/or for seeking to migrate to another MNO.

b) **Price structure and level**. While IDA will not be imposing ex ante rate regulation for wholesale access, the MNOs should offer such access at reasonable rates, no higher than the retail prices charged by the Host MNO for similar services or a combination of services. The offered rates should also be flexible, in that they should be reasonably adjusted to reflect changes in the retail rates unless otherwise agreed. The MNOs should also not restrict the service and price offerings of the MVNOs.

Question 8: IDA would like to seek views and comments on the proposed negotiation principles to facilitate wholesale access negotiations between "thick" MVNOs and MNOs.

PART IV: POLICY CONSIDERATIONS FOR DEVELOPMENT OF HETEROGENOUS NETWORKS ("HetNet")

80. As indicated in the Infocomm Media Masterplan ("**IMM**"), IDA is seeking to facilitate the deployment of HetNet in Singapore to enable seamless connectivity across different wireless platforms. Deployment of HetNet can bring about more efficient use of scarce spectrum resources, and better meet the expected increase in demand for mobile data traffic by providing a better load distribution among different wireless networks. It is also envisaged to bring about more innovative services to the benefit of the industry and consumers.

81. The respondents were generally supportive of IDA's initiative to facilitate the deployment of HetNet. However, to better facilitate HetNet deployment, some respondents suggested that IDA should consider reviewing the COPIF 2013 to facilitate the deployment of small cells on non-conventional infrastructure such as lamp posts, and introduce a centralised coordinating body to streamline the application process for such deployments. Education would similarly play an important role as it would assuage and manage the public's concerns on radiation from the densification of small cell deployments. There were also suggestions for IDA to consider issues pertaining to QoS and data protection when formulating any HetNet policy framework. Finally, given that the technologies enabling HetNet are still at their developmental phase, some respondents suggested that IDA should continue monitoring the evolution of technology and conduct technical trials to better understand the issues that may arise from a HetNet deployment.

82. IDA notes the concerns and suggestions of the respondents. As announced at the Smart Nation Innovations conference on 22 April 2015, IDA will be conducting a series of HetNet trials with industry participants in the second half of 2015. To facilitate these trials, IDA has also issued the "Short Term Allocation Framework for the TDD bands" as highlighted earlier. IDA will be monitoring the outcomes of these trials and other HetNet developments globally. These would be taken into consideration when formulating any HetNet-related regulatory framework.

PART V: CONCLUSION

83. To conclude, IDA will be allocating the following spectrum bands in the next spectrum auction:

Table 3: List of spectrum bands to be allocated in the next auction

		700 MHz	900 MHz	2.3 GHz TDD	2.5 GHz TDD
To be allocated for long-term spectrum rights	Frequencies	703-748 MHz/ 758-803 MHz	890-915 MHz/ 935-960 MHz	2300-2330 MHz	2570-2615 MHz
	Amount of spectrum	90 MHz (2 x 45 MHz)	50 MHz (2 x 25 MHz)	30 MHz	45 MHz
	Expected start date of spectrum right	2018 at the earliest	1 April 2017		
To be allocated for short-term spectrum rights[47]	Frequencies	-	882-887 MHz/ 927-932 MHz	-	-
	Amount of spectrum	-	10 MHz (EGSM band: 2 x 5 MHz)	-	-
	Expected start date of spectrum right	-	1 April 2017	-	-

84. Part of these spectrum bands will be set aside for an auction that is open to only new entrants, with the remainder for the general spectrum auction that is open to the incumbent MNOs and the new MNO, if any. The indicative reserve prices for the spectrum set-aside package for the new entrant auction, and for the general spectrum auction, are listed in the table below. Once the spectrum allocation framework is finalised, IDA will inform the industry of the details of the auction format, auction rules and regulatory obligations relevant for the spectrum auction.

[47] If there is certainty before IDA commences the spectrum allocation exercise that the 885-890 MHz / 930-935 MHz pair band will be ready for use from 2017, IDA will make available the EGSM band to all qualified participants to bid for in the spectrum auction for longer term use.

Table 4: Overview of reserve prices for spectrum auction

Spectrum Band	Lot size (or package size for new MNO set-aside)	Spectrum right duration (indicative)	Indicative reserve price
New MNO spectrum set-aside *(if there are no new entrants participating in this new entrant auction, the spectrum will be allocated in the general spectrum auction based on the relevant lot sizes and reserve prices)*	2 x 10 MHz in 700 MHz band; 2 x 10 MHz in 900 MHz band; and 20 MHz in 2.3 GHz band	12 to 16 years	S$40 million for the entire block
700 MHz band	2 x 5 MHz	12 to 16 years	S$20 million per 5 MHz pair
900 MHz band			
EGSM in 900 MHz band *(allocated under FROR)*		3 to 5 years	Pro-rated based on reserve price for long-term spectrum right for 900 MHz band
2.3 GHz TDD band	5 MHz	12 to 16 years	S$5 million per 5 MHz lot
2.5 GHz TDD band			

85. The incumbent MNOs will have to comply with any regulatory obligations tied to the spectrum auction and the relevant regulatory frameworks governing mobile networks and services. While the incumbent MNOs are not required to provide roaming access to the new MNO, they will be required to provide interconnection and mobile number portability within a reasonable timeframe to the new MNO. They will also be required to negotiate in good faith with the new MNO to provide access to common antenna systems.

86. The new MNO will be required to comply with rollout deadlines of 18 months for nationwide coverage (except underground MRT stations/lines and road tunnels), and 60 months for underground MRT stations/lines and road tunnel coverage, from the start of the 900 MHz spectrum right. It will also be required to comply with the relevant regulatory frameworks governing mobile networks and services, such as QoS, the Telecom Resiliency Code, and an audit framework related to mobile networks by timeframes to be specified by IDA.

87. All MNOs, including the new MNO, will be required to negotiate in good faith with MVNOs who request for wholesale access. IDA will provide a list of negotiating principles to aid such negotiations for "thick" MVNOs, and IDA may mediate between the MNOs and "thick" MVNOs using the negotiation principles as the point of reference.

88. IDA will separately consult on the band plans, uses, and/or re-farming of the 800 MHz band, 1.4 GHz band, the 3G Bands, and the 3.5 GHz band after the relevant assessments and studies for these bands are completed.

89. In summary, for this consultation, the questions on which IDA would like to seek views and comments are as follows:

Question 1

The proposed allocation of the 700 MHz band together with other suitable bands for mobile services in the next spectrum allocation exercise; and the mechanism to allow the delay of the commencement date of the 700 MHz spectrum right, and correspondingly, the expiry date as well as the spectrum right payment due date, in the event of a delay in the ASO.

Question 2

a) *The proposed 800 MHz band plan based on the 3GPP band 26, or a combination of 3GPP band 27 and band 5 (excluding the EGSM band), including views on the possible phased approach and timeline to migrate existing users of the band; and*
b) *The impact to existing users (i.e., Trunked radio and SRD) of the 800 MHz band plan based on the 3GPP band 26, or a combination of 3GPP band 27 and band 5 (excluding the EGSM band).*

Question 3

The allocation of the short-term spectrum rights for the EGSM band, including the approach to extend the short-term spectrum right.

Question 4

a) *The proposed re-allocation of the L-band for wireless broadband in Singapore in the longer term; and*
b) *The allocation of the L-band for trial, temporary use, and/or commercial services in the interim period.*

Question 5

a) The proposed approach for local operators to coordinate with neighbouring countries' operators to address potential co-channel interference in the use of the 2.5 GHz band;

b) *The use of the proposed 5 MHz guard band in the 2.5 GHz band to prevent interference between TDD and FDD systems operating in adjacent bands, versus the imposition of suitable mitigation measures to prevent interference; and*

c) *The possible adoption and/or suitable restriction levels for Block Edge Mask, synchronisation of TDD networks and any other suitable mitigation measures to prevent co-channel or adjacent channel interference between different TDD systems or between TDD and FDD systems.*

Question 6

The proposed allocation of the spectrum bands in the next allocation exercise, including on the proposed uses and spectrum right durations of the spectrum bands, the proposed 'Clock Plus' auction format, as well as the appropriate spectrum caps and regulatory obligations to ensure the optimal use of the spectrum.

Question 7

The proposed facilitation framework for the new MNO, including on the set-aside spectrum, the reserve price for the set-aside spectrum, the auction format, and the regulatory obligations on the new MNO.

Question 8

The proposed negotiation principles to facilitate wholesale access negotiations between "thick" MVNOs and MNOs.

90. Lastly, in view of the interest from the industry to participate in the auction of these spectrum bands, IDA will conduct a clarification session for interested bidders to clarify any questions they may have regarding this consultation. Interested bidders are invited to indicate their interest in attending the clarification session by writing to IDA_ILO@ida.gov.sg with the email header "Clarification on spectrum allocation framework" by 10 July 2015.

PART VI: INVITATION TO COMMENT

91. IDA would like to seek the views and comments from the industry and members of the public on the proposed spectrum auction and new entrant facilitative framework set out in this document.

92. Respondents who submit their views or comments regarding the issues identified in this consultation document should organise their submission as follows: (a) cover page (including their personal/company particulars and contact information); (b) table of contents; (c) summary of major points; (d) statement of interest; (e) comments; and (f) conclusion. Supporting materials may be placed as an annex to the comments raised.

93. All views and comments should be submitted in soft copies (Microsoft Word or PDF Format), and should reach IDA by **12 noon, 12 August 2015**. All views and comments should be addressed to:

Ms Aileen Chia
Deputy Director General (Telecoms and Post)
Infocomm Development Authority of Singapore
10 Pasir Panjang Road
#10-01 Mapletree Business City
Singapore 117438
Fax: (65) 6211 2116

AND

Please submit your soft copies, with the email header "Second Consultation on Proposed Framework for the Allocation of Spectrum for IMT and IMT-Advanced Services and for the Enhancement of Competition in the Mobile Market", via email to IDA_consultation@ida.gov.sg.

IDA reserves the right to make public all or parts of any written submission and to disclose the identity of the source. Respondents may request confidential treatment for any part of the submission that the respondent believes to be proprietary, confidential or commercially sensitive. Any such information should be clearly marked and placed in a separate annex. If IDA grants confidential treatment, it will consider, but will not publicly disclose, the information. If IDA rejects the request for confidential treatment, it will return the information to the party that submitted it and will not consider this information as part of its review. As far as possible, parties should limit any request for confidential treatment of information submitted. IDA will not accept any submission that requests confidential treatment for all, or a substantial part, of the submission.

ANNEX A

PROPOSED NEGOTIATION PRINCIPLES FOR WHOLESALE ACCESS

Negotiation Terms	Details*

Scope of service	• Host 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.
Commercial terms	• Host MNO and the RP should negotiate in good faith and use best efforts to complete negotiations within a reasonable time frame. • The wholesale prices imposed by Host MNO should be reasonable, and in any case, should not be higher than the retail prices 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 RPs from terminating an existing agreement by the giving of reasonable notice and/or for seeking to migrate out from the existing Host MNO to another Host MNO.

** IDA may amend and review these principles from time to time.*