



**CONSULTATION PAPER ISSUED BY THE
INFO-COMMUNICATIONS MEDIA DEVELOPMENT AUTHORITY**

ON

**PROPOSED POLICY FRAMEWORKS FOR THE ALLOCATION OF
800 MHZ, TDD 1900 MHZ AND FDD 2100 MHZ SPECTRUM BANDS**

17 MAY 2019

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1. INTRODUCTION

- 1.1 The public wireless networks in Singapore comprises networks operating on licensed spectrum bands (e.g., public 3G/4G mobile networks for the mass consumers, digital trunked radio¹ (“**TR**”) for businesses and enterprise users) as well as networks operating on licence-exempt spectrum bands (e.g., Wireless@SG). In particular, for networks operating on licensed spectrum bands, IMDA takes steps to ensure the timely availability of licensed spectrum to support these networks. While IMDA prepares for the upcoming fifth generation of mobile technology (“**5G**”) (as set out in our Consultation Document titled “Second Consultation on 5G Mobile Services and Networks” issued on 7 May 2019), there is a need to ensure that licensed spectrum allocated for existing public and enterprise mobile use continue to be reviewed and re-farmed for new technologies and to facilitate innovative services as the market evolves. IMDA will also need to ensure that there is no service disruption to existing users even as demand preferences shift.
- 1.2 In this Consultation Document, IMDA seeks views and comments on IMDA’s proposed spectrum allocation frameworks for the 800 MHz, TDD1900 MHz and FDD2100 MHz spectrum bands.
- 1.3 This Consultation Document sets out the following for discussion:
- Section 2: 800 MHz Spectrum Band
 - Section 3: TDD1900 MHz Spectrum Band
 - Section 4: FDD2100 MHz Spectrum Band
 - Section 5: Spectrum Allocation Framework
 - Section 6: Invitation to Comment
- 1.4 This consultation will be open for a period of eight weeks, and will close by 12 noon on 15 July 2019.

¹ TR is a two-way radio system where a pool of spectrum resource is shared among many users automatically via a controller.

2. 800 MHZ SPECTRUM BAND

- 2.1 Singapore has a good mix of localised private networks and public nationwide networks which serve businesses and enterprise users. These networks usually operate on TR technologies, such as Integrated Digital Enhanced Network (“**iDEN**”), Terrestrial Trunked Radio (“**TETRA**”) or NXDN, for example. Business and enterprise users usually prefer dedicated networks for increased security, flexibility and control, and use features that are not typically found on public mobile networks. These features include the ability to make group calls and mission critical Push-to-talk (“**PTT**”) functionality. Besides these enterprise networks, business or enterprise users can also be served by public mobile networks, depending on their respective requirements and needs.
- 2.2 The 800 MHz band is currently allocated to several types of services. Besides supporting digital TR services (e.g., walkie-talkies) for businesses and enterprise users, the 800 MHz band is also allocated for Short-Range Devices (“**SRDs**”) (e.g., for radio-frequency identification (“**RFID**”) and car remote controls) and, for International Mobile Telecommunications (“**IMT**”) services in the Extended Global System for Mobile Communications (“**EGSM**”) band.

Recap and Follow-Up from Previous Consultations

- 2.3 Through the feedback from previous public consultations², IMDA noted that there had been interest in the 800 MHz band (806 - 834 MHz / 851 - 879 MHz for a total of 2 x 28 MHz) for mobile services, digital TR services and public protection and disaster relief (“**PPDR**”) services. To facilitate re-farming, IMDA has been migrating affected users in this band and aims to complete this migration by 2021.
- 2.4 Following engagements with affected users and taking into consideration harmonisation with neighbouring countries, IMDA will continue to allocate 2 x 3 MHz for narrowband digital TR services and 1 MHz for SRDs³, and will also reserve 2 x 10 MHz for PPDR services. IMDA then undertook a further study in assessing the demand and possible uses for the remaining 800 MHz spectrum which straddles 3rd Generation Partnership Project (“**3GPP**”) bands 26 and 27⁴.

² “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”; “5G mobile services and networks”.

³ IMDA has engaged vendors and users of SRDs in the 866 – 869 MHz band and understands that majority of the SRDs operate in the 868 – 869 MHz band, while very few SRDs operate in 866 – 868 MHz. Nonetheless, it is still in IMDA’s interest to re-farm 868 – 869 MHz in the long run. The retention of 868 – 869 MHz for SRDs is to allow existing users more time for migration.

⁴ 3GPP band 20 also overlaps with the available spectrum, but is not harmonised for use in ITU Region 3. Band 20 does not fully overlap with the available spectrum and has duplex spacing that differs from the other relevant 3GPP bands (i.e., 26 and 27). It also has a reversed duplex arrangement (the uplink

IMDA's further study identified 2 x 13 MHz (810 – 823 /855 – 868 MHz) of spectrum to be made available for reassignment (after taking into consideration the necessary guard band).

Study of User Demand

- 2.5 IMDA's study revealed that enterprise users have needs that are more specialised and these have traditionally been met by dedicated enterprise service providers⁵, instead of public mobile networks. IMDA understands that the reasons for this include: (a) public mobile networks have not traditionally been designed to fulfil the requirements of these enterprises; and (b) Mobile Network Operators (“**MNOs**”) have cited constraints in establishing private networks within their existing public networks to provision the specialised features needed by enterprise users. While MNOs expressed keen demand in the 800 MHz band for the provision of public mobile services, some enterprises consider voice services to be “mission critical” (“**MC**”) and have certain service quality requirements that public mobile networks have not traditionally been designed to fulfil. These requirements include functionalities such as PTT and group calls, in addition to more stringent service quality requirements such as low latency, higher reliability and increased network security.
- 2.6 Enterprise users who are currently being served by enterprise networks operating in the 800 MHz band have expressed that their demand for enterprise-type services including MC PTT is expected to remain unchanged. Further, such users expect their demand for enterprise *data* services to grow as technology in this area evolves further, which may alter their business and operating models. These users have shared that they are unlikely to migrate to public mobile networks given the technical and business constraints. Therefore, IMDA has assessed that there is a need to continue to set aside spectrum to serve enterprise users' needs, as this group of users will likely be displaced in the absence of such dedicated networks.
- 2.7 With the growing demand for enterprise data, dedicated enterprise networks can no longer rely on narrowband TR technologies (which are voice-centric and support very low data rate) and would need to migrate to a broadband-based technology that would be able to support higher data rates as well as MC voice services. Long Term Evolution (“**LTE**”) is a proven technology for data services and there are already existing solutions in the market for LTE to support various MC applications⁶. As such, in the near term, IMDA is of the view that LTE would

and downlink arrangement is reversed), which would lead to interference issues with adjacent services as well as networks in neighbouring countries.

⁵ These service providers have traditionally used digital TR technologies such as TETRA, NXDN and iDEN to provide services, as these technologies have been designed at the onset to fulfil enterprise requirements.

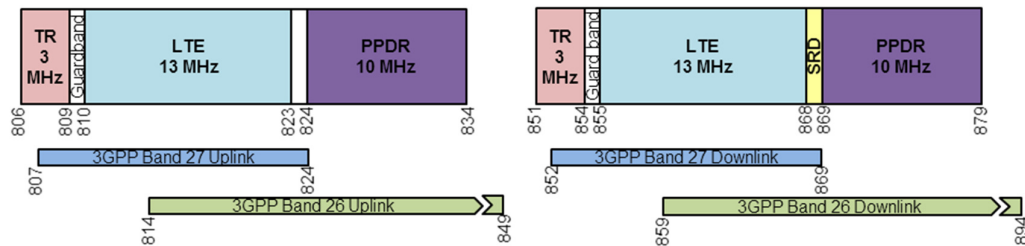
⁶ In 2016, the standard for MC PTT was introduced in 3GPP Release 13 and subsequently in Release 14 and 15, more MC functionalities were incorporated.

be the choice of technology to serve the demands of dedicated enterprise network.

IMDA's Proposal for the 800 MHz Spectrum Band

2.8 Taken together, IMDA has decided to assign available spectrum in the 800 MHz band to LTE-based services to serve enterprises based on a combination of 3GPP bands 26 and 27. The proposed band plan is illustrated in **Figure 1** below.

Figure 1: Proposed Band Plan for 2 x 13 MHz in 800 MHz Band



2.9 As highlighted in previous consultations, IMDA recognises the need for guard bands between TR and LTE services and have catered 1 MHz at 809 – 810 / 854 – 855 MHz for this purpose.

2.10 To arrive at this proposal, IMDA considered the opportunity cost of allocating the available spectrum in the 800 MHz band for dedicated enterprise use. In this regard, the other candidate use with strong demand for spectrum in this band is public mobile services. The upper portion (814 – 823 / 859 – 868 MHz) overlaps with both 3GPP bands 26 and 27 while the lower portion (810 – 814 / 855 – 859 MHz) overlaps with 3GPP band 27 only. IMDA notes that the LTE device ecosystems in both these bands are not well developed at this time, as there are less than 400 LTE devices compatible with band 26, and only a handful of devices that are compatible with band 27⁷. IMDA is also not aware of any public mobile LTE networks that support 3GPP bands 26 or 27.

2.11 IMDA notes that existing spectrum holdings may increase the MNOs' valuations for the available spectrum in the 800 MHz band, as MNOs would be able to deploy Carrier Aggregation (“CA”) over the 800 MHz spectrum and their existing bands. At this juncture, 3GPP specifications allow for CA of band 27 with bands 3 and 8, while band 26 is able to be aggregated with the bands 1, 3 and 7, for example. That said, IMDA understands that most MNOs can already achieve better data rates by carrier aggregating their existing spectrum holdings (which has more CA possibilities) rather than using 3GPP band 26.

⁷ Source: GSA's GAMBOD LTE devices database

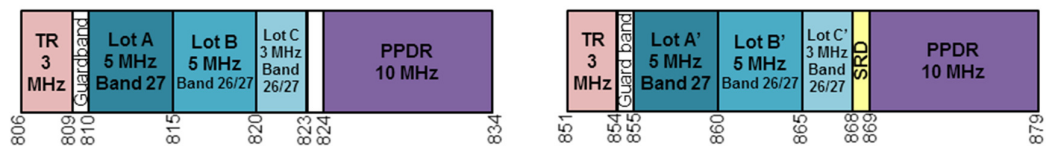
- 2.12 IMDA also notes that the available spectrum may be a potential 5G band in the future. However, it is not meaningful to set aside this spectrum for 5G given the limited amount of spectrum available now, which cannot be harnessed to deliver the full potential of 5G, in addition to the absence of a well-developed 5G device ecosystem. Furthermore, there will also be a need to co-ordinate with our neighbouring countries for any 5G deployments, who have not identified this spectrum for 5G use.
- 2.13 In view of the less developed device/network ecosystems for bands 26 and 27 for LTE, and the absence of similar ecosystems for 5G, IMDA has assessed that the opportunity cost to assigning the available spectrum for dedicated enterprise use is significantly low.
- 2.14 IMDA will continue to migrate existing TR users and this is expected to be completed by 2021. IMDA will also continue the cessation of SRDs in 866 – 868 MHz in 2019 and aims to complete it by 2023, or earlier if possible. IMDA recognises the importance for the continued use of 868 – 869 MHz for SRDs given the pervasive use in Singapore, and understands that more time is required for existing users to migrate from this band. IMDA will continue to encourage and recommend that new SRDs migrate to the alternative 920 – 925 MHz band. Noting that there may be interference issues once mobile broadband networks are deployed locally or in our neighbouring countries⁸, IMDA will monitor the situation and review the plans for 868 – 869 MHz. There is a possibility that the use of SRDs in 868 – 869 MHz would be ceased by 2028. Taking into consideration that an additional 1 MHz (868 – 869 MHz) would possibly be freed up by 2028, IMDA may in the future look into the possibility of removing the 1 MHz guard band between TR and LTE services, such as by implementing mitigation measures so that the available spectrum could be expanded from 2 x 13 MHz to 2 x 15 MHz.
- 2.15 Given the aforementioned assessment, IMDA is considering allocating spectrum in this band on a 7- to 10-year term, so as to cater for new technology developments and upgrades in the coming years.
- 2.16 Due to the limited supply of spectrum in this spectrum band and the interest indicated by various parties for spectrum in this band, IMDA expects to allocate spectrum in this band via an auction process. IMDA proposes for the 2 x 13 MHz spectrum to be allocated in 3 lots, that is, 2 lots of 2 x 5 MHz and 1 lot of 2 x 3 MHz (see **Figure 2**) as these are the permissible channel bandwidths specified in 3GPP specifications and would also provide more flexibility in the adoption of 3GPP bands 26 or 27. IMDA is, however, open to hearing views on

⁸ SRDs are intended for operation in unprotected and shared frequency bands. SRDs shall not cause interference with other authorised radio-communication services, and be able to tolerate any interference caused by other radio-communication services, electrical or electronic equipment.

whether there are compelling reasons to pair Lots A and B or Lots B and C instead. To minimise impact to end users who are currently being served by enterprise networks operating in the 800 MHz band, IMDA is also considering to allocate a 2 x 5 MHz lot on a First Rights of Refusal (“**FROR**”) basis to the existing spectrum holder, GRID Communications Pte Ltd, at a specified reserve price. The remaining spectrum will be allocated via an auction as one lot of 2 x 5 MHz and one lot of 2 x 3 MHz.

2.17 The spectrum rights for available spectrum in the 800 MHz band will commence in 2022 at the earliest, subject to the completion of the existing TR migration and cessation of SRDs.

Figure 2: Proposed Allocation for 2 x 13 MHz Spectrum



Question 1: IMDA seeks views on the proposed allocation approach for the 800 MHz spectrum band, in particular:

- (a) Whether the proposed lot sizes allow for meaningful use of the spectrum or if there are other alternative combinations of spectrum lot sizes that should be considered for efficiency reasons;
- (b) Whether the proposed spectrum right duration is adequate from a business viability and investment perspective; and
- (c) The reasons for your views on the above.

3. TDD1900 MHZ SPECTRUM BAND

- 3.1 The Time Division Duplex (“**TDD**”) 1900 MHz spectrum band (“**TDD1900 MHz**”) was allocated for 3G mobile services, as part of a spectrum package comprising 2 x 45 MHz of paired spectrum in the 2100 MHz band (1920 – 1964.9 / 2110.3 – 2154.9 MHz)(“**FDD2100 MHz**”⁹) and 15 MHz of unpaired spectrum in the 1900 MHz band (1904.9 – 1920 MHz) in 2001 (the “**2001 3G Auction**”). Three spectrum rights licences were awarded to M1, Singtel Mobile (“**STM**”) and StarHub Mobile (“**SHM**”) at the reserve price of S\$100 million each. The spectrum rights for both the FDD2100 MHz and TDD1900 MHz bands expire in 2021.
- 3.2 While both TDD1900 MHz and FDD2100 MHz spectrum were allocated for 3G mobile services, IMDA understands that the MNOs have only used the FDD2100 MHz spectrum to provide 3G mobile services. The TDD1900 MHz spectrum, on the other hand, has been largely unused due to poor device support and ecosystem development globally. Given that 3G systems have been in operation for almost 20 years, IMDA believes that it is highly unlikely that there will be further development for 3G in the TDD1900 MHz band. Similarly, IMDA understands that 4G network deployment in the TDD1900 MHz band is also limited. For efficient use of spectrum, it will be in IMDA’s interest to re-farm the TDD1900 MHz band for other purposes.

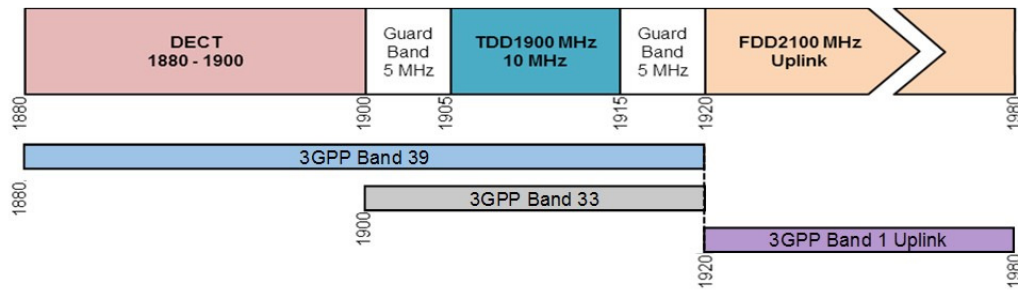
IMDA’s Proposal for the TDD1900 MHz Spectrum Band

- 3.3 IMDA has therefore identified 10 MHz of available spectrum in the TDD1900 MHz band (1905 – 1915 MHz) for LTE-based voice and data communication services, based on 3GPP bands 33 or 39, for enterprises. IMDA intends to assign this together with the 2 x 13 MHz of bandwidth in the 800 MHz band for the provision of enterprise mobile services, as IMDA envisages an increase in demand for both enterprise voice and enterprise data services in the longer term.
- 3.4 IMDA is cognisant that there is a need to cater for guard bands between the TDD1900 MHz and FDD2100 MHz bands as well as between TDD1900 MHz and Digital Enhanced Cordless Telecommunications (“**DECT**”) spectrum, and intends to set aside 5 MHz at both ends for this purpose. There may also be a need for the new TDD1900 MHz network to deploy band-pass filters in the event the 5 MHz guard band is insufficient to prevent interference between TDD and FDD systems.

⁹ Subsequent references to FDD2100 MHz encompasses frequencies in 1920 – 1979.7 / 2110.3 – 2169.7 MHz

3.5 The proposed band plan is illustrated in **Figure 3** below:

Figure 3: TDD1900 MHz Band Plan



3.6 IMDA is considering aligning the spectrum right for this band with that of the 800 MHz band, i.e., 7- to 10-year spectrum right, as IMDA continues to monitor developments on the potential uses for this spectrum band. Due to the limited supply of spectrum in this spectrum band and the interest indicated by some parties for the provision of enterprise mobile services in this band, IMDA expects to allocate spectrum in this band via an auction process together with the 800 MHz band. Based on the technical parameters and limitations where guard bands are required to prevent interference with adjacent services, IMDA proposes to auction the 10 MHz as a single block at a specified reserve price.

Question 2: *IMDA seeks views on the proposed allocation approach for the TDD1900 MHz spectrum band, in particular:*

- (a) *Whether there is a need for additional filters if the guard band between FDD and TDD systems is 5 MHz, and the specifications of the required band-pass filter;*
- (b) *Whether there are known technical frameworks for the co-existence of LTE-based networks operating in 3GPP band 1 and band 33/39;*
- (c) *Whether the proposed lot sizes allow for meaningful use of the spectrum;*
- (d) *Whether the proposed spectrum right duration is adequate from a business viability and investment perspective; and*
- (e) *The reasons for your views on the above.*

4. FDD2100 MHZ SPECTRUM BAND

- 4.1 The FDD2100 MHz spectrum band is currently allocated for 3G mobile services and was assigned in two separate auctions, the 2001 3G Auction (2 x 45 MHz) and the 3G spectrum right auction in 2010 (2 x 15 MHz). The spectrum rights for the FDD2100 MHz spectrum band expire in 2021.
- 4.2 Given the ubiquity of 4G mobile services and devices in Singapore today, 4G subscriptions currently account for the majority of mobile subscriptions. Correspondingly, the number of 3G subscriptions has been declining¹⁰ as end users generally prefer the faster 4G services which offer enhanced speeds and service quality. That said, there are still a significant number of 3G subscriptions¹¹ that continue to be active – these comprise both end users, businesses and transitory inbound roamers.
- 4.3 Besides the significant number of active 3G subscriptions and inbound roamers, IMDA also understands that 4G voice services are not supported on all 4G-capable devices, e.g., low-end 4G handsets will require 3G connectivity for voice calls. This means that some 4G subscribers will continue to rely on 3G mobile networks for voice calls. Given these considerations, IMDA has assessed that 3G mobile networks will still be needed in Singapore within the short to medium term, e.g., until at least 2025, if not later.
- 4.4 Today, the available spectrum in the FDD2100 MHz has been assigned in equal proportion to M1, STM and SHM. Each MNO has approximately 2 x 20 MHz of spectrum in the FDD2100 MHz spectrum band. The existing assignment is as shown in **Figure 4**:

Figure 4: Existing Assignment for FDD2100 MHz Band



- 4.5 Although the FDD2100 MHz was originally used for 3G mobile services, it is increasingly being deployed for 4G services with more countries and operators planning to re-farm this band for 4G use. The use of CA has also helped to propel this trend, giving operators the ability to combine spectrum assets in

¹⁰ Total 3G subscriptions in Singapore have declined 22% year-on-year (average) between 2016 and 2019 (source: IMDA).

¹¹ 1.8 million as at January 2019 (source: IMDA).

different bands, including the FDD2100 MHz, to boost speeds needed for uploads and downloads, thus supporting the 4G mobile data needs. The FDD2100 MHz also enables a notable number of CA combinations apart from the popular 3GPP band 3 (1800 MHz) and 3GPP band 7 (2600 MHz). Moreover, the FDD2100 MHz band has been included as New Radio (“NR”) operating band, “n1”, under 3GPP Release 15 specification for 5G NR.

IMDA’s Proposal for the FDD2100 MHz Spectrum Band

- 4.6 The amount of available spectrum in the FDD2100 MHz spectrum band remains unchanged at 120 MHz. Given the importance of 3G and 4G networks in Singapore, IMDA has assessed that the FDD2100 MHz band should be allocated to 3G and 4G mobile services. Since these networks will continue to be required in Singapore within the short to medium term, IMDA is considering allocating spectrum in this band on a 15-year spectrum right. Due to the limited supply of spectrum in this spectrum band and the interest indicated by the MNOs for spectrum in this band, IMDA expects to allocate spectrum in this band via an auction process.
- 4.7 IMDA notes that M1, STM and SHM have existing 3G mobile networks and these will continue to be required to serve the needs of their customers. This being the case, IMDA is considering to allocate two lots of 2 x 5 MHz on a FROR basis to these MNOs at a specified reserve price. This will provide certainty for MNOs who have 3G mobile networks for the continued provision of 3G services beyond 2021 in order to maintain existing service quality and end users’ experience. The remaining six lots of 2 x 5 MHz will be allocated via an auction on a technology neutral basis (i.e., for the provision of either 3G or 4G services).

Question 3: *IMDA seeks views on the proposed allocation approach for the FDD2100 MHz spectrum band, in particular:*

- (a) Whether the proposed FROR allocation allows existing 3G mobile network operators to serve the needs of their customers or if there are other alternative combinations of FROR allocations that should be considered; and*
- (b) Whether the proposed spectrum right duration is adequate from a business viability and investment perspective; and*
- (c) The reasons for your views on the above.*

5. PROPOSED SPECTRUM ASSIGNMENT FRAMEWORK

5.1 IMDA proposes to conduct two separate spectrum auctions to assign spectrum in these bands, as auctions are a fair, transparent and efficient method to allocate scarce resources. IMDA proposes to adopt a “Clock Plus” auction format for both these spectrum auctions:

- (a) For the assignment of the 800 MHz and TDD1900 MHz spectrum bands (collectively, the “**Enterprise Bands**”) (the “**Enterprise Spectrum Auction**”); and
- (b) For the assignment of the FDD2100 MHz band for mobile services (the “**FDD2100 MHz Spectrum Auction**”),

(collectively, the “**Spectrum Auctions**”).

Auction Format

5.2 The Clock Plus auction format was adopted in the 4G spectrum auction in 2013 as well as the general spectrum auction in 2017 and consisted of three main stages:

- (a) Initial offer stage: Qualified bidders¹² will be required to submit an initial offer in respect of the quantity of spectrum lots they demand in the relevant Spectrum Auctions, 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 excess demand. Once this stage of the auction is completed, successful qualified bidders will go on to the “Assignment stage”.

¹² Potential enterprise network operators will be required to participate in a pre-qualification phase before they are able to participate in the Enterprise Spectrum Auction. Only MNOs are allowed to participate in the FDD2100 MHz Spectrum Auction.

- (c) Assignment stage: This stage of the auction will determine the actual frequency bands to be assigned to each qualified bidder, and IMDA may consider allowing for joint proposals from qualified bidders on the specific assignments of frequency bands. Otherwise, or in the case where there is no joint proposal, IMDA 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 IMDA.

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.

Spectrum Caps

5.3 IMDA has determined that the spectrum caps are as follows:

Spectrum Auction	Relevant Spectrum Caps
Enterprise Spectrum Auction	<p>Bidder of 10 MHz of unpaired TDD1900 MHz spectrum is not allowed to bid for any 800 MHz spectrum lots and vice versa</p> <p>There is a cap of two lots of paired 2 x 5 MHz (including any FROR lot) for the 800 MHz spectrum bidder</p>
FDD2100 MHz Spectrum Auction	Four lots of paired 2 x 5 MHz (including the FROR lots)

5.4 In determining these spectrum caps, IMDA has taken into account the reasonable amount of spectrum for qualified bidders to provide 3G mobile services (i.e., for the FDD2100 MHz Spectrum Auction), or LTE-based broadband services (i.e., for the 800 MHz and TDD1900 MHz Spectrum Auction), balanced with the need to prevent monopolisation of spectrum or spectrum hoarding.

Put-to-Use and Rollout Requirements

5.5 IMDA is also considering imposing regulatory obligations to ensure the optimal use of spectrum, e.g., stipulating a deadline to use the spectrum or other similar roll-out obligations, failing which IMDA reserves the right to rescind the spectrum right(s) without compensation.

5.6 In particular, for the Enterprise Bands, IMDA is considering limited roll-out (e.g., 50%-75% nationwide outdoor service coverage within 2-3 years of the start

date for the spectrum right) obligations for holder(s) of at least 2 x 5 MHz in the 800 MHz spectrum band and holder of the TDD1900 MHz spectrum band.

- 5.7 For the FDD2100 MHz spectrum, spectrum holders are required to use these spectrum bands to augment their existing networks to provide nationwide 3G, 4G and/or IMT-Advanced telecommunication services. In particular, new FDD2100 MHz spectrum holders are required to utilise the FDD2100 MHz spectrum on a standalone basis to provide at least 50% nationwide outdoor coverage of 4G and/or IMT-Advanced services within 12-18 months from the commencement of the spectrum right.
- 5.8 In addition, all FDD2100 MHz spectrum holders (new and existing) would have to comply with 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. These 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.

Reserve Price

- 5.9 To arrive at the reserve prices for the allocation of the 800 MHz, TDD1900 MHz, and FDD2100 MHz spectrum bands, IMDA considered the intrinsic value¹³ of the relevant spectrum bands and where relevant, the international benchmarks of reserve and final bid prices for similar bands. While IMDA 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.

¹³ 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 well as commercial factors such as the expected market demand and market share for each qualified bidder.

5.10 Therefore, based on IMDA’s assessment, the indicative reserve price of each spectrum lot for the Spectrum Auctions is as follows:

Spectrum Auction	Relevant Reserve Prices
800 MHz and TDD1900 MHz Spectrum Auction for a spectrum right duration of 7 – 10 years	SGD \$450,000 – SGD \$900,000 for a 2 x 5 MHz lot in the 800 MHz band; SGD \$100,000 – SGD \$250,000 for a 2 x 3 MHz lot in the 800 MHz band; and SGD \$450,000 – SGD \$900,000 for an unpaired 10 MHz lot in the TDD1900 MHz band.
FDD2100 MHz Spectrum Auction for a spectrum right duration of 10 – 15 years	SGD \$10 million – 15 million for each 2 x 5 MHz lot in the FDD2100 MHz band

Question 4: *IMDA 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, the proposed reserve prices as well as the proposed spectrum caps and regulatory obligations to ensure the optimal use of spectrum.*

5.11 In summary, IMDA will be allocating the following spectrum bands in the two Spectrum Auctions:

Spectrum Auction	Spectrum bands	Frequencies	Amount of Spectrum	Expected start date of spectrum right
800 MHz and TDD1900 MHz Spectrum Auction	800 MHz	810 – 823 / 855 – 868 MHz	26 MHz (2 x 13 MHz)	2022
	TDD1900 MHz	1905 – 1915 MHz	10 MHz	2022
FDD2100 MHz Spectrum Auction	FDD2100 MHz	1920 – 1980 / 2110 – 2170 MHz	120 MHz (2 x 60 MHz)	2022

6. INVITATION TO COMMENT

- 6.1 IMDA would like to seek views and comments from members of the public and the industry on the above issues.
- 6.2 Parties that submit comments on the issues identified in this Consultation Document should organise their submissions as follows:
- (a) Cover page (including their personal/company particulars and contact information);
 - (b) Table of contents;
 - (c) Summary of major points (structured to follow the individual Parts of the Consultation Document);
 - (d) Statement of interest;
 - (e) Comments (in response to the Questions set out in the Consultation Document and any other comments); and
 - (f) Conclusion.

Supporting material may be placed in an Annex.

- 6.3 Where feasible, parties should identify the specific sections of the Consultation Document on which they are commenting and provide reasons for their proposals.
- 6.4 All submissions must reach IMDA by 12 noon on 15 July 2019. Softcopy of submissions in both Microsoft Word and Adobe PDF format should be provided. Parties submitting comments should include their personal/company particulars as well as the correspondence address, contact number and email addresses on the cover page of their submission. All comments should be addressed to:

Aileen Chia (Ms)
Deputy Chief Executive (Policy, Regulation & Competition Development),
Director-General (Telecoms & Post)
Infocomm Media Development Authority
10 Pasir Panjang Road
#03-01 Mapletree Business City
Singapore 117438

Please submit your softcopy via email to: Consultation@imda.gov.sg

- 6.5 IMDA reserves the right to make public any written submissions and to disclose the identity of the source. Commenting parties may request confidential treatment of any part of the submission that the commenting party believes to

be proprietary, confidential or commercially sensitive, with supporting justification for IMDA's consideration. In such cases, the submission must be provided in a non-confidential form suitable for publication, with any confidential information redacted as necessary and placed instead in a separate annex.

- 6.6 If IMDA grants the request for confidential treatment, IMDA will consider the information as part of its assessment, but will not publicly disclose the information. If IMDA rejects the request for confidential treatment, it will return the information to the party that submitted it and will not consider the information as part of its review. As far as possible, parties should limit any request for confidential information submitted. IMDA will not accept any submission that requests confidential treatment for the entire, or a substantial part of, the submission.