DECISION ISSUED BY THE INFO-COMMUNICATIONS MEDIA DEVELOPMENT AUTHORITY

ON

NEXT WAVE OF 5G GROWTH & DEPLOYMENT IN SINGAPORE: POLICY AND REGULATORY DESIGN FOR 2.1 GHZ BAND

23 SEPTEMBER 2021

CHAPTER 1: BACKGROUND

1. On 26 July 2021, IMDA consulted on the policy and regulatory design for the 2.1 GHz spectrum band for the next wave of 5G growth and deployment in Singapore.

2. 5G plays a key role in the growth and development of Singapore's mobile market and digital economy. Beyond faster mobile broadband speeds, 5G is expected to enable a multiplicity of new and innovative use-cases which leverage on 5G technology and network capabilities, in areas such as smart estates, industry 4.0, urban mobility, maritime operations, amongst others.

3. IMDA had articulated its 5G policy objectives in IMDA's Decision on the *Policy for Fifth-Generation (5G) Mobile Networks and Services in Singapore* issued on 17 October 2019 (**5G Decision**), which include the following:

   a. Maximise value of 5G for the economy and welfare for the consumers;

   b. Facilitate efficient allocation of scarce spectrum resources;

   c. Bring about 5G networks that are secure and resilient; and

   d. Support the growth of Singapore's telecommunications sector.

4. To achieve these policy objectives, IMDA's 5G Decision indicated that IMDA would facilitate 5G networks that were based on Standalone (**SA**) network architecture. Given the limited amount of spectrum in the 3.5 GHz band which was issued as part of IMDA's 5G Call for Proposal (**CFP**), IMDA had facilitated the deployment of two nationwide 5G SA networks for a start. Deployments of these two nationwide 5G SA networks, one by Singtel Mobile Singapore Pte Ltd (**Singtel**) and the other by a Joint-Venture Consortium formed by M1 Limited (**M1**) and StarHub Mobile Pte Ltd (**StarHub**), are ongoing and are making progress towards achieving at least 50% outdoor coverage by end-2022 and nationwide outdoor coverage (at least 95%) by end-2025.

5. In IMDA's 5G Decision, IMDA had also preliminarily identified the next wave of 5G spectrum that IMDA might potentially allocate for 5G services. Among these bands, is the 2.1 GHz band that is currently supporting 3G services. The existing spectrum rights for the 2.1 GHz band will be expiring on 31 December 2021[1].

[1] Besides frequency spectrum in the 2.1 GHz band, M1, Singtel and StarHub were also issued unpaired frequency spectrum in the 1.9 GHz Time Division Duplex (**TDD**) band (1904.9 MHz – 1920 MHz) in their respective spectrum rights which were issued in 2001. The allocation of spectrum in the 1.9 GHz TDD band will be reviewed separately from the 2.1 GHz band.

6. The 2.1 GHz band, if assessed to be suitable for 5G, affords IMDA the opportunity to support the next wave of 5G growth for all Mobile Network Operators (**MNOs**), including the opportunity for the deployment of additional nationwide SA networks if there is market demand.

7. Against this backdrop, IMDA sought views on 26 July 2021 on the policy proposals regarding the allocation and use of the 2.1 GHz spectrum band upon the expiry of the existing spectrum rights.

8. At the close of the consultation on 23 August 2021, IMDA received comments from 10 respondents (each a **Respondent** and collectively, **Respondents**).

9. IMDA thanks all Respondents for their responses to the consultation.

10. This document sets out the key issues raised in the consultation, and IMDA's responses and decisions on these issues. IMDA has taken into account and given thorough consideration to all the comments received which are relevant to the consultation, notwithstanding that not all the comments are specifically mentioned or addressed herein.

CHAPTER 2: TECHNOLOGICAL & MARKET DEVELOPMENTS

11. In assessing the suitability of 2.1 GHz for 5G use in Singapore, IMDA considered whether the 2.1 GHz band could be used to support other services, including 4G and legacy 3G services , as well as international trends and global ecosystem developments.

5G Networks & Services

International Trends – Increasing Use of 2.1 GHz for 5G

12. The 2.1 GHz band is one of the sub-6 GHz bands with good propagation characteristics, which makes it beneficial for 5G coverage.

13. The 2.1 GHz band is increasingly being used for the deployment of 5G networks internationally, including in Germany, Hong Kong and United Kingdom. Since IMDA's Consultation on the *Proposed Policy Frameworks for the Allocation of 800 MHz, TDD 1900 MHz and FDD 2100 MHz Spectrum Bands* issued on 17 May 2019, several countries have auctioned the 2.1 GHz band for 5G use and others, like Australia, are conducting trials to assess its suitability for 5G.

14. The number of countries using the 2.1 GHz band for 5G networks is expected to increase as the demand for 5G picks up, and as regulators around the world assess its suitability for 5G deployment.

Global Ecosystem Maturity

15. The 5G ecosystem for the 2.1 GHz band has also been growing. Today, the 3rd Generation Partnership Project (**3GPP**) New Radio (**NR**) band "**n1**" (i.e., where the 2.1 GHz spectrum band lies) is supported by many network equipment vendors, chipset manufacturers and device vendors.

16. Overall, the device ecosystem for 5G in this band has matured at a faster pace than expected. Based on statistics from the Global mobile Suppliers Association Analyser for Mobile Broadband Data, as at end-August 2021, the number of 5G handsets operating on the 5G NR band n1 has grown more than ten-fold from 17 handsets in 2019 to more than 200 handsets in 2021. The growing availability of handsets means consumers would be able to choose from a wide variety of handset models from multiple manufacturers.

17. The 5G ecosystem support for the 2.1 GHz band is expected to continue to grow, thus improving the commercial readiness of the band for 5G.

Minimising Interference with Use in Neighbouring Countries

18. For Singapore, due to our small geographical size and close proximity to our neighbouring countries, the possibility of cross-border interference is an important factor that IMDA will take into account when determining spectrum allocation. As Singapore and our neighbouring countries have deployed mobile cellular networks on the 2.1 GHz band in the Frequency Division Duplex mode, any interference between the uplink and downlink of local and foreign networks is minimised.

4G Networks & Services

Domestically – 4G Spectrum Remains Important to Support Continuing Demands of users and Deliver Good Service Experience for 4G Users

19. Singapore has achieved nationwide 4G coverage since early 2015. Today, more than 90% of Singapore's mobile subscribers are 4G subscribers and the number of 4G users continues to grow[2]. IMDA notes that consumers enjoy good quality 4G services today.

20. 4G is expected to remain the "anchor" mobile technology and service in Singapore for some years to come. As 4G services are well supported by multiple spectrum bands, IMDA has assessed that there is less need to allocate additional spectrum for 4G at this juncture.

3G Networks & Services

Domestically – Spectrum Still Needed to Support 3G Users' Needs

21. The 2.1 GHz band is the main spectrum band supporting 3G services in Singapore today. IMDA notes the following:

    a. While the total number of 3G subscribers in Singapore today has declined, this number is not insignificant. There are approximately 700,000 3G subscriptions as at June 2021 (close to 8% of all mobile subscriptions) and more than 1.5 million handsets/devices still depend on 3G networks today. These handsets and devices may not support 4G voice calls, or are still using 3G SIM cards. Affected users include seniors, foreign workers, transport operators, and healthcare organisations; and

[2] https://www.imda.gov.sg/infocomm-media-landscape/research-and-statistics/telecommunications/statistics-on-telecom-services/statistics-on-telecom-services-for-2021-jan

b. Inbound roamers such as tourists and business travellers may still rely on 3G networks, for both data and voice applications.

As such, 3G services remain relevant for Singapore in the short to medium term.

IMDA's Proposal in Consultation Document

22. As the national regulator for frequency spectrum in Singapore, IMDA has the duty to allocate and assign frequency spectrum, which is a scarce national resource, to meet national policy objectives and ensure the most efficient use of spectrum.

23. Bearing in mind the increasing use of the 2.1 GHz band internationally for 5G and the growing 5G ecosystem for the 2.1 GHz band, and that 4G services would be well supported by multiple spectrum bands domestically, IMDA proposed that the best and most efficient use of the 2.1 GHz band would be for the provision of 5G services. IMDA also proposed that it would not issue additional spectrum or repurpose the 2.1 GHz spectrum for the provision of 4G services.

24. IMDA noted that there was continued demand for 3G use. IMDA proposed that a small amount of the 2.1 GHz band be used to support the continued provision of 3G services.

Summary of Industry Responses

25. From all the responses received, IMDA noted that the Respondents were generally supportive of IMDA's assessment of the technological and market developments relating to the 2.1 GHz band.

<u>5G Networks & Services</u>

26. In relation to 5G ecosystem maturity, the Respondents submitted that the 2.1 GHz band was "widely deployed" for 5G and "supported by a wide availability" of devices.

<u>4G Networks & Services</u>

27. Some Respondents submitted that the 2.1 GHz band could also be used to support 4G services concurrently with 5G, through the use of Dynamic Spectrum Sharing (**DSS**).

3G Networks & Services

28. There were Respondents, including current users of 3G services, who submitted that 3G services remained relevant for Singapore in the short to medium term. For example, 3G would still be required to provide voice and data services to subscribers who were holding on to legacy handsets, Machine-to-Machine (**M2M**) devices and inbound roamers. While users could start to look at migration from 3G networks to 4G or 5G, it was noted that the pace of such migration would be affected by the global chip shortage and users' own equipment refresh plans.

IMDA's Assessment and Decision

29. The Respondents' views were aligned with IMDA's understanding of the technological and market developments, i.e.,

    a. Ecosystem support for 5G services in the 2.1 GHz band was sufficiently mature and continued to grow; and

    b. Internationally, the 2.1 GHz band was being used for 5G services.

30. IMDA will therefore allocate the 2.1 GHz band to be used primarily for 5G from 1 January 2022, after the existing 3G spectrum rights in this band expire on 31 December 2021.

31. With 4G services well supported by multiple spectrum bands in Singapore, IMDA's assessment remains that there is no need to allocate additional 2.1 GHz spectrum for 4G.

32. While IMDA notes that DSS can be used to support 4G and 5G services by allowing spectrum resources to be dynamically shared between both these technologies on the same band, IMDA is of the view that DSS is less relevant for the 2.1 GHz band in view of the above assessment. Any request for use of DSS on the 2.1 GHz band will be considered on a case-by-case basis. Notwithstanding, IMDA recognises the benefits of DSS. IMDA will consider permitting DSS on 4G bands when IMDA reviews the repurposing of 4G bands in the future.

33. With the Respondents' agreement on IMDA's assessment that 3G services remained relevant in the short to medium term and that there were about 700,000 3G subscribers and more than 1.5 million 3G dependent handsets/devices for whom continuity remains important, IMDA will therefore maintain the proposal to allow part of the 2.1 GHz band to be used for the continuity of 3G services.

CHAPTER 3: REGULATORY FRAMEWORK FOR ALLOCATION OF 2.1 GHZ FOR 5G SA IN SINGAPORE

IMDA's Proposal in Consultation Document

IMDA's 5G Policy Outcomes

34. In refarming the 2.1 GHz band for 5G, the long-term policy outcomes in IMDA's 5G Decision must be achieved. In particular:

    a. Deployment of 5G based on SA network specifications
    IMDA recognised that only SA network standards will deliver the full capabilities and performance of 5G such as network virtualisation, intelligence at network edges, and dynamic provisioning or differentiated services for different use-cases. This is technologically superior to 5G Non-Standalone (**NSA**) networks, which can only deliver faster mobile broadband speeds;

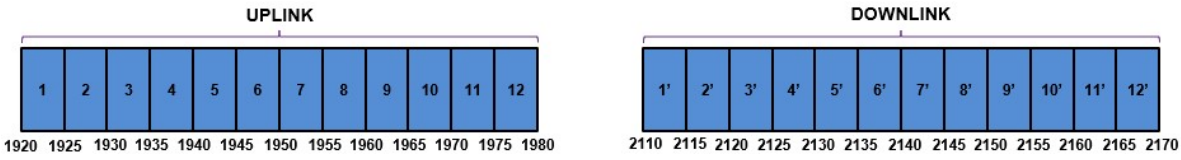
    b. 5G SA networks must be secure and resilient; and

    c. Provide growth opportunities for Singapore's telecommunications sector. Recognising the fast pace of technological advancements and market development, IMDA's regulatory framework will allow pathways for future network builds and technology upgrades, taking into account new spectrum bands coming on board.

2.1 GHz for 5G SA Deployments

35. IMDA proposed to make available 2 x 60 MHz of spectrum in the 2.1 GHz band (i.e., the 1920 – 1980 MHz and 2110 – 2170 MHz bands) for 5G SA network deployment. This would represent a total of 12 paired lots with a lot size of 2 x 5 MHz each.

Figure 1: The 2.1 GHz spectrum band



Support Next Wave of 5G Growth for all MNOs & Service Enhancements

36. The 2.1 GHz band has good propagation characteristics when compared to other 5G bands currently in use in Singapore, such as the 3.5 GHz and mmWave bands.

37. Given that the 2.1 GHz band would be able to provide 5G coverage in Singapore, thus enhancing consumers' experience, IMDA's view is that the most optimal uses for the 2.1 GHz band would be as follows:

a. To complement existing 5G networks on 3.5 GHz, for coverage and capacity enhancements – this would allow Singapore to have enhanced nationwide 5G SA coverage and user service experience; and

b. To provide an opportunity for 5G growth and expansion in Singapore, such as the deployment of additional nationwide 5G SA networks, should there be demand for it.

38. The 2.1 GHz band would also facilitate 5G SA deployment in buildings and road/MRT tunnels, as existing infrastructure in these areas could be repurposed for 5G.

Allocation to Existing MNOs

39. Given the limited amount of spectrum available in the 2.1 GHz band, IMDA had proposed to make available the opportunity to acquire spectrum in this band to existing four MNOs only, namely, M1, Singtel, StarHub and TPG, if they are interested.

5G Network Deployment Requirements

40. The deployment of all 5G SA nationwide networks would need to meet IMDA's requirements, in order to further IMDA's 5G policy outcomes. Accordingly, all 5G SA networks would be required to meet the following baseline requirements:

a. Commitment to Deploy 5G SA networks – This is consistent and in line with the long-term policy outcomes in IMDA's 5G Decision where MNOs must commit to SA deployments in 5G spectrum bands;

b. Rollout and Deployment Milestones

i. For 5G CFP winners[3]: Existing coverage commitments (i.e., rollout milestones) arising from the 5G CFP would continue to apply. In relation to their nationwide (at least 95%) outdoor coverage obligations, 5G CFP winners would be able to use both the 3.5 GHz and the 2.1 GHz bands in combination to meet such obligations.

[3] The 5G CFP winners are Singtel and the Joint-Venture Consortium formed by StarHub and M1 (**the Consortium**).

ii. For all other MNOs[4]: IMDA would require such MNOs to deploy a new 5G SA network using the 2.1 GHz band which would meet the 5G SA outdoor coverage requirements described below:

A. At least 50% using the 2.1 GHz band within 2 years from the commencement of the 2.1 GHz spectrum rights; and

B. Nationwide (at least 95%) within 5 years from the commencement of 2.1 GHz spectrum rights. The MNOs would be allowed to use the 2.1 GHz band and any of their other 5G spectrum bands to meet the nationwide coverage obligation.

c. Network Design and Resilience – As per 5G CFP requirements, the design of 5G networks should meet (i) key resilience and security requirements stipulated in the relevant IMDA Codes of Practice (or exceed such requirements where possible); and (ii) IMDA's resilience and cybersecurity requirements specified based on the following principles, from the outset:

i. Defence-in-Depth[5]: Adopt security-by-design principles by implementing various defence mechanisms which are secure and scalable (e.g., capability to turn on encryption upon request);

ii. Zero-trust Environment[6]: Ensure that the 5G network is always secure and trusted through the deployment of network security solutions (e.g., implementing a "demilitarised zone" and other relevant measures);

iii. Network Element Assurance: Ensure that a risk assessment strategy and policy will be applied to the 5G infrastructure (e.g., through policy compliance with the Network Equipment Security Assurance Scheme currently being defined by 3rd Generation Partnership Project (**3GPP**) and Global System for Mobile Communications, and demonstrate how security assurance is achieved such as through the security testing of equipment);

iv. Resilience by Outcome: Demonstrate end-to-end network resilience to minimise outages and impact;

[4] This referred to TPG, and would include StarHub and M1 if they were to bid separately and would depend on the manner in which they use the 2.1 GHz spectrum to deploy their network.

[5] A series of defensive mechanisms that are multi-layered with redundancies to increase the security of a system and address different attack vectors.

[6] An organisation should not trust anything inside or outside the perimeters of its networks and systems and must verify everything trying to connect to its networks and systems before granting access.

v. Minimise Dependency: Configure networks, to the extent feasible, to minimise instances where a failure of the (a) fibre network used to provide broadband services, and/or (b) infrastructure used to provide other mobile services in a geographical area, could also affect 5G services in the same geographical area; and

vi. Adopt Technology: Use of advanced technologies for resilience purposes, e.g., the use of automation and machine learning to detect, respond and recover from service disruption expeditiously; and

d. Provide 5G wholesale services on the 5G network deployed on the 2.1 GHz band to any requesting MNOs or Mobile Virtual Network Operators (**MVNOs**) in accordance with IMDA's prescribed framework[7].

41. 5G NSA Deployment – MNOs would need to first hold 5G spectrum rights for a 5G band and the accompanying licences for 5G SA deployment, and commit to nationwide 5G SA deployment using the said 5G band alone or in combination with other bands to which they hold 5G spectrum rights before IMDA would consider any commercial 5G NSA deployment in the same 5G band. IMDA's approval would have to be sought for any 5G NSA deployment. IMDA's position on 5G NSA deployment is in accordance with IMDA's *Regulatory Framework for Deployment of 5G Non-Standalone (NSA) Services in Singapore* issued to MNOs on 29 March 2021.

3G Service Continuity

42. Noting the continued demand for 3G services in Singapore and the need for a gradual migration of legacy 3G services to newer 4G and 5G services, IMDA also proposed to allocate a small amount of the 2.1 GHz band on a First-Right-of-Refusal (**FROR**) basis (**FROR Lots**) for the continued provision of 3G services by MNOs who had existing 3G networks on the 2.1 GHz band, namely Singtel, StarHub and M1 (**3G MNOs**). This was to ensure that there would be no service disruption or degradation to existing 3G subscribers due to the reallocation of the 2.1 GHz spectrum rights.

Number of FROR Lots for 3G Service Continuity

43. Based on the current number of 3G subscribers and 3G equipment in circulation, IMDA had assessed that a pair of 5 MHz spectrum in the 2.1 GHz band, deployed together with a pair of 5 MHz spectrum in the 900 MHz band would be sufficient to support existing 3G service demand while providing

[7] https://www.imda.gov.sg/-/media/Imda/Files/Regulations-and-Licensing/Licensing/Telecommunication/Services-Based-Operations-Licence/Wholesale-Framework.pdf?la=en

adequate 3G coverage. Accordingly, IMDA had proposed to set aside 5 MHz of paired spectrum in the 2.1 GHz band, for each 3G MNO, on an FROR basis.

Conditions of Use for FROR Lots

44. Should the 3G MNOs decide to apply for the FROR Lots, these lots would need to be used to provide 3G services and could only be repurposed for 5G after the 3G MNO shuts its entire 3G network (i.e., on both 2.1 GHz and 900 MHz bands). The cessation of 3G networks would be subject to IMDA's prior approval.

45. If 3G MNOs chose not to apply for the FROR Lots which would be circumscribed with the conditions described above, these MNOs could bid for non-FROR Lots, which could then be used flexibly for both 3G and 5G services.

Existing 4G Services on 2.1 GHz May Continue Without Any Further Expansion

46. IMDA noted that some of the existing 3G MNOs were using the 2.1 GHz band in a limited and localised manner to support 4G services. Should these MNOs wish to continue their existing use of the 2.1 GHz spectrum to support 4G services with spectrum that they would be allocated, IMDA would be prepared to allow this. These MNOs would need to ensure that there would be no degradation in the quality of 3G and 5G services (as the case might be) which they ought to deploy on the 2.1 GHz band. IMDA would not approve any further expansion of the existing 4G use on the 2.1 GHz band when the new spectrum rights start. Any decision by IMDA to allow the existing use for 4G services to continue on the 2.1 GHz band should not be construed by the industry to give rise to any expectation that IMDA would adopt the same approach towards other spectrum bands in the future.

Subsequent Applications for Spectrum Sharing Arrangements

47. Should MNOs decide to bid separately for 2.1 GHz spectrum and subsequently wish to pool/combine the spectrum together and jointly deploy them using the same Radio Access Network (**RAN**), IMDA's approval would have to be sought. IMDA would take into consideration all relevant factors at that juncture (including, e.g., the existing 5G coverage obligations that the MNOs would have and how that might be affected). Any approval provided by IMDA would be subject to conditions, including that the spectrum amount that exceeded the spectrum cap when aggregated be returned to IMDA without compensation of the sums paid. Depending on the technical architecture, IMDA might require compliance with the nationwide rollout obligation for separate bidders seeking to build new set(s) of RAN.

Summary of Industry Responses

2.1 GHz for 5G SA Deployments

48. Most Respondents supported IMDA's proposal to allocate the 2.1 GHz band for the deployment of 5G SA networks in Singapore.

49. One Respondent submitted that IMDA ought to adopt a "hands-off" approach by allowing the MNOs to decide on the most efficient way to use all allocated spectrum bands.

Support Next Wave of 5G Growth for all MNOs & Service Enhancements

50. Some Respondents submitted that aggregating the 2.1 GHz band with other 5G bands (such as the 3.5 GHz band) could improve 5G coverage extensively. This would result in wider population coverage and capacity increases throughout the network.

Allocation to Existing MNOs

51. While there were no objections to allocate the 2.1 GHz spectrum band to existing MNOs, two Respondents provided comments on the use of the 2.1 GHz band for purposes other than those identified by IMDA, such as enterprise 5G and hybrid satellite mobile connectivity.

5G Network Deployment Requirements

52. In relation to rollout and deployment milestones, one Respondent submitted that if 5G CFP winners were allowed to use both the 3.5 GHz band and the 2.1 GHz band in combination to meet 5G coverage obligations, then:

    a. Only Antina[8] should be allowed to participate in the 2.1 GHz band spectrum allocation, and not M1 and StarHub individually; and

    b. FROR privilege should not be extended to Antina as it would not offer 3G services.

    This was because allowing M1 and StarHub to participate individually would give them "two bites of the cherry", as they could potentially combine their 2.1 GHz spectrum with the 3.5 GHz band in a RAN sharing arrangement with Antina, resulting in a potential joint aggregation of 10 out of the 12 available lots on the 2.1 GHz band.

[8] The separate legal entity established by M1 and StarHub pursuant to the award of the 5G CFP to the M1 and StarHub Joint-Venture Consortium.

53. One Respondent suggested that international standards like Network Equipment Security Assurance Scheme (**NESAS**) and/or Common Criteria (**CC**) would be a good reference for resilience and security requirements.

54. One Respondent wanted IMDA to mandate the provision of 5G wholesale services deployed on 2.1 GHz and to also strengthen IMDA's wholesale framework.

55. Some Respondents submitted that IMDA should consider permitting the deployment of both 5G SA and 5G NSA on the 2.1 GHz band.

3G Service Continuity

56. A Respondent who is an MNO but does not provide 3G services, also requested for one FROR Lot on the basis that such an allocation would "ensure a balancing of the competitive landscape" as the said MNO does not have any 5G spectrum in the 3.5 GHz band for nationwide 5G deployment.

Number of FROR Lots for 3G Service Continuity

57. Comments relating to IMDA's proposal to set aside one FROR Lot for each of the 3G MNOs to support their continued provision of 3G services were mixed. While some Respondents were supportive of the proposal, one Respondent, who is an existing 3G MNO, submitted that one FROR Lot would not be sufficient and could cause 3G service degradation, and requested for two FROR Lots instead.

Conditions of Use for FROR Lots

58. One Respondent suggested removing any restriction on the use of FROR Lots, although that Respondent also suggested that all MNOs (not just 3G MNOs) be allocated one FROR Lot at the winning bid price.

Existing 4G Services on 2.1 GHz May Continue Without Any Further Expansion

59. One Respondent who is an existing 2.1 GHz spectrum right holder supported IMDA's proposal to allow the MNOs currently using the 2.1 GHz band to provide 4G services on a limited basis, to continue to do so.

Subsequent Applications for Spectrum Sharing Arrangements

60. One Respondent supported the return of spectrum in excess of the cap without refund in the scenario where MNOs decide to bid separately for the 2.1 GHz spectrum and subsequently pool/combine the spectrum together and jointly deploy them using the same RAN.

Duration of 5G NSA Market Trials

61. Some Respondents also requested for IMDA to extend the 5G NSA market trials that were being conducted on the 2.1 GHz band to minimise impact to trial users.

IMDA's Assessment and Decision

62. IMDA's spectrum management approach is guided by several considerations, including but not limited to Singapore's small size and geographical proximity to neighbouring countries, how the spectrum resources can advance desired national outcomes, and the promotion of innovation, amongst others. It is IMDA's prerogative as the national regulator to find the appropriate balance between the various considerations in formulating its spectrum management policy. For the reasons set out in this document, IMDA has decided that the 2.1 GHz spectrum should be used in the manner as set out below.

IMDA's 5G Policy Outcomes and 2.1 GHz for 5G SA Deployments

63. IMDA reiterates that IMDA's long term policy objectives, as summarised in paragraph 34, remain unchanged – IMDA will facilitate the deployment of 5G SA networks in the 2.1 GHz band as these networks will deliver the full capabilities and performance of 5G. IMDA will make available 2 x 60 MHz of spectrum in the 2.1 GHz band for this deployment. It is worth noting that several mobile network operators in countries such as China, USA and South Korea have already commenced 5G SA deployment.

Support Next Wave of 5G Growth for all MNOs & Service Enhancements

64. The reallocation of 2.1 GHz for 5G will support the next wave of 5G growth for all MNOs. In particular, spectrum in the 2.1 GHz band will complement existing 5G networks on 3.5 GHz for coverage and capacity enhancements. At the same time, the 2.1 GHz band will provide an opportunity for 5G growth and expansion in Singapore, such as the deployment of additional 5G SA networks, should there be demand for it.

Allocation to Existing MNOs

65. With no objection to the allocation of the 2.1 GHz band to existing MNOs for cellular mobile services, IMDA maintains its position to only allow existing MNOs to participate in the spectrum allocation exercise.

66. IMDA notes that there are requests to expand the allocation of 2.1 GHz spectrum to enterprise 5G and hybrid satellite mobile connectivity use, which are outside the proposed scope of the present review.

67. IMDA has considered the requests but maintains its proposal to allocate the 2.1 GHz spectrum for cellular mobile – specifically for 5G use – as this remains a more optimal use of spectrum resources for the following reasons:

a. 5G SA networks allow the use of advanced capabilities such as network slicing which allows multiple networks to be created to support diverse consumer and enterprise use-cases with different performance requirements. Allocating the 2.1 GHz band to public mobile cellular use allows for more efficient use of the scarce resource which will also help serve enterprises' needs; and

b. Singapore has nationwide availability of competitive and pervasive high-speed mobile and fibre broadband services, and is one of the most connected regional submarine cable hubs. Against this highly connected urban landscape, there is less demand for satellite mobile services. Additionally, there are other forms of satellite connectivity available today to serve areas beyond terrestrial coverage.

5G Network Deployment Requirements

68. MNOs who are allocated the spectrum rights for the 2.1 GHz band will have to commit to the baseline requirements as articulated in paragraph 40 for all 5G SA networks. This is the same approach as adopted for the 5G CFP. The key requirements are reiterated below.

a. Rollout and Deployment Milestones: IMDA will adopt the same approach as the 5G CFP, which was communicated to all MNOs during the 5G CFP process, i.e., MNOs may use a combination of 5G spectrum (where permitted by IMDA) to meet their nationwide SA coverage requirement, as described in paragraph 40b above. Therefore:

i. 5G CFP winners[9] may use their 3.5 GHz band and the 2.1 GHz band to meet their existing nationwide SA coverage obligations. Additionally, IMDA will require the 5G CFP Winners to minimally commit to a timeline to use the 2.1 GHz band to augment their 5G SA network on the 3.5 GHz band; and

[9] See footnote 3. For the avoidance of doubt, existing coverage commitments (i.e., rollout milestones) arising from the 5G CFP will continue to apply.

ii. All other MNOs[10] will have to first deploy a new 5G SA network of at least 50% outdoor coverage using only the 2.1 GHz band within two years of the commencement of the 2.1 GHz spectrum rights.[11] These MNOs will be required to provide nationwide (at least 95%) outdoor 5G SA coverage within 5 years from the commencement of 2.1 GHz spectrum rights, and may use the 2.1 GHz band and any other 5G spectrum bands that they have (including the 3.5 GHz band) or may be allocated in the future to do so.

For the avoidance of doubt, the requirement for StarHub and M1 to deploy a new 5G SA network if they bid individually means that they must deploy separate RANs, as opposed to relying on the shared RAN deployed by Antina. Additionally, IMDA would clarify that only existing MNOs are allowed to participate in the 2.1 GHz spectrum auction, as indicated in paragraph 65 above. Antina is not entitled to participate in the 2.1 GHz band spectrum allocation to obtain spectrum rights as it is not an MNO. In this connection, IMDA would also clarify that as published on IMDA's website, StarHub and M1 are joint-spectrum right holders of spectrum in the 3.5 GHz band – Antina has not been issued with any spectrum rights following the completion of IMDA's 5G CFP process in June 2020.

b. Network Design and Resilience: IMDA will maintain the requirements outlined in paragraph 40c above, which are consistent with the 5G CFP requirements:

i. Key resilience and security requirements stipulated in the relevant IMDA Codes of Practice (or exceed such requirements where possible); and

ii. IMDA's resilience and cybersecurity requirements specified based on the principles as indicated in the 5G CFP.

In relation to a suggestion from a Respondent that international standards like NESAS and CC will be a good reference for resilience and security requirements, IMDA considers NESAS to be more fit-for-purpose for the telecoms mobile industry and should continue to be the baseline. However, IMDA is prepared to consider other equivalent standards which can achieve the same outcome as NESAS.

[10] See footnote 4.
[11] The 5G CFP winners are currently subject to similar obligations in respect of their 3.5 GHz band.

c. Wholesale: IMDA retains our proposal in paragraph 40d and will mandate the provision of 5G wholesale services on the 2.1 GHz band. IMDA notes the comments to strengthen the wholesale framework and will consider them separately in the next review of the framework.

69. IMDA is open to 5G NSA networks to allow consumers to enjoy early benefits of 5G NSA technology before 5G SA services are available. However, in accordance with IMDA's *Regulatory Framework for Deployment of 5G Non-Standalone (NSA) Services in Singapore* issued to MNOs on 29 March 2021 (see paragraph 41 above), MNOs would need to first hold 5G spectrum rights for a 5G band and the accompanying licences for 5G SA deployment, and commit to nationwide 5G SA deployment using the said 5G band alone or in combination with other bands to which they hold 5G spectrum rights before IMDA would consider any commercial 5G NSA deployment in the same 5G band. Consistent with IMDA's 5G Decision, MNOs who wish to deploy NSA networks must seek IMDA's separate approval.

70. In relation to the 2.1 GHz, this means that MNOs who obtain 2.1 GHz spectrum rights for 5G and have committed to providing nationwide SA services can deploy commercial 5G NSA services using the 2.1 GHz spectrum band in the short term, in line with IMDA's Regulatory Framework for Deployment of NSA Services in Singapore. MNOs who currently hold 3.5 GHz spectrum rights for 5G and have committed to nationwide SA services can similarly deploy commercial 5G NSA services using the 3.5 GHz spectrum band in the short term.

71. Notwithstanding, IMDA reiterates that it considers NSA deployments to be transitory and for the short to medium term only. IMDA's policy preference is for 5G NSA networks not to continue perpetually, especially after nationwide SA coverage has been achieved, i.e., by end-2025.

3G Service Continuity

72. In relation to setting aside FROR Lots, IMDA reiterates that the policy intent is to ensure that there is no service disruption or degradation to the provision of 3G services to existing 3G subscribers. This being the case, IMDA will not grant FROR to MNOs who do not currently operate 3G networks as the concerns of service continuity are inapplicable to them.

Number of FROR Lots for 3G Service Continuity

73. IMDA also maintains its assessment that one FROR Lot per 3G MNO is largely sufficient (when used in conjunction with spectrum in the 900 MHz band), given that 3G subscriptions are declining, and most bandwidth intensive applications are already served by 4G networks. Where MNOs require additional 2.1 GHz spectrum, these may be obtained through the competitive auction process.

74. IMDA would add that setting aside lots on a FROR basis is an exceptional arrangement based on the facts of this case and shall not be construed to give rise to any expectation by the industry that IMDA will adopt the same or similar measures in the future.

Conditions of Use of FROR Lots

75. FROR Lots can only be used for 3G services, until the 3G MNO has fully shut down its entire 3G network, i.e. on both 2.1 GHz and 900 MHz bands (unless an exception has been granted by IMDA). For the avoidance of doubt, the cessation of 3G networks would be subject to IMDA's prior approval.

No Further Expansion of Existing 4G Deployments

76. For MNOs who have existing 4G deployments within the 2.1 GHz band, IMDA will allow these MNOs to continue with such deployments subject to there being no degradation in the quality of the 3G or 5G services (as the case may be) which they must deploy on the 2.1 GHz band. However, IMDA will not approve any further expansion of the existing 4G use in this band.

Duration of 5G NSA Market Trials

77. As for the 5G NSA market trials (including those conducted on the 2.1 GHz band), IMDA maintains the position that market trials are generally for the short-term and offered on a temporary basis. The 5G NSA market trials are intended to facilitate the MNOs' gauging of market sentiment towards new technologies such as 5G NSA. An end date of 31 December 2021 affords the MNOs sufficient time to do this and is also in keeping with the short-term nature of market trials.

78. Further, MNOs who wish to offer commercial 5G NSA services on their 5G bands may do so with IMDA's approval (see paragraph 69 above). There is therefore no need for IMDA to further extend these market trials beyond 31 December 2021.

Subsequent Applications for Spectrum Sharing Arrangements

79. For the avoidance of doubt, IMDA clarifies that for the purpose of this spectrum allocation, bids will be considered to have been submitted jointly if two entities intend to and will use a shared RAN, in any form, for the purposes of deploying their 5G SA networks on the 2.1 GHz band.

80. With regard to the scenario where individual bidders subsequently wish to pool/combine their 2.1 GHz spectrum together and jointly deploy them using the same RAN, IMDA notes that there were no objections to IMDA's proposal. Therefore, IMDA maintains its position that it will treat such an arrangement as having the equivalent effect of a joint-bid. IMDA's approval will have to be sought for such an arrangement. IMDA will take into consideration all relevant factors at that juncture (including, e.g., the existing 5G coverage obligations that the MNOs have and how this may be affected). Any approval by IMDA for such an arrangement will be subject to conditions, including that the spectrum amount in excess of the spectrum cap (see paragraph 105a) when aggregated as a result of the combination, shall be returned to IMDA without any compensation of the sums paid.

CHAPTER 4: ALLOCATION FRAMEWORK AND MECHANISM FOR 2.1 GHZ BAND

IMDA's Proposal in Consultation Document

2.1 GHz Allocation Framework

81. IMDA had adopted a CFP approach in the allocation of the first tranche of 5G spectrum (i.e., two packages of 100 MHz of 3.5 GHz spectrum and 800 MHz of mmWave spectrum each) for nationwide 5G network deployment as it had determined that the CFP would be the more appropriate mechanism to achieve IMDA's policy outcome of securing two full-fledged nationwide, trusted and resilient 5G SA networks for Singapore from the outset.

82. With certain 5G policy outcomes secured following the conclusion of the 5G CFP, IMDA had assessed that a market-based allocation approach, i.e., auction, would be the more appropriate allocation mechanism for the 2.1 GHz spectrum as it would afford bidders the flexibility to decide on how much spectrum they wish to acquire and at what price.

Auction Format and Parameters

83. The auction will be conducted in two steps – comprising the Pre-auction and Auction.

    a. In the Pre-auction step, bidders must demonstrate compliance with conditions of auction as stipulated in paragraph 68 – bidders who are successful at this phase may proceed to participate in the Auction.

    b. In the Auction step, IMDA will adopt a **clock plus** format – which is the same format adopted in the 4G spectrum auction in 2013 and the general spectrum auction in 2017.

84. The Auction step will consist of 3 main stages – (i) Initial Offer stage, (ii) Quantity stage, and (iii) Assignment stage.

    a. Initial Offer stage: MNOs are required to submit an Initial Offer with quantity of spectrum lots demanded (including any exercise of FROR Lots). If demand is greater than supply, the auction will proceed to the "Quantity stage". Where demand is equal or less than supply, MNOs will pay reserve price for the quantity they demanded and proceed to "Assignment Stage".

    b. Quantity stage: Each round, MNOs specify demand for quantities of lots and the price increases at every round at increments to be determined by IMDA. Bidders will be required to place a price for lots they want when they reduce bids or exit the auction (i.e., expressly stating an "exit bid" will be

mandatory). IMDA noted MNOs' earlier feedback that one or two lots would not be cost-effective for 5G SA deployment. Therefore any MNO, who is allocated a single or two 2.1 GHz lot(s) at the end of the Quantity stage but has never submitted a bid for a single or two 2.1 GHz lot(s) in its Initial Offer or at any Round of the Quantity stage, may opt to reject the allocation of one or two lot(s) in its entirety. Successful bidders of the rest of the lots (including FROR Lots) can then go on to the "Assignment stage".

c. Assignment stage: This stage involves the selection of specific spectrum lots after the conclusion of the Quantity stage. MNOs are allowed to discuss the assignment amongst themselves to find a common agreement. If MNOs are unable to agree, the process will move on to a one-time sealed bid. IMDA will prioritise contiguous selection of spectrum lots and reduce 'movement' within the lots to minimise disruption to existing 3G services. For the avoidance of doubt, the FROR Lots will be prioritised to be allocated within the assignment of the existing 3G subscription rights for the 2.1 GHz band.

Available Spectrum for Auction

85. There is a total of 60 MHz (paired) spectrum available in the 2.1 GHz band. In line with the channel bandwidths associated with the 2.1 GHz band for 5G under 3GPP specifications (e.g., 5 MHz, 10 MHz, 15 MHz, 20 MHz, etc.), IMDA had proposed to allocate spectrum in this band in 5 MHz (paired) lots (12 lots in total). All 12 lots would be available for auction, subject to FROR applications made by the 3G MNOs. In this connection, any FROR Lot that had not been taken up by the 3G MNOs would be available for auction.

Spectrum Cap

86. IMDA proposed a spectrum cap of five lots per MNO. The 5-lot cap would include the FROR Lot. IMDA's view was that this cap would provide adequate flexibility and optionality to all MNOs on how they would like to deploy their networks, given each MNO's diverse requirements. IMDA had considered a 4-lot spectrum cap, but was of the view that it might limit the flexibility of MNOs who might require slightly more spectrum to enhance their network capacity and performance. While IMDA noted that five lots (i.e., 25 MHz channel bandwidth) in the 2.1 GHz band would be commercially less common, it was nonetheless one of the available channel bandwidths supported by 3GPP. MNOs who obtained five lots also would have the option to deploy the 2.1 GHz as two separate carriers. Overall, the 5-lot cap would give MNOs more flexibility to determine the required spectrum holdings to support their 5G deployment.

87. This cap would also apply if StarHub and M1 intend make a joint-bid as a consortium (i.e., IMDA would treat them as a single bidder).

Reserve Price

88. IMDA had considered that it would be important to set reserve prices at levels that would reasonably reflect the potential economic value of the spectrum, to better ensure that the auction mechanism could efficiently achieve its key objective of efficient allocation of scarce spectrum resources. Therefore, IMDA proposed a reserve price of S$10 - S$15 million per lot. This took into account the intrinsic value[12] of the 2.1 GHz band and where relevant, the international benchmarks of reserve and final bid prices for similar spectrum bands. This would also be the price at which the 3G MNOs might acquire the FROR Lots.

Spectrum Right Duration

89. IMDA proposed to adopt a spectrum right duration of 15 years for the 2.1 GHz band, with a commencement date of 1 January 2022.

90. This would include a 3-month transition period from 1 January 2022 – 31 March 2022 (the **Transition Period**). Existing spectrum right holders would need to take the necessary measures for migration of services during this Transition Period, unless MNOs mutually agreed to extend this Transition Period beyond the 3-months period. Given the large number of 3G subscribers that were served by the 2.1 GHz band, as well as the extensive deployment of 2.1 GHz network infrastructure in buildings and tunnels, IMDA considered it reasonable to provide for the abovementioned Transition Period, so as to reduce the occurrence of service disruptions, facilitate the transition and ensure the orderly migration of services.

Summary of Industry Responses

2.1 GHz Allocation Framework

91. Respondents were generally supportive of IMDA's proposal to allocate spectrum in the 2.1 GHz band via auction.

Auction Format and Parameters

92. There were no objections broadly to the format of the auction, but Respondents raised comments on specific steps/stages of the auction:

    a. With respect to the Pre-Auction step, one Respondent objected to the need for the 5G CFP winners to demonstrate compliance with the conditions of auctions given that they would have met these conditions through the 5G CFP process.

[12] 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, and commercial factors such as the expected market demand and market share for each qualified bidder.

b. On the Quantity stage, some Respondents expressed concerns regarding the option to reject one or two lots. These Respondents submitted that this option could result in unsold lots, and bidders might "drive-up spectrum prices" without any "serious intent" of obtaining spectrum in the auction. There was also feedback about the market inefficiency of having lots left behind and not allocated.

c. With respect to the Assignment stage, two Respondents requested to be directly assigned their existing 3G frequencies to minimise disruption to 3G services.

Spectrum Cap

93. Comments regarding the proposed spectrum cap were mixed. Some Respondents suggested alternative spectrum caps of six lots and four lots (excluding FROR Lots), while one Respondent suggested to reduce the spectrum cap to three lots (excluding FROR Lots).

94. The Respondent who requested for a larger spectrum cap cited that a 6-lot cap was supported by chipset and equipment vendors while another Respondent did not want FROR Lots included into the spectrum cap so as not to "discriminate" joint bids.

95. The Respondent who requested for a 3-lot spectrum cap does not operate a 3G network. This Respondent also suggested that all MNOs be given one FROR Lot.

Reserve Price

96. There were only two comments received on the proposed reserve price range: one Respondent opined that reserve prices should be set at the lower end of IMDA's range, i.e., S$10 million, while another Respondent submitted that the reserve price should be lower than IMDA's proposed range, considering the international benchmarks.

97. With respect to FROR pricing, one Respondent, an MNO not providing any 3G services today, submitted that the 3G MNOs should not be allowed to acquire FROR Lots at the reserve price, but at the winning auction bid price instead. This Respondent also submitted that the FROR Lots should not be circumscribed in terms of use.

Spectrum Right Duration

98. Some Respondents submitted that the spectrum right duration be increased to 20 years.

99. A few Respondents, namely the existing 3G MNOs, submitted that the 3-month Transition Period would be insufficient for service migration, especially for services in buildings and tunnels. These Respondents proposed alternative periods, ranging from 6 to 24 months.

IMDA's Assessment and Decision

2.1 GHz Allocation Framework

100. Given that there were no comments or objections, IMDA maintains its proposal to adopt an auction approach to allocate the 2.1 GHz band as it affords bidders the flexibility to decide on how much spectrum they wish to acquire and at what price.

Auction Format and Parameters

101. Given that there were no objections broadly to the format, IMDA will maintain the 2-step auction, i.e., Pre-Auction and Auction (clock plus format), and the three stages of Auction, i.e., Initial Offer, Quantity and Assignment as summarised in paragraphs 83-84.

102. In view of the comments received on specific step/stage of the process, IMDA will make some adjustments to the auction format and the parameters as described below.

103. Pre-Auction: IMDA maintains that bidders must demonstrate compliance with the conditions of auction (as stipulated in paragraph 68). To clarify, 5G CFP winners may, in lieu of submitting full details of compliance with each network design and resilience requirement, commit that their 5G networks using the 2.1 GHz band in respect of network design and resilience are the same as those committed under the 5G CFP.

104. Auction – Initial Offer Stage: The MNOs are to submit an Initial Offer specifying the quantity of spectrum lots demanded (including any FROR Lots). If demand is greater than supply, the auction will proceed to Quantity Stage (as summarised in paragraph 105). Where demand is equal or less than supply, MNOs will pay reserve price for the quantity they demanded and proceed to the Assignment stage.

105. Auction – Quantity Stage: At each round, the MNOs are to specify the quantities of lots they demand, and the price shall increase at every round in increments to be determined by IMDA. Bidders will be required to place a price for the lots they demand when they reduce bids or exit the auction (i.e., it shall be mandatory to expressly state an "exit bid"). This is as per the proposal summarised in paragraph 84b.

Spectrum Cap

a. IMDA will retain the spectrum cap of five lots for Quantity Stage (inclusive of one FROR Lot applicable only to 3G MNOs) as it provides adequate flexibility to MNOs given their diverse requirements (as summarised in paragraph 86). IMDA remains of the view that a spectrum cap of four lots may limit the flexibility of MNOs who require slightly more spectrum to enhance their network capacity and performance.

Flexibility to Reject Quantity Stage Allocation of One or Two lots

b. Since there were no objections to the views that one or two lots would not be cost-effective for 5G SA deployment, IMDA maintains the auction design to allow an MNO who is allocated one or two lots at the end of Quantity Stage, but who has not submitted a bid for one or two lots in its Initial Offer or at any round of Quantity Stage, the option to reject the allocation of one or two lots in its entirety (as stipulated in paragraph 84b).

c. However, IMDA also notes some Respondents' concerns that allowing the rejection of one or two lots might give rise to the risk of frivolous bidding and drive up prices. Taken together with the feedback for higher spectrum caps, IMDA agrees with the feedback that there is market inefficiency of having lots left behind and not allocated. IMDA will therefore adjust the auction format to introduce a second Quantity stage (**Quantity Stage II**).

106. Auction – Quantity Stage II: If there are leftover lots from the first Quantity stage (**Quantity Stage I**) arising from bidders rejecting the allocated one or two lots in its entirety in the final round, IMDA will allocate these leftover lots in the same auction exercise to allow for more optimal allocation, planning and use of the resources. This also recognises that there is industry demand for more spectrum based on the fact that some Respondents had requested for higher spectrum caps beyond five lots. Quantity Stage II for the auction of the leftover lots will be conducted no differently from Quantity Stage I with the same Reserve Price, save for the following:

Eligibility

a. Winners of Quantity Stage I (excluding the bidder(s) who rejected the spectrum lots) may participate in Quantity Stage II to bid for the leftover lots; and

Spectrum Cap

b. The spectrum cap will be raised to six lots (including the 2.1 GHz lots bidders have secured from Quantity Stage I).

107. Auction – Assignment Stage: This stage involves the selection of specific spectrum lots after the conclusion of Quantity Stage I and II (if applicable). IMDA will allow the MNOs to discuss the assignment amongst themselves to find a common agreement. If MNOs are unable to agree, the process will move on to a one-time sealed bid.

108. To address concerns about disruptions to existing 3G services, IMDA will, for the one-time sealed bid, provide combinations of spectrum assignment that will prioritise the preservation of continuity of 3G services. MNOs will be given the opportunity to provide additional combinations of options, that also maintains the principle of preservation of continuity of 3G services, for IMDA's consideration and inclusion in the sealed bid process.

109. IMDA notes that trying to achieve contiguous spectrum assignment at the outset will likely affect continuity of 3G services, given existing spectrum assignments in the 2.1 GHz band. IMDA considers 3G service continuity to be a priority at the assignment stage. IMDA will allow winning bidders to subsequently seek arrangements amongst themselves that would achieve contiguous spectrum assignment in the future, and carry out such arrangements with IMDA's approval.

Reserve Price & Continuity Price

110. IMDA reiterates that the 2.1 GHz spectrum auction is a 5G auction. Having considered the feedback from the Respondents, IMDA will set the Reserve Price for one 2.1 GHz spectrum lot at S$12 million for both Quantity Stages I and II.

111. IMDA notes the submission from one Respondent that the FROR Lots should be priced at the winning bid price. Based on the policy objective that the 2.1 GHz spectrum allocation is intended for the next wave of 5G growth and deployment, IMDA agrees that all the lots (including FROR Lots) should be priced at 5G prices, as a matter of principle. As such, IMDA will adjust the pricing approach to FROR Lots as follows:

    a. Given that the 3G MNOs are constrained and MNOs can only use the FROR Lots to provide 3G services in the short to medium term, at least until their 3G networks are entirely shut down, it will not be reasonable to expect them to pay the full clearing price for these lots upfront. IMDA will therefore price the FROR lots at S$3 million (referred to as the "**Continuity Price**") at the point of allocation. IMDA has determined the Continuity Price after taking into consideration the intrinsic value of the 2.1 GHz band for 3G service continuity; and

b. A 3G MNO must pay a top-up price for the FROR Lot immediately once that 3G MNO ceases its 3G network[13]. The top-up price shall be the difference between the Quantity Stage I clearing price[14] and the Continuity Price, pro-rated on a straight-line basis with reference to the remaining period of the spectrum right (i.e., amortised on a straight-line basis with reference to the remaining period of the spectrum right).

IMDA reiterates that its decision to set aside spectrum lots on a FROR basis is already in itself an exceptional arrangement. IMDA's above pricing approach for the FROR Lots is unique to the facts of this case. This shall not be construed to give rise to any expectation by the industry that IMDA will adopt the same or similar measures in the future.

112. As the 2.1 GHz band is being allocated primarily for 5G as stated above, IMDA expects the 3G MNOs to cease the use of the FROR Lots for 3G sooner rather than later in order to maximise the efficient usage of scarce resources for 5G.

113. If the shutdown of 3G by any of the 3G MNOs becomes protracted, IMDA reserves the right to require that 3G MNO to provide its plan for the cessation of 3G services and/or to determine the cut-off date for 3G services.

Spectrum Right Duration

114. Having considered the Respondents' feedback, IMDA still maintains its position that 15 years is sufficient to provide investment certainty for the MNOs. This period is also consistent with the spectrum right duration for the 3.5 GHz band.

115. IMDA also clarifies that the 3-month Transition Period is for the existing MNOs to "switch-off" the relevant portions of their network. This means that MNOs can continue to migrate and provision services to their subscribers with the new spectrum rights they hold, subsequent to the 3-month Transition Period.

116. As such, IMDA maintains that the 3-month Transition Period is sufficient for the existing MNOs to cease transmission in the spectrum lots that they no longer hold rights to and shut off transmission of all mobile signals in the said lots. However, IMDA may consider extensions under the following circumstances:

[13] Unless an exception has been granted by IMDA, which may be subject to such conditions as IMDA deems fit to impose in its absolute discretion, including in relation to payment of the top-up price.
[14] This will be the Reserve Price for one 2.1 GHz spectrum lot if the auction does not have a Quantity stage.

a. Access to buildings and tunnels to cease transmission in the spectrum lots will require coordination with building owners and agencies, and this may take time. IMDA may consider providing an exceptional extension of time beyond the 3-month Transition Period for in-buildings and tunnels only. This is however subject to IMDA's approval and if granted, shall generally be for a very limited duration unless there are exceptional reasons; and

b. In applying for IMDA's approval, the MNO must demonstrate that it has done everything possible to implement the cessation of transmission but remains unable to due to circumstances beyond its control.

Indicative Timeframe for the 2.1 GHz Spectrum Auction

117. The indicative timeline for the events leading up to the 2.1 GHz spectrum auction is provided in the table below.

Table 1: Indicative time

Milestone	Indicative Timeline
Pre-Auction Submission to IMDA	October/ November 2021
Submission of Initial Offer and Banker's Guarantee	
Conduct of Quantity Stage I	November/ December 2021
Conduct of Quantity Stage II (if applicable)	
Conduct of Assignment Stage	

118. IMDA reserves its rights to take any appropriate action that IMDA deems fit (e.g., extending the timelines for the auction) in the event of any reconsideration requests or appeals against IMDA's decision.

CHAPTER 5: SUMMARY OF IMDA'S DECISION

119. IMDA has decided to allocate 2 x 60 MHz of spectrum in the 2.1 GHz band for 5G SA network deployment via auction. Details of the spectrum band are in the table below. Only existing MNOs can participate.

Table 2: Overview of the spectrum to be allocated

Spectrum band	Frequency range	Amount[15]	Availability
2.1 GHz	1920 – 1980 MHz/ 2110 – 2170 MHz	2 x 60 MHz	1 January 2022

120. IMDA will structure the 2.1 GHz spectrum auction in 2 steps: (i) the Pre-Auction and (ii) the Auction, of which the Auction will be conducted in 3 stages – the Initial Offer stage, the Quantity stage and the Assignment stage.

121. Existing MNOs must demonstrate compliance to the conditions of auction during the Pre-Auction before they may proceed to the Auction. The key conditions of auction, which adopts the same approach as the 5G CFP, are:

a. Commitment to deploy 5G SA networks on the 2.1 GHz band;

b. Rollout and deployment milestones

i. 5G CFP winners[16]: Existing coverage commitments (i.e., rollout milestones) arising from the 5G CFP will continue to apply. In relation to their nationwide (at least 95%) outdoor coverage obligations, 5G CFP winners can use both the 3.5 GHz and the 2.1 GHz bands in combination to meet such obligations. Additionally, IMDA will require the 5G CFP Winners to minimally commit to a timeline to use the 2.1 GHz band to augment their 5G SA network on the 3.5 GHz band;

ii. All other MNOs[17] will have to first deploy a new 5G SA network of at least 50% outdoor coverage using only the 2.1 GHz band within 2 years of the commencement of the 2.1 GHz spectrum rights.[18] These MNOs will be required to provide nationwide (at least 95%) outdoor 5G SA coverage within 5 years from the commencement of 2.1 GHz spectrum rights, and may use the 2.1 GHz band and any other 5G spectrum bands that they have (including the 3.5 GHz band) or may be allocated in the future to do so;

[15] The amount includes the FROR lots.
[16] See footnote 3. For the avoidance of doubt, existing coverage commitments (i.e., rollout milestones) arising from the CFP will continue to apply.
[17] See footnote 4.
[18] The 5G CFP winners are currently subject to similar obligations in respect of their 3.5 GHz band.

c. Network Design and Resilience: As per 5G CFP requirements, the design of the 5G networks should (i) meet key resilience and cybersecurity requirements stipulated in the relevant IMDA Codes of Practice (and to exceed such requirements where possible); and (ii) be architected based on principles such as Defence-in-Depth and Zero-Trust Environment, at the outset; and

d. Provide 5G Wholesale Services on the 5G network deployed on the 2.1 GHz band to any requesting MNOs or MVNOs in accordance with IMDA's prescribed framework.

122. IMDA will set aside one lot of 2 x 5 MHz per 3G MNO for 3G service continuity. This ensures that there will not be service disruptions or degradation to the provision of 3G services to existing 3G subscribers.

123. Existing 3G MNOs who have successfully proceeded to Auction step may then exercise the option for one FROR Lot each. The remaining 2.1 GHz lots will then be put through the Quantity stage(s) to determine the quantity of lots each bidder will get.

124. An overview of the key auction parameters is provided below.

Table 3: Overview of key auction parameters

Lots	Number of lots	Spectrum right duration	Price
FROR (applicable to 3G MNOs only)	12 lots of 2 x 5 MHz each	15 years	S$3 million per lot (Continuity Price*)
Remaining		15 years	S$12 million per lot (Reserve Price)

** A 3G MNO must pay a top-up price for the FROR Lot immediately once that 3G MNO ceases its 3G network.*

125. All successful bidders of the lots (including the FROR Lots) then proceed to the Assignment stage which involves the selection of specific spectrum lots after the conclusion of the Quantity stage(s).

126. If there are leftover lots from the first Quantity stage (Quantity Stage I) arising from bidders rejecting the allocated one or two lots in its entirety in the final round, IMDA will allocate these leftover lots in the same auction (Quantity Stage II) exercise to allow for more optimal allocation, planning and use of the resources. This also recognises that there is industry demand for more spectrum based on the fact that some Respondents had requested for higher spectrum caps beyond five lots.

127. Quantity Stage II for the auction of the leftover lots will be conducted no differently from Quantity Stage I with the same Reserve Price, save for the following:

Eligibility

a. Winners of Quantity Stage I (excluding the bidder(s) who rejected the spectrum lots) may participate in Quantity Stage II to bid for the leftover lots; and

Spectrum Cap

b. The spectrum cap will be raised to six lots (including the 2.1 GHz lots bidders have secured from Quantity Stage I).

128. The specific details pertaining to 2.1 GHz spectrum auction will be provided in the auction rules documents that IMDA will issue to MNOs.

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