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**THE INFO-COMMUNICATIONS MEDIA DEVELOPMENT
AUTHORITY**

ON

**SECOND CONSULTATION ON 5G MOBILE SERVICES AND
NETWORKS**

**Submission by StarHub Mobile Pte Ltd to the
Infocomm Media Development Authority**

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Introduction:

1. StarHub Mobile Pte Ltd (“**StarHub**”) wishes to thank the Info-comm Media Development Authority of Singapore (the “**Authority**”) for the opportunity to comment and provide inputs on its proposals to facilitate the deployment of 5G infrastructure and services in Singapore. We sincerely appreciate the thought and effort that has gone into the Authority’s consultation paper.

2. 5G deployments are a necessary next step for mobile network operators (“**MNOs**”), and StarHub is keen to participate in the provision of 5G services in Singapore. This consultation is an important step for the Authority to design a framework that supports the deployment of 5G as efficiently and as effectively as possible in Singapore.

3. In particular, given the limited amount of 5G spectrum available at this stage, it is critically important that the Authority craft its regulatory framework with care. We agree with the proposal to have two separate parcels of 5G spectrum, to generate competition and resiliency in the provision of 5G services. However, to allow meaningful competition for 5G, both spectrum parcels **must** be equal in size. If one spectrum parcel is smaller from the start, this could drive the market towards an outcome where only one 5G network can flourish. This would be to the detriment of customers and of the economy.

4. Regulatory requirements imposed on 5G networks and services must also take into account: (i) the nascent stage of 5G; (ii) the high rollout costs associated with 5G infrastructure; and (iii) the uncertain business case for 5G. It would be a mistake to over-regulate 5G networks, and divert away funds which would be better focused on coverage, capacity and developing innovative services for customers. The imposition of overly onerous regulatory obligations on 5G services may end-up undermining or deterring 5G rollouts altogether.

5. StarHub’s detailed responses to the Authority’s questions are attached below. We sincerely appreciate the Authority’s consideration of our comments, and look forward to the launch of the 5G call for proposal (“**CFP**”).

StarHub's Response to the Authority's Questions:

Question 1: IMDA would like to seek the industry's views on skills requirements and the potential job demands in the future of networks and next generation of application/use-cases with 5G technology.

6. From a network perspective, engineers with 4G network skillsets have the fundamental skills needed to support the initial design, planning and operation of 5G networks. However, as the technical specifications for 5G become clearer, 4G engineers will need to go through additional training to understand 5G specific requirements, including: (i) network virtualisation and slicing; (ii) 5G resiliency; (iii) edge / smart radio systems; (iv) cybersecurity; and (v) software-defined networks.

7. StarHub has been actively engaging vendors and industry players on 5G. As with past mobile technologies, we see that technical standards, equipment and devices will primarily be driven by international developments. It will be necessary for operators in Singapore to closely follow those developments, and ensure that they have the necessary skillsets.

8. From a broader economy perspective, it will be necessary for an entire ecosystem to be developed, in order for 5G to succeed. For example, Augmented Reality / Virtual Reality ("AR/VR") content will need to be developed, and the skillsets for this will be needed. Skillsets for the development of smart factories are currently lacking, and must be prepared. These skillsets will be needed outside of the infocomms sector, and will be critical to the success of 5G services. The introduction of 5G is an opportunity for the industry and Government to work closely together on training of Singaporean workers, to prepare them for the new digital economy.

Question 2: IMDA would like to seek views on:

i) The types of innovative use-cases that could capitalise and further enhance Singapore's competitive advantages, trigger new growth potential and/or strengthen Singapore's existing strategic pillars; and

9. Given the availability of fast 4G services in Singapore today, the benefits of 5G may not necessarily be about simply faster speeds. This is particularly true during the initial stages of 5G services, when the available spectrum for 5G will be relatively limited. Rather, we see 5G's promise of ultra-low latency and ultra-high capacity as enablers for unique use-cases that can greatly boost productivity and increase efficiency. For example, 5G could enable real-time connectivity between people, devices and machines that could assist in industries such as manufacturing and logistics.

10. From current discussions with the industry, we see key 5G use-cases primarily centred around:

- (i) Smart seaports and airports (particularly with autonomous or remotely-managed loading / unloading, and the movement of transport vehicles);

- (ii) Transport systems and connected vehicles (including in-vehicle entertainment, diagnostics, and remote management);
- (iii) Health care (such as remote monitoring and faster processing of medical records – especially data-intensive 3D imaging files);
- (iv) Tourism (especially with AR/VR services to provide a more immersive tourist experience);
- (v) Smart factories (with the ability to manage / monitor / repair factory machinery and equipment);
- (vi) Drones (with the ability to remotely-manage delicate movements, using the low-latency capabilities of 5G services);
- (vii) Gaming (particularly cloud-hosted gaming services that take advantage of 5G’s low latency and high capacity);
- (viii) Public safety (dramatically increasing the volume and timeliness of video traffic that can be delivered to and from Law Enforcement and Emergency Services officers); and
- (ix) Enterprise WiFi replacement (as an interim solution for business customers that are not yet served via the NBN fibre network).

11. However, some globally touted 5G use-cases may not be relevant for Singapore. For example:

- Fixed Wireless Access (“**FWA**”) is sometimes claimed as a “killer” 5G application. However, in a dense urban environment like Singapore, with its pervasive fibre coverage, FWA may only serve a niche purpose; and
- Tele-medicine may be appropriate for larger countries, where medical services may not be widely-available. However, this use-case may not be relevant given the availability of healthcare options in Singapore.

12. In our discussions with vendors and industry players, we note that some 5G use-cases could be served via 4G (or even 3G) today. At the outset, 5G use-cases may primarily be focused on time / mission-critical business activities which leverage on the ultra-low latency capabilities of 5G. In the meanwhile, 4G technologies continue to improve, and as more spectrum is released, 4G speeds will also continue to grow. 4G coverage, speeds and quality in Singapore are already touted as some of the best in the world, and the local MNOs are still investing heavily in our existing 4G networks.¹ 4G may therefore continue to be the baseline service used by customers in Singapore.

13. Going forward, we foresee a natural progression towards 5G (particularly as use-cases grow and customer usage patterns move beyond 4G capabilities). However, deriving a sustainable business case (and obtaining customer buy-in to pay a premium for 5G) will be the key challenge for 5G deployments.

Question 2:

ii) Areas of government support that the industry requires in order to enable innovation and development in 5G.

14. As highlighted above, the uncertain business case for 5G has been a common theme across the industry. A McKinsey study showed that 60% of global Chief Technology Officers felt that the 5G business case is the biggest challenge in their 5G strategy.²

15. The Government therefore has a key role to play to develop the 5G ecosystem in Singapore, and to ensure that 5G networks can be deployed as quickly and as efficiently as possible. We would therefore make the following suggestions:

➤ 5G spectrum should be made available free of charge. Specifically, in its consultation paper, the Authority has stated the following:

(1) That the base price for the 3.5 GHz spectrum may be tagged to international auction clearing prices. We respectfully disagree with this proposal. If the Authority is seeking to allocate 5G spectrum via a CFP (with strong emphasis on network rollout requirements), it should not also require MNOs to pay for the spectrum based on benchmarked auctioned prices.

Our suggestion is for the 3.5 GHz spectrum to be allocated free of charge, and, correspondingly, for “Offer Price” to be removed as a consideration in assessment of the CFP submissions. MNOs will have to take significant risks given the uncertain business case for 5G. Removing the cost for the 5G spectrum would assist greatly in ameliorating the risks involved.

(2) We agree with the Authority’s proposal to allocate the mmWave spectrum free of charge. However, the Annual Charge of \$1,232,000 for the mmWave spectrum is excessive. Given the unproven nature of this spectrum band, and its potentially limited use-case, it is not justifiable to pay such a high annual management fee. We respectfully suggest that the Authority waive the annual fees for the mmWave spectrum, similar to the manner in which the Authority has waived the fees payable for 5G trials.

¹ As noted in the recent Straits Times article of 11-June 2019: “*Despite 5G fanfare, mobile operators still boosting older network connections*”.

² Reference: <https://www.mckinsey.com/industries/telecommunications/our-insights/cutting-through-the-5g-hype-survey-shows-telcos-nuanced-views>.

- Tax incentives could be provided for investments in 5G, to help address the existing uncertainty in the business case for the aggressive deployment of 5G services. We understand that this has been done in:
 - (1) Korea – where up to 3% of tax credits will be provided for investments in 5G infrastructure³;
 - (2) Japan – which offers a 5% tax cut for investment in 5G facilities; and
 - (3) Britain – which implemented a five-year 5G facility holding tax exemption.⁴
- The Government should be a first-mover to adopt potential 5G use-cases. Government support for 5G services would then serve as a strong example for the rest of the economy to follow.
- As mentioned above, joint training efforts between the industry and the Government will be a key pillar to support the 5G ecosystem in Singapore. We would strongly welcome efforts by the Authority to make funding available for 5G-related training courses.
- 5G spectrum should be reserved solely for MNOs, and should not be allocated for private 5G networks. Allowing private 5G networks would further dampen the already uncertain business case for 5G. If individual pockets of 5G are allowed, this could also cause interference issues and require additional mitigation (with associated costs) to be implemented. From a technical-perspective, 5G technologies would support network splicing, which allow individual companies to run their own “pseudo” private networks. It is therefore unnecessary for the Authority to separately issue out private 5G network licences.
- A key challenge in developing 5G use-cases will be the need to interface with multiple Government agencies to obtain approvals for individual projects. For example, to develop a 5G business case for drones, the developer may have to approach the Authority to discuss equipment specifications, the Civil Aviation Authority to discuss height limits and the Ministry of Home Affairs to discuss security concerns. Each agency may have their own approval processes and regulatory frameworks, and their view on 5G services may differ. If the Government is keen to develop 5G, a single agency should be appointed to coordinate between all relevant Government agencies for 5G-related matters.
- As the Authority has correctly recognised, 5G deployments may mean more equipment being pushed to the “edge” of the networks, to provide ultra-low latency

³ Reference: https://www.pwc.com/kr/ko/publications/samil-commentary/samilcommentary_dec2018_en.pdf.

⁴ Reference: <http://www.businesskorea.co.kr/news/articleView.html?idxno=26751>.

services. Taken together with the poorer propagation characteristics of the high frequency 5G spectrum, this would mean additional space being required for deployment of mobile equipment (including in non-traditional building structures such as lampposts and low-rise buildings). The Code of Practice for Information Facilities in Buildings (“COPIF”) will therefore need to be reviewed to cater for 5G once equipment specifications become clearer.

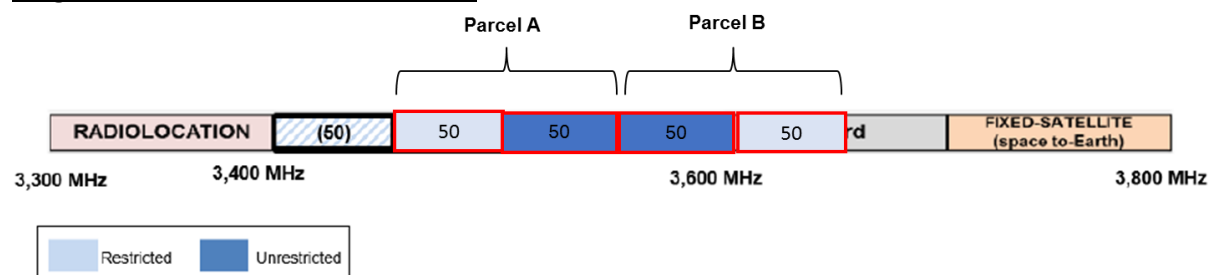
The need for more mobile installation space could result in new bottlenecks going forward, with multiple operators competing for a limited amount of “prime” space. The Authority will need to review this point closely, to ensure that 5G operators are not unreasonably deterred from deployment of infrastructure.

Question 3: IMDA would like to seek views and comments on the suitable technical parameters, including the reasonable amount of guard band needed to reduce potential interference between IMT and FSS use in the 3.5 GHz band.

16. We believe that a proposed 100 MHz guard band between IMT and FSS is excessive, and unnecessarily reserves spectrum which could be better put to effective use. Our view is that a guard band of 20 MHz would be sufficient to prevent interference between IMT and FSS use. This is view supported by Nokia’s recent submission to the Federal Communications Commission⁵, and ITU’s 2015 study.⁶

17. Having reviewed the characteristics of the 3.5 GHz band in Singapore, we suggest that the Authority adopt the allocation set-out in Diagram 1 below.

Diagram 1: StarHub’s First Preference:



18. We believe that having two equally sized parcels is the best option to facilitate meaningful competition for 5G. To mitigate potential concerns about the reduction in the guard band, we propose reducing the guard band to 50 MHz, and for 3600 to 3650 MHz to be designated as “restricted” spectrum. This would then address possible IMT interference issues with FSS services.

⁵ Reference: <https://ecfsapi.fcc.gov/file/102976959340/Nokia%20Comments%20on%203.7%2010-29-2018%20FINAL.pdf>. Nokia has stated that, under its assumptions “a guard band of 20 MHz between FSS and 5G would provide sufficient protections to the FSS earth stations”.

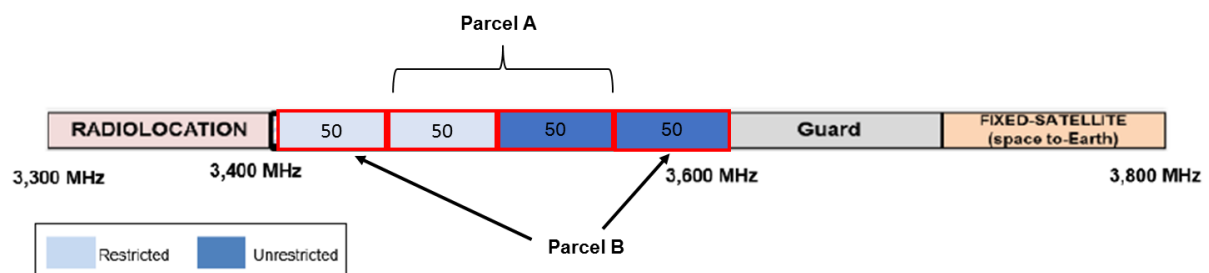
⁶ Reference: https://www.itu.int/dms_pub/itu-r/opb/rep/R-REP-S.2368-2015-PDF-E.pdf. ITU has noted that “increasing the size of the guard band beyond 20 MHz has no effect on reducing the separation distance required to protect the FSS receiving earth station”.

19. As a start, when there are restrictions on the use of the 3.5 GHz band, each parcel could utilise 50 MHz outdoors, and 100 MHz indoors through carrier aggregation. This would allow the winning MNOs to achieve double the capacity and headline speeds for indoor 5G services. Following co-existence testing, the restricted use spectrum could then be converted to unrestricted usage. This would then allow the full capability of 5G to be harnessed using a 100 MHz carrier.

20. Separately, we also seek the Authority’s advice as to whether it plans to require FSS providers to migrate out of the 3.7 GHz band entirely. If the Authority’s goal is to promote 5G deployments, it should be looking how best to quickly and efficiently facilitate 5G deployments. Handicapping 5G to facilitate FSS services would not be in the best interests of the economy and of customers.

21. If the Authority prefers not to reduce the guard band, our second recommendation is set-out in Diagram 2 below.

Diagram 2: StarHub’s Second Preference:



22. This would entail allocating the “reserved” 50 MHz of 3.5 GHz spectrum as part of Parcel B, and would create two parcels of 100 MHz each. Parcel A would continue to have an advantage with contiguous spectrum. However, as technology progresses Parcel B would be able to utilise the full 100 MHz of spectrum via carrier aggregation.

Question 4: IMDA would like to seek views and comments on the following:

i) Whether the industry agrees with the timelines on the expected availability of the next wave of 5G spectrum; and

23. The current pairing of the 3.5 GHz band with the mmWave spectrum is the most common spectrum pairing for global 5G deployments. Nevertheless, we foresee that the future of mobile technology is moving towards ultra-low latencies, ultra-fast speeds and ultra-high capacities. To support these functions, significantly more 5G spectrum will be needed.

24. In particular, spectrum in the sub-6 GHz band, which offers reasonable radio propagation characteristics, will be critical for deployment of 5G networks. The recommended timeline of 2025 for the next wave of spectrum appears to be reasonable as

the 5G ecosystem (including technical specifications and availability of customer devices) will be significantly more mature at that stage.

25. We would suggest that the Authority carry out a checkpoint review again in a few years, to assess the maturity of 5G standards, and whether timings for release of spectrum should be brought forward, or delayed further.

26. Given the significantly larger amounts of spectrum needed to support 5G (as compared to 4G and 3G), the costs for 5G spectrum should also be reassessed. This will ensure that spectrum costs do not form a significant constraining factor which negatively impacts the business case for 5G. For this current exercise, given the nascency of 5G, and the unclear business case, the 5G spectrum should be allocated free of charge.

Question 4:

ii) Whether current deployments in the 2.5 GHz FDD spectrum band (based on 3GPP Band 7) and in the 2.5 GHz TDD spectrum band (based on 3GPP Band 38), should be reformed to 3GPP Band 41 for future 5G services in Singapore, and the views on the associated cost and challenges.

27. Since 2014, MNOs in Singapore have deployed LTE in the 2.5 GHz FDD spectrum band (based on 3GPP Band 7). With growing 4G traffic being projected over the next few years, this band will still be needed to support 4G services.

28. However, as 5G matures and becomes the prevalent technology, we agree that this band could be re-used for 5G. Existing rights holders should be given the ability to provide 5G within their spectrum rights.

Question 5: IMDA would like to seek views, comments and suggestions on:

i) Whether Singapore should have two nationwide networks as a start given the considerations and trade-offs;

ii) The proposed 3.5 GHz lot sizes and spectrum packages;

29. As commented above, we fully support the proposal to allocate two parcels of 5G spectrum. However, both parcels must be equally sized, to ensure that there is meaningful competition for 5G. Our foremost preference is for the Authority to reduce the proposed guard band by 50 MHz, and allocate an additional 50 MHz of restricted spectrum to Parcel B (see Diagram 1 above).

30. However, allocating equally-sized parcels is only the first step. 5G is a new technology with an unproven business case. If the Authority wants 5G to flourish, the winning bidders must be allowed to deploy 5G based primarily on commercial considerations. If onerous regulatory obligations are imposed on the 5G winners from the outset, this will undermine

the business case for 5G, and will significantly reduce the ability of the winners to invest in rollout, service quality and supporting innovative business cases.

31. If onerous obligations are imposed, we see two possible outcomes:

- 5G rollout will be stunted, with limited rollout and development of 5G services. There will be two 5G networks, with unrealised potential, and inability to meet customer demand.
- The market may converge towards a single 5G operator, thus defeating the entire purpose of the Authority's proposals.

Question 5:

iii) Whether 5G equipment would be able to support 3.5 GHz bandwidths in multiples of 50 MHz;

32. From the 3GPP roadmap, multiples of 10 MHz could be supported. However, we believe that the optimal allocation would be 100 MHz, in-line with our proposal above.

Question 5:

iv) The value, if any, in assigning the remaining 50 MHz restricted 3.5 GHz spectrum in the same assignment exercise as the unrestricted lots;

33. We strongly recommend that the Authority make available two parcels of 100 MHz of 3.5 GHz spectrum. This ensures the parcels start off on an equal footing. To repeat, our primary recommendation is to reduce the size of the guard band to 50 MHz, and for the parcels to be as follows:

- Parcel A: 3450 to 3550 MHz; and
- Parcel B: 3550 to 3650 MHz.

34. If the Authority prefers not to reduce the guard band, our secondary proposal is for the reserved 50 MHz lot to be included in Parcel B, to ensure both parcels have 100 MHz of spectrum.

Question 5:

v) The proposed mmWave lot sizes and preferred band plan option; and

vi) The rank order preference of the 3.5 GHz spectrum package and mmWave lot combinations.

35. We have considered this matter in some detail. On a forward-looking basis, we recommend Option B, as this option offers the most blocks of 800 MHz spectrum which are compatible with both n257 and n258 standards.

36. We believe that the n257 standards are more mature. The MNOs could therefore carry out network deployments in n257-compatible bands. As the n258 ecosystem matures, 24.3 to 26.7 GHz could then be allocated for use, with 26.7 to 27.5 GHz utilised as a guard band.

37. We would also repeat our request that 5G spectrum (including mmWave) should only be allocated to the MNOs. The Authority should not facilitate the creation of private 5G networks, which could disrupt the business case for 5G, and cause unnecessary interference to the 5G networks deployed by MNOs.

Question 6: IMDA would like to seek views, comments and suggestions on:

i) The proposed network rollout and performance obligations to be imposed on the spectrum right holders;

ii) The methodology and measurement criteria for the coverage obligation;

38. We are agreeable with the proposed 50% rollout obligation. However, deploying a brand new 5G network with 50% coverage in Singapore would require significant capital outlay. The business case for 5G, for such a widespread development, is unclear.

39. Therefore, in consideration for the MNOs taking significant business risks in committing to such a 50% rollout, we respectfully request that the Authority allows the 5G spectrum to be made available free of charge.

40. In addition, we would strongly request that the Authority does not impose additional indoor coverage requirements, or quality of service (“QoS”) standards, for 5G. 5G use-cases will be highly specific and customised for individual customers. Equipment may be deployed specifically to serve individual customers, and 5G operators would have commercial incentive to provide a level of service that meets each customer’s needs. We can see no commercial business case for mandating indoor coverage requirements. Given the customised nature of 5G it would be impractical to impose an overall 5G QoS standard. Imposing such requirements (particularly at this nascent stage) would significantly compromise the business case for 5G.

Question 6:

iii) The network design and resilience challenges of 5G (in particular, enabling technologies, such as SDN, NFV and Cloud Computing that may fundamentally change how the network would be designed and deployed) and possible measures to address them, and whether there are other aspects that should be considered to enable trusted and resilient 5G network; and

41. We agree with the importance of having a baseline level of network resiliency for 5G networks. The challenge is providing additional resiliency when the business case for 5G is still so uncertain. Many 5G use-cases (particularly mass-market use-cases targeted at consumers) can be supported by 4G. There is therefore little (or no) commercial justification to support enhancing all 5G deployments.

42. Any specific resiliency requirements for 5G services should be handled on a case-by-case basis, and subject to commercial discussions between the MNOs and the requesting customers. This is how StarHub operates today for our 3G and 4G services.

43. We would strongly discourage any blanket “gold-plating” of 5G infrastructure. Onerous obligations on resiliency and redundancy would divert limited MNO resources available for deployment of infrastructure and supporting of innovative use-cases. It may very well also discourage participation in the CFP.

Question 6:

iv) The framework for the provision of 5G wholesale services.

44. StarHub supports the current “*Negotiation Principles for Wholesale Access*” issued by the Authority on 18-February 2016. The Authority would have seen the successful launch of a number of MVNOs in the market, and this indicates that further regulatory intervention is not required.

45. If additional wholesale requirements (such as price regulation) are imposed on holders of 5G spectrum, such requirements must be stated upfront, to provide full certainty. MNOs will need to have clarity on the regulatory regime to make informed decisions on their CFP proposals. It would be unreasonable and unrealistic to expect MNOs to provide CFP proposals while the framework for wholesale services is not yet clarified.

46. In addition, we would also request clarification on the following points:

- The Authority should clarify its views on regulatory requirements to provide minimum levels of resiliency, redundancy and excess capacity to wholesale customers. Such requirements may not be practical given limited resource constraints and competing requirements. We therefore respectfully suggest that any resiliency requirements should be based on commercial discussions and feasibility.
- 5G wholesale customers should not be allowed to pick and choose the services they buy from 5G operators. In rolling out 5G infrastructure, the MNO would have incurred significant upfront capital outlay. It may be necessary to bundle its 5G services with value-added services (such as cybersecurity for 5G) to adequately recover its initial costs. A wholesale customer should not be in a position to request the 5G operator to strip out such ancillary services and offer only a plain “vanilla” service. This would not be commercially viable for the 5G operator.

Question 7: IMDA would like to seek views, comments and suggestions on the spectrum assignment framework, including:

i) The proposed assignment approach;

47. We are agreeable to the CFP approach for assigning 5G spectrum. However, given the uncertainties over 5G, the Authority should allocate the 5G spectrum free of charge to support the 5G business case. Accordingly Offer Price should be removed as a weightage factor.

48. The focus should also not be about speeds and coverage. Singapore already has pervasive 4G coverage with internationally-recognised 4G broadband speeds. Rather, 5G deployments will be based on specific use-cases and innovative applications. This will not be achieved by MNOs haphazardly deploying to areas where there is no demand.

49. As mentioned above, we are agreeable to a 50% rollout obligation. However, within the near to medium term, we do not see significant demand to support a widespread 5G rollout. Nonetheless, if there is genuine demand, and the business case allows it, the MNOs will have every incentive to rollout as widely and as quickly as possible.

Question 8:

ii) The spectrum right duration of the 3.5 GHz package and mmWave lots;

50. Given the limited quantity of 5G spectrum available, and the high costs associated with 5G rollout, we would urge the Authority to review its current proposed 12 – 15 year allocations. MNOs awarded 5G spectrum need assurances on their ability to garner a return on investment on 5G deployments. This may necessitate the Authority allocating the 5G spectrum for a longer period of 25 years (or for such time as a return on investment is achieved).

Question 8:

iii) The evaluation criteria, sub-criteria and weights to assess the proposals;

iv) The assessment methodology, including evidence (documentary or otherwise) to evaluate the proposals; and

v) The enforcement and/or audit mechanisms to ensure that applicants are able to deliver on their proposals.

51. As mentioned above:

- The Offer Price should be removed as a weightage criterion;

- It will be impractical to require indoor coverage and other QoS requirements for 5G networks; and
- Imposing “gold-plated” requirements on resiliency and redundancy will draw much-needed funds away from actual 5G deployment, and support for innovative use-cases.

52. In assessing CFP proposals, we would recommend the Authority look at key performance indicators such as:

- Proposed launch date;
- Number of potential use-cases and ability to deliver such use-cases;
- Number of base stations deployed;
- Capital expenditure commitments; and
- Commitments on number of engineers to be trained for 5G services.

53. Confirmation on compliance with the KPIs could be via audits or physical inspections.

Question 8: IMDA would like to seek views and comments on the trade-offs (particularly on resilience, 5G capabilities) and technical feasibility of the various levels of infrastructure sharing.

54. Sharing of infrastructure on a commercial basis makes sense. Sharing can allow an overall reduction in deployment costs, and also potentially assist in improving resiliency (e.g., if MNOs can use different sets of transmission to serve different areas). Infrastructure sharing has already been implemented between the existing MNOs, on a commercial basis, for in-building and in-tunnel areas. Allowing sharing of spectrum would also allow the MNOs to jointly leverage on the spectrum to maximise 5G capabilities.

55. In addition, 5G is based on individual use-cases. If an enterprise in one location (e.g., an airport) is already purchasing 5G services from one MNO, it would not make commercial sense for another MNO to deploy 5G to that same location. Requiring duplicated rollout of infrastructure would be unnecessary and uneconomic, and create a wastage of limited resources.

56. However, we would disagree with any mandatory sharing requirement. Sharing needs to be based on an arrangement where there are mutual benefits to both parties. A mandatory sharing arrangement may result in one party benefitting disproportionately from the arrangement.

Question 9: IMDA would like to seek views and comments on the following:

i) The synchronisation approach for 5G TDD networks in a multi-operator environment for the 3.5 GHz and mmWave bands, specifically for the following:

a. Synchronised networks: the required frame alignment, compatible frame structures and BEM specifications for AAS and non-AAS base stations; and

b. Unsynchronised networks: the amount of guard band, geographical separation and BEM specifications for AAS and non-AAS base stations;

ii) The adoption of other suitable mitigation measures to mitigate interference between unsynchronised networks; and

57. We recommend synchronisation to fully maximise the potential of the limited spectrum available in the 3.5GHz band. Unsynchronised networks will require the allocation of more guard bands, which would further limit the amount of spectrum available.

58. We are studying the technical details for synchronised networks, and further discussions with vendors and between MNOs will be required.

Question 9:

iii) The need for IMDA to mandate a regulatory requirement for synchronisation across the 5G TDD networks or leave it to operators to co-ordinate their network deployment and parameters in order to reduce interference between networks.

59. We recommend that the Authority should leave it to MNOs to co-ordinate their network deployment and parameters. The MNOs are already doing this today for our 4G TDD networks.

60. The Authority should only intervene if MNOs are unable to resolve this issue, and a dispute arises.

Question 10: IMDA would like to seek views and comments on the following:

i) The interest from industry players to leverage 5G spectrum or other mobile spectrum bands for fixed-wireless services that support mobile connectivity; and

ii) The policies (e.g., spectrum allocation, numbering) that should be considered to facilitate such use-cases.

61. There may be potential for FWA in Singapore to meet niche commercial needs. We are open to reviewing such business models, but we submit that this should be based on commercial assessments rather than regulatory requirements. We recommend that the Authority maintain an “agnostic” approach towards 5G use-cases (i.e. allowing MNOs to

choose whether or not they wish to deploy 5G services for FWA. At this stage, we see no need for specific regulatory facilitation of FWA use-cases.

Conclusion:

62. In summary, StarHub's key points are as follows:

- StarHub is keen to participate in the 5G CFP exercise and provide 5G services in Singapore. We see 5G as critical to the development of the Singapore infocomms market.
- We agree with the Authority's proposal to issue two parcels of 5G spectrum. Our primary concern is that both parcels should be made **equal** in the spectrum they provide. Having equal parcels will ensure fair competition for 5G services in Singapore.
- StarHub suggests that the guard-band in the 3.5 GHz band be reduced to 50 MHz, and an additional 50 MHz of restricted spectrum be allocated as part of the 5G CFP exercise. This would ensure both parcels in the CFP are equal.
- Given uncertainty over 5G business cases, MNOs would have to take significant business risks to participate in the 5G CFP and to commit to a 50% 5G rollout. To ameliorate such risks, we encourage the Authority to provide the 5G spectrum free of charge.
- At this nascent stage of 5G, the Authority should not impose onerous regulatory obligations (such as indoor coverage and excessive resiliency requirements) on 5G operators. 5G operators should be allowed to negotiate directly with customers who require customised requirements. Unnecessary regulatory obligations would absorb limited funds, and discourage participation in the 5G CFP exercise.

63. StarHub is grateful for the opportunity to comment on this matter and we sincerely appreciate the Authority's consideration of our comments. We look forward to participating in the upcoming 5G CFP exercise.