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**") thanks the Infocomm Media Development Authority of Singapore (the "**Authority**") for the opportunity to comment on its public consultation on 5G technology developments and spectrum requirements. We appreciate the efforts to gather feedback on the future of mobile services In Singapore. We fully agree that mobile technologies are an important driver for the Government's Smart Nation goals; and that ensuring Singapore remains at the forefront of 5G will enable Singapore to maintain its competitive edge with world-class telecoms infrastructure.

2. A key factor in fostering 5G services is to ensure a conducive regulatory environment that promotes innovation, investment and risk-taking. Given the spectrum and infrastructure-intensive characteristics of 5G, it is essential that the Authority explore ways to reduce the regulatory burden on the industry, lower the costs of deploying mobile services, and make it easier for companies to trial new mobile solutions. The deployment of 5G services (and mobile services in general) needs to involve a coordinated effort across all Government agencies, to ensure a whole-of-Government approach in the push towards a Smart Nation.

3. Additionally, while it is important for Singapore to keep abreast of international standards, we would caution against attempting to take the lead in the setting of 5G standards. Doing so runs the risk of leaving Singaporean companies with standards that may not be widely adopted or supported by key international manufacturers. This will have an impact on the costs for deployment, the roadmap for future developments, and international inter-operability. Rather, given the ever-evolving face of technology, it is also necessary for the Authority to continue reviewing international standards, and be agile enough to change its frameworks as necessary. What may hold true today, may not be relevant in 3 to 5-years. In addition, a key factor in facilitating 5G services in Singapore is for the Authority to adopt a forward-looking approach in its adoption of technologies. Singapore must not be unnecessarily wedded to existing technologies (such as Wi-Fi and satellite services), which could prevent or deter the development of new mobile services.

4. Apart from setting spectrum policies, it is also critical that the Authority ensure that physical infrastructure in Singapore is 5G-ready. The Code of Practice for Info-communication Facilities in Buildings ("**COPIF**") needs to be amended to ensure that the mobile network operators ("**MNOs**") have access to the spaces necessary for the deployment of mobile infrastructure. More space (both in-building, on roof-tops and in other outdoor locations) will be needed as the MNOs continue their roll-out of 4G services, while preparing for 5G.

5. StarHub's detailed comments and responses to the Authority's specific queries are attached below. We sincerely appreciate the Authority's consideration of our comments.

StarHub's Comments:

Technology and Use Cases:

Question 1: IMDA would like to seek views and comments on the estimated timeline for the deployment of 5G. Besides ensuring that spectrum is made available in a timely manner, what other regulatory measures could assist in facilitating the deployment of 5G technology and applications? What other use cases should IMDA take note of when developing the regulatory framework?

6. StarHub envisages that the deployment of widespread commercial 5G services in Singapore will take place after the following criteria are fulfilled:

(1) 5G standards are agreed and set on a global basis;

(2) Manufacturers begin producing network equipment in-line with the 5G standards; and

(3) Key global vendors start to introduce 5G-compatible devices into the market.

7. While we note plans in countries such as Japan and South Korea to roll-out "pre-5G" networks, such networks will be limited in their scale and scope, focused on their domestic markets. In the near-term, these will not be full-fledged 5G deployments.

8. Critically, we believe that any widespread deployment of 5G must be predated by: (1) clearly defined parameters for 5G services; and (2) a strong business case which supports the rollout of 5G infrastructure. This is particularly important given the large spectrum requirements, and infrastructure-intensive investments needed.

9. Taking the example of 3G, there was significant worldwide hype over the development of 3G technologies, and operators started rolling out 3G networks from the early 2000s onwards. However, the take-up and usage of 3G technologies only accelerated following the introduction of the first smartphones in 2007 (more than half a decade later). Rather than deploying large-scale 5G networks before services are ready, the widespread deployment of 5G in Singapore must ride on the market making available "killer" 5G applications and services.

Regulatory Framework for 5G Services:

10. Notwithstanding the uncertainty over when 5G services will be widely deployed, it is paramount that Singapore actively facilitates the rapid adoption of 5G. We support the Authority's move to waive frequency fees for 5G trials. However, more can be done (particularly at this nascent stage) to encourage the deployment of potential 5G and other new mobile services.

11. StarHub's suggestions are as follows:

- <u>Sufficient spectrum needs to be made available for mobile services.</u> In its consultation paper, the Authority has suggested that over 3 GHz of spectrum is projected to be needed for 5G services, while less than 2 GHz of spectrum is currently projected to be

available. To meet the demands of the public, and the needs of a Smart Nation, it is imperative that the Authority release as much spectrum as possible (subject to international harmonisation) to support mobile services in Singapore. This would be the most effective use of scarce spectrum resources.

- Spectrum costs must be significantly reduced. Spectrum costs make-up a significant proportion of the costs needed to deploy mobile networks. Having MNOs pay more for spectrum means that they have less funds available for their network deployments, and for the development and implementation of new technologies. This point has been clearly highlighted in a recent Business Times article[1] which noted the high prices paid in the recent 4G spectrum auction, and cautioned that "*The government needs to keep an eye on* [5G] *spectrum prices and ensure that overpayment doesn't result in less money being made available for innovation and services roll-out*". Given the large amounts of spectrum needed for 5G, it is imperative that the Authority carefully consider the costs of the spectrum. Past spectrum fees should not be taken as a gauge for how much 5G spectrum should be valued.

- Licence fees must be reduced. Apart from spectrum fees, the licence fees paid for 5G services should also be reduced, in the same way as it was for 3G services. The existing high licence fees act as a cost barrier to the introduction of new 5G services, and reduces the incentive for MNOs to take risks in deployment and innovation. As existing licence fees are based on the revenues generated by an operator, rather than on the profitability of that operator's services, the existing licence fees would be entirely inappropriate for 5G services.

- The COPIF needs to be amended to ensure that Singapore's physical infrastructure is 5G-ready. As highlighted above, the COPIF is an essential instrument in ensuring that building owners set-aside sufficient space for the deployment of telecoms infrastructure in Singapore. As the Authority has recognised in its consultation document, more equipment will be needed to support faster speeds and more spectrum bands. For higher capacity services, MNOs will also need to deploy larger number of small cells (both within and outside of buildings). Increasing amounts of backhaul (including both the physical fibres and the associated transmission equipment) will be needed to support higher capacity services. This means that the MNOs will need increasing amounts of space for the deployment of their infrastructure.

  We therefore support the Authority's proposals to amend the COPIF to require building owners to provide free roof-top space to the MNOs. However, as we have highlighted to the Authority, more can be done to ensure that building owners fully support the Government's Smart Nation goals. This means allowing MNOs more space for their deployments (including deployments in non-building sites such as

[1] Quoted from the article in the 31-May 2017 edition of the Business Times, entitled: "*With 5G telephony, government needs to keep an eye on spectrum pricing*".

lampposts), and ensuring that building owners fully cooperate with the MNOs in their deployments. Given the critical role of mobile services in growing a Smart Nation, the Authority needs to ensure that building owners see the bigger picture of facilitating new mobile deployments, rather than just being focused on their own narrow interests (such as the "aesthetics" of their building or seeking to profit from additional rental charges).

Another key deployment area is MRT and road tunnels. Unfortunately, the space allocated today for mobile equipment in tunnels is insufficient and creates a situation where the MNOs are unable to deploy additional equipment for newer mobile technologies. Given the difficulties involved in carving out additional space once a tunnel is built, it is imperative that the Authority work with the transport agency well in advance, to ensure that space provided is future-proof. Otherwise, this creates a situation where customers are unable to enjoy future mobile services while on the MRT trains.

The changes necessary to facilitate 5G should be introduced under the current COPIF consultation. Singapore cannot afford to wait until 5G standards are finalised before making the necessary physical infrastructure changes. This will be far too late and will mean that the clear majority of buildings (both existing and to-be-built) will not be prepared for 5G services.

- A coordinated "Whole-of-Government" approach is necessary to facilitate 5G deployments. We appreciate the Authority's efforts to facilitate 5G deployments for the good of users in Singapore. However, other Government agencies may not share the same goals. Today, StarHub faces difficulties when deploying its infrastructure, in the form of increasing costs, onerous terms and restrictions on deployments. We respectfully submit that all Government agencies should view mobile deployments as critical services, and not seek to impede or profit when MNOs request for new deployment space. A coordinated effort is necessary to allow Singapore to achieve its Smart Nation goals.

- Quality of Service ("**QoS**") requirements on 5G must be removed. The Authority has recognised that 5G networks will be different from the traditional 3G / 4G networks deployed today. Rather than the traditional methods of having wide areas served by macro cells, 5G services will most likely be provided mostly over small cells / small antennas which are concentrated in key customer areas. Therefore, the traditional approach of having stringent QoS standards on mobile service coverage needs to be changed. Imposing widespread QoS standards on 5G deployments will simply make it prohibitively expensive for the deployment of these technologies. Furthermore, as the Government has recognised, "*Singapore is … one of the few countries known to have imposed QoS standards on telecommunication services for compliance purposes*" and that "[t]*he* [International Telecommunication Union] *itself does not recommend nor require members to create QoS frameworks to protect the customer interest*".[2]

[2] Reference the Parliamentary reply by the Minister of Communications and Information on 8-April 2013.

Given the unique characteristics of 5G, and the current uncertainty over the 5G business case, the imposition of any 5G QoS standards will be entirely unnecessary.

- Regulatory holiday for 5G services. In-line with the comments above, given the uncertainty over 5G services, it is imperative that the Authority refrain from imposing additional regulatory obligations on 5G providers, to avoid a chilling impact on new and innovative deployments. We would suggest that, at the minimum, the Authority look at a 10-year regulatory holiday for 5G services, to allow 5G deployments to stabilise before the imposition of regulatory obligations.

- Public education is critical. As the Authority is aware, a key issue being raised today is whether the deployment of mobile equipment could create potential health concerns. Today, MNOs are already severely restricted in their deployments due to building owners' concerns over the prominent placement of antennas. This creates a real problem for the MNOs as we have to either: (1) hide our equipment; (2) site equipment further away from the public eye; or (3) find alternative sites altogether. These actions reduce our QoS and negatively impacts on the MNOs' ability to provide pervasive mobile coverage. Given the need for increasing number of antennas for both 4G services (and 5G services going forward), it is imperative that a public education campaign is carried out to educate consumers about the deployment of mobile infrastructure. If the Government is keen on advancing its Smart Nation agenda, it must be able to argue successfully against proponents of NIMBY ("not in my backyard") who seek to benefit from excellent mobile coverage, but do not agree with having mobile equipment located near their homes.

Question 2: To facilitate and understand potential spectrum requirements for IoT deployments in Singapore, IMDA would like to seek views on the following:

i) Based on the current spectrum allocated for mobile services in the sub-1 GHz frequency bands, are there further suitable spectrum resources that could be released to support both IoT and LTE services?

12. We agree that Band 26 in the 800 MHz spectrum band would be suitable for IoT deployments. However, given the recent conclusion of the last 4G spectrum, and the current usage within the 800 MHz band, we would suggest that any auction of the 800 MHz band be delayed until a later date when there is greater clarity on the availability of the band. Another suitable band for IoT services is the 700 MHz band, which was recently allocated. It is critical that spectrum in this band is made available as soon as possible for mobile use.

ii) How will future generations of mobile networks (e.g. high capacity, low latency) support the growth of IoT and what would be the spectrum requirements?

13. Current demand for IoT services appears to be relatively low, and the full ecosystem may not yet be ready for widespread take-up of these services. While there are some deployments (such as sensor networks), these tend to be relatively small scale, limited in scope and are typically not coordinated. Nonetheless, going forward, we foresee applications that will require audio-visual content, such as Augmented and Virtual Reality, high resolution

surveillance as well as autonomous cars. We believe that the Government has a key role to play in driving the IoT ecosystem, and demand for such services.

14. From an MNO-perspective, what StarHub needs to support such future developments is timely access to the low-band spectrum (i.e., the 700 MHz band). This would allow us to support IoT services to a wider geographical area. As noted above, the need for high capacity 5G-type services is likely to be concentrated in certain customer areas (and supported by denser deployments of small cells). Therefore, on-top of the base low-band spectrum layer, MNOs will also need access to significant amounts of high-band spectrum, to provide the necessary high-speeds needed in selected areas.

Question 3: IMDA would like to seek views and comments from industry on what they consider will be the key technologies for 5G and whether current regulatory frameworks sufficiently facilitate the deployment of such technologies.

15. The current mobile regulatory frameworks are based on a switched-circuit, nationwide coverage, low-band spectrum environment. As the Authority has recognised, this is not how 5G deployments will be deployed. StarHub believes that a fundamentally different regulatory regime, which encourages risk-taking, creativity and market solutions, will be needed. Our proposed suggestions for the 5G regulatory regime are set-out in the response to Question 1 above.

Spectrum Requirements:

Question 4: IMDA would like to seek views and comments on whether going forward, there is a need for further spectrum below 1 GHz to be identified and release for mobile services?

16. We do not see any other sub-1 GHz bands which are currently suitable for mobile services. Nonetheless, it is important for the Authority to continue closely monitoring international developments in this area.

Question 5: IMDA would like to seek views and comments on the following:

i) The frequency arrangement that is better suited for adoption in Singapore for the L band (i.e. SDL, TDD or FDD) and the supporting reasons; and

17. Today, there is uncertainty as to the optimal frequency arrangement for the L band. As we cautioned above, it is critical that Singapore not seek to be a "first mover", and end-up being locked-in to a specific standard (which would also entail high costs for moving out). The Authority should therefore adopt a technology neutral approach for now until global standards are defined.

ii) The timeline for access to the L band and the availability of the equipment (specifically whether it will be available earlier or later than 2020).

18. Based on our discussions with potential vendors, the equipment availability is likely to be after 2020, when global standards are finalised.

Question 6: Considering the spectrum bands within the range of 1-6 GHz to support the deployment of enhanced mobile broadband services, IMDA would like to seek views on whether all of the 91 MHz of spectrum in the L-band should be allocated for IMT to address Singapore's data demand and growth.

19. Yes, we fully agree with the full allocation of the L-band for IMT services. This is a necessary step given the importance of mobile services, and the Government's push towards a Smart Nation.

Question 7: If it is only the extended C-band that is considered for IMT, would the migration of existing satellite users to the other parts of the C-band (i.e. 3.7-4.2 GHz) impact their service provisioning?

20. Given its importance, we suggest that mobile services be accorded priority over satellite services. As highlighted above, it is critical that the Authority focus its efforts on facilitating 5G, rather than stay wedded to existing technologies.

Question 8: Considering the challenges of co-channel deployment of FSS and IMT services in the extended C-band, IMDA would like to seek views and comments on the coexistence measures for adjacent bands and cross border operations.

21. Based on StarHub's assessment, the smaller footprint of 5G services will significantly reduce concerns over cross-border issues. Nonetheless, we fully agree that cross-border cooperation, at a Government-to-Government level, is important to ensure a coordinated approach. In this regard, any guard bands implemented in Singapore must be aligned with our neighbours, to minimise interference issues.

22. A key cross-border issue is the ongoing discussions over the availability of the 700 MHz spectrum band. We would urge the Authority to work closely with regulators in neighbouring countries to quickly resolve this issue, and to allow the 700 MHz band to be fully utilised for mobile services in Singapore as soon as practically possible.

Question 9: IMDA would like to seek views and comments on whether there are other frequency bands in the 1-6 GHz frequency band that IMDA should consider for IMT / 5G.

23. We have no comments on this question at this time.

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

i) The role mmWave bands will play in delivering the vision of 5G, in particular, what services could not be delivered by alternative frequency bands and / or technologies;

24. We believe that mmWave bands will be critical in providing low latency, high bandwidth and close proximity services. At this point in time, we cannot confirm the exact applications that may be available (as noted above, 5G services are still yet to be fully defined).

Potentially, different types of 5G applications may also work in different mmWave bands. StarHub intends to work closely with device manufacturers on this issue.

ii) The amount of spectrum required in the mmWave spectrum bands to meet 5G applications that will require higher bandwidths; and

25. This is still an unknown quantity given the uncertainties surrounding 5G services. Nonetheless, we would encourage the Authority to release as much spectrum as possible for mobile services. This maximises the economic gains from this scarce resource.

iii) The specific mmWave bands that you consider should be a priority in Singapore for IMT services and why?

26. We do not have specific comments, but would urge the Authority to closely review international standards on this matter.

Question 11: Considering that there are 11 candidate bands under consideration at WRC-19, how would making available the 28 GHz band help in the deployment of 5G services in Singapore? Would this band play a significant role in achieving the targets set out for 5G (i.e. higher throughput, ultra-low latency)?

27. We do not have any specific comments at this time, but it is important that the Authority closely monitor international developments to ensure that Singapore follows closely the global standards.

Question 12: If the 28 GHz band is opened for IMT services in Singapore, would there be any future competing services that may be deployed in this band which may cause interference issues?

28. We do not have any specific comments at this time.

Estimating Spectrum Demand

Question 13: IMDA seeks views and comments on the estimated spectrum demand of 3360 MHz by 2025 and whether this estimate is realistic?

29. Based on StarHub's review, the growth in traffic will fundamentally depend on 5G applications, and availability of devices. Given the uncertainty, it would be difficult to provide projected growth forecasts. Nonetheless, as mentioned above, there is a need for the Authority to make available as much spectrum as possible for mobile services as this maximises the economic potential of the spectrum. A forward-looking approach is also needed to ensure that, where necessary, the Authority shifts older technologies (such as Wi-Fi and satellite services) out of existing spectrum bands, to encourage the adoption of newer mobile technologies. .

30. In addition, as there is uncertainty over the 5G business case, we would caution against imposing regulatory obligations which would deter the growth of 5G services. The

imposition of onerous regulatory obligations (such as QoS and resiliency obligations) should only take place after 5G services have stabilised.

Question 14: Noting that several regulators have made available mmWave bands for IMT services, IMDA would like your views and comments on whether access to the mmWave spectrum should be provided earlier than 2022 for commercial network deployment?

31. This would have to be based on when the standards are finalised, and equipment are made available. We would urge the Authority to adjust its proposal to cater for the standards as they become recognised.

Use of Licence-Exempt Spectrum for IMT Services:

Question 15: Considering the current regulations/policies for licence-exempt use and the possibility of LTE-U (LTE-unlicensed) interfering with Wi-Fi users, IMDA would like to seek views and comments on the following:

i) The adoption of LBT (listen-before-talk protocol) to facilitate sharing of licence-exempt spectrum and whether there would be any implication arising from such a requirement;

32. We greatly appreciate the Authority's efforts to make licence-exempt spectrum available for 5G / IMT services. However, it is critical to ensure that any restrictions placed on the use of such unlicensed spectrum do not deter or even cripple efforts by the industry to utilise the spectrum. In this regard, the Authority needs to calibrate its priorities, to decide whether it should be actively pushing for mobile services over unlicensed bands, or whether it should continue to stay wedded to the provision of Wi-Fi services.

33. In StarHub's view, public Wi-Fi is a "cheap and cheerful" service: a lower quality, best efforts service, provided (typically) free of charge. Wi-Fi is used as a back-up to mobile services, and generally customers do not have high expectations over the use of public Wi-Fi services.

34. On the other hand, mobile services are of a higher quality and reliability, and customer expectations for mobile services is higher. This is borne out by the Authority's own MyConnection results, which show that the 4G users enjoy faster speeds and lower latency when compared to Wireless@SG users. Given a choice, we believe that customers would prefer for their phones to remain on the mobile networks, in order to benefit from a higher QoS standard.

35. Therefore, where mobile and Wi-Fi services are competing for the same unlicensed spectrum, we strongly believe that mobile services must be accorded priority. If the provision of mobile services over unlicensed spectrum is hampered by regulations protecting Wi-Fi, this would be detrimental to the development of future mobile services.

ii) The need for further technical requirements and regulatory measures to facilitate the sharing of licence-exempt spectrum in an efficient and fair manner; and

iii) The need for companies with commercial LTE-U networks to upgrade to LAA once the software/hardware products are commercially available.

36. As stated above, StarHub's strong recommendation is for mobile services to take priority over the provision of Wi-Fi services within the unlicensed spectrum band.

Question 16: During the interim period before regulations are finalised, IMDA plans to facilitate industry trials for LAA/LTE-U technologies. As such IMDA would like to seek views and comments on the following:

i) Besides the information listed in Para 80, should MNOs/MVNOs interested in conducting LTE-U trials submit any further information for IMDA's assessment; and

37. We are concerned with the restrictions placed upon MNOs interested to carry out LTE-U trials. If the industry's hands are tied at the outset, this will inevitably result in lesser innovation and slower growth of 5G services.

38. As mentioned above, Wi-Fi is fundamentally a best-effort service, and typically offered free of charge. The Authority should not be limiting the future of 5G, for Wi-Fi. We would also note that Wi-Fi users are not required to scan for other networks before using Wi-Fi in any location. It is therefore not clear why trials for 5G services are being treated worse than the provision of unlicensed Wi-Fi services.

ii) To minimise impact to Wi-Fi users, should IMDA limit LAA/LTE-U trials to parts of the 5 GHz licence-exempt spectrum?

39. No, we believe that LAA/LTE-U trials should be allowed in all parts of the 5 GHz band. The short-term impact to Wi-Fi users must be balanced against the long-term benefits of mobile customers being able to enjoy ubiquitous coverage, including across the unlicensed bands.

Question 17: IMDA would like to seek views and comments on the following:

i) The possibility of deploying LAA and / or MuLTEfire in other frequency bands besides the licence-exempt 5 GHz band; and

40. We have no specific comments at this time, and more technical trials will be needed to test out the viabilities of these services in Singapore's environment. It is important to ensure that provision of 4G services needs to be tied to a valid MNO licence, and to the provision of services over a licensed spectrum band. We would discourage opening-up the market to potential players providing mobile services purely over the unlicensed bands. This will impact on the operations of duly-licensed MNOs, and create QoS issues for customers.

ii) The regulatory and coexistence measures that should be adopted for MuLTEfire.

41. We have no specific comments at this time. However, any such measures need to be aligned with global (rather than Singapore) standards.

Question 18: Considering that the LWA (LTE-WiFi Aggregation) approach would not create coexistence issue with Wi-Fi users, would this approach be better suited for countries with extensive Wi-Fi usage?

42. As highlighted above, Wi-Fi is effectively a best efforts service with no QoS. Using a LWA approach in Singapore would result in customers enjoying a relatively lower quality for their mobile services. We would therefore recommend against this approach. Again, any standards adopted by Singapore need to be aligned with global standards, rather than be based on a unique Singapore standard.

Question 19: IMDA would like to seek views on how the above approaches (i.e. LAA, MuLTEfire and LWA) would enhance the capacity of the mobile network in ways that Wi-Fi offloading is not able to achieve.

43. As 4G services become more pervasive, offloading to Wi-Fi will result in a lower quality and speed, which will impact overall customer experience. We therefore recommend that Singapore adopt a cellular-based standard (i.e., LAA / MuLTEfire), which will provide a better end-to-end coherency and quality, as compared to using Wi-Fi for offload. The LTE element will allow customers to enjoy a better throughput and quality and allows a homogenous and seamless LTE experience across multiple different spectrum bands.

Conclusion:

44. A summary of the key points of StarHub's submission is as follows:

- We fully support the Authority's efforts to gather feedback on policies and standards to facilitate 5G deployment in Singapore. 5G frameworks in Singapore must be based on international best practices, to ensure that Singapore can make use of widely adopted standards and technologies;

- Today, there is significant uncertainty over the exact standards for 5G. Nonetheless, any deployment of 5G must be based on clearly defined parameters for 5G services, and a strong business case supporting the rollout of 5G infrastructure;

- 5G deployments will differ greatly from the existing mobile technologies (which are based on a switched-circuit, nationwide coverage, low-band spectrum world). Policies for facilitating 5G must therefore also evolve to encourage new and innovative deployments. We would recommend the following:

    - Amendments to the COPIF to require building and facility owners to set-aside sufficient space for 5G mobile deployments;

    - Reduction in spectrum and licence fees to reduce the cost barriers faced by the industry; and

    - A move away from traditional regulatory and QoS frameworks based on older mobile technologies;

- A whole-of-Government approach needs to be taken in order to facilitate 5G deployments in Singapore. In order to push for the Government's Smart Nation goals, a coordinated effort is required amongst all agencies in Singapore;

- Efforts must be made to ensure that low-band spectrum is cleared-out for mobile services. This is critical to ensure that there is a pervasive coverage layer that can act as the base for future 5G services. Importantly, the 700 MHz spectrum band needs to be made available as soon as possible, to ensure a level-playing field for all MNOs in Singapore; and

- 5G technologies represent the future of mobile technologies, and will be a key driver of Singapore's Smart Nation goals. There needs to be a conscious effort by the Authority to facilitate 5G even if it means impacting on existing services such as satellite and Wi-Fi. If the Authority's goal is to continue protecting existing services, then this would have a chilling effect on the deployment of new and innovative mobile technologies.

45. StarHub is grateful for the opportunity to comment on this matter and we appreciate the Authority's consideration of our comments.