
**CONSULTATION ON PROPOSED FRAMEWORK FOR
THE REALLOCATION OF SPECTRUM FOR FOURTH
GENERATION (4G) TELECOMMUNICATION SYSTEMS
AND SERVICES**

**Submission by StarHub Mobile Pte Ltd to the Info-
communications Development Authority of Singapore**

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1. General

StarHub Mobile Pte Ltd (“StarHub”) appreciates the opportunity to provide feedback on the Authority’s consultation on the proposed framework for the reallocation of spectrum for fourth generation (“4G”) telecommunication services.

While StarHub supports the Authority’s efforts to make available spectrum for 4G services, we have some key concerns over the Authority’s proposed approach. Those key concerns are as follows:

- i. The Authority has not included the 700 MHz and 900 MHz bands in the spectrum reallocation exercise. The 700 MHz band is extremely important to the future of 4G services in Singapore. We submit that the Authority should either: (a) make this band available for reallocation or (b) provide greater certainty on the availability of the 700 MHz band, including the likely amount of spectrum to be made available and timeline within which it will be made available (if the reallocation is not possible in the upcoming exercise). In regard to the 900 MHz band, by excluding this band from the spectrum reallocation exercise, StarHub will be placed at a major commercial disadvantage, as the failure to include the 900 MHz band in the spectrum reallocation exercise creates a significant uncertainty for StarHub as to the continuity of our 2G services. To ensure a level-playing field, we submit that the Authority should include the 900 MHz band in the spectrum reallocation exercise, so that mobile operators will be in a better position to plan their future spectrum needs and deployment of various mobile networks and services. Alternatively, the Authority should exclude a certain amount of 1800 MHz from the reallocation exercise for StarHub’s 2G services, given the very limited 900 MHz spectrum available to StarHub.
- ii. The Authority should not artificially restrict the supply of spectrum (by reserving spectrum for potential new entrants or future demand), as this would drive up the cost of spectrum and the deployment of 4G services by existing operators. It is unrealistic to assume that 2x20 MHz of spectrum bandwidth is sufficient for a nationwide deployment of 4G services. Rather, each mobile operator will need at least 4x20 MHz of spectrum bandwidth to meet the needs of customers and the market. It is critical that each operator is given sufficient spectrum to deploy nationwide 4G services, failing which the quality of 4G services will inevitably suffer.
- iii. Mobile operators will not be able to provide 4G services according to the proposed definition of 4G. The Authority should not adopt a strict definition of 4G technologies and services (which does not provide any meaningful purpose); and should not compel the mobile operators to only use the spectrum for 4G services. Rather, the mobile operators should be given the flexibility to implement and offer the appropriate services and technologies, across the spectrum they have been allocated, in response to customer needs and market demand. In particular, StarHub has deployed 2G services on its existing 1800

MHz band, and should be allowed to continue to provide these services in this band beyond 2017.

- iv. The dates proposed by the Authority for nationwide 4G coverage are unrealistic. These dates fail to take into account the practical challenges and constraints that mobile operators face. The mobile operators would need a significantly longer period than the Authority has proposed to deploy nationwide 4G services.
- v. The Authority has overlooked the costs (to mobile operators, the industry and customers) that would be created by a spectrum auction. This problem is worsened as the Authority is proposing to artificially restrict the supply of spectrum that could be used for 4G services. We submit that the Authority should first assess whether the overall demand for spectrum would indeed outstrip supply for the deployment of LTE. If sufficient spectrum is available to meet demand, then the Authority and the existing mobile operators could take a collegial approach towards the allocation of the spectrum that will best meet the interest of the industry and consumers. If an auction is necessary, the choice of the spectrum reallocation method should seek to minimise the cost of spectrum. In particular, the Authority must allow mobile operators to have the first-right-of-refusal on their existing spectrum already in use. This approach would avoid the massive and costly migration, and the disruption of services to customers, that a migration to new bands would generate. StarHub does not believe that there is any merit in requiring the industry to undertake such migration simply as the result of the spectrum reallocation exercise.

StarHub provides its specific comments to the consultation in the following section.

2. Specific Responses

Part II: Available Spectrum

Question 1

IDA seeks views on the proposed allocation of the 1800 MHz, 2.3 GHz and 2.5 GHz spectrum bands.

In its consultation, the Authority has proposed making the 1800 MHz, 2.3 GHz and 2.5 GHz spectrum bands available in the upcoming spectrum reallocation exercise for 4G. The Authority has excluded the 700 MHz band and the 900 MHz band from this exercise.

700MHz band for 4G

StarHub is very concerned with the exclusion of the 700 MHz band from the spectrum reallocation exercise. StarHub understands that the majority of the 4G end-user devices are now based on the 700 MHz band. The 700 MHz band is an essential band for mobile operators to deploy 4G telecommunication services cost-effectively and efficiently, achieving the desired quality of service standards and data throughputs¹. Therefore, it is very important for the 700 MHz band to be made available for 4G. By way of comparison, countries such as India have already announced that the 700MHz band will be used for 4G services.

While StarHub notes that the regional co-ordination on the re-farming and use of the 700 MHz band is still ongoing, we believe that it is necessary for the Authority to provide greater certainty on the availability of spectrum in the 700 MHz band, including the likely amount of spectrum to be made available and the timeline within which that spectrum would be made available. This will facilitate the mobile operators' planning for the deployment of 4G telecommunication services. If the 700 MHz band is not included (or at least clarified) in the spectrum reallocation exercise, that will create significant uncertainty for the mobile operators as to what spectrum will be available – and when – for 4G services.

900 MHz band for 4G

StarHub is also very concerned with the exclusion of the 900 MHz band from the spectrum reallocation exercise. StarHub would note that, as with the 1800 MHz band, the 900 MHz spectrum rights expire in March 2017. While 4G deployments in the 900 MHz band may be less common now, given the absence of the 700 MHz band and potential technology developments in the future, we submit that the 900 MHz band should be included in the spectrum reallocation exercise. With all the potential 4G

¹ For example, the number of 4G base stations required for the 700 MHz band would be at least 4 times lesser than those required for the 2.5 GHz band.

spectrum bands available for reallocation, the mobile operators would be in a better position to plan their future spectrum needs and deployment of various mobile services.

In addition, unlike other mobile operators, StarHub still provides its 2G services via the 1800 MHz band. For historical reasons, the 900 MHz spectrum that StarHub holds is very limited. In making the 1800 MHz band subject to the spectrum reallocation exercise, but not including the 900 MHz band in that exercise, StarHub will be placed at a major commercial disadvantage. The reallocation exercise would create significant uncertainty for StarHub in regard to its ongoing ability to provide 2G services to its customers. Should the 2G services remain relevant after the expiry of the spectrum right, and StarHub no longer has the necessary 1800 MHz band for the provision of 2G services, StarHub would be forced to undertake massive and costly migration to alternative spectrum band in order to continue the provision of 2G services. It is critical that the Authority ensures a level playing field in the spectrum reallocation exercise.

Given the above concerns, StarHub submits that the Authority should either:

- i. Include the 900 MHz band in the upcoming spectrum reallocation exercise. This would ensure a level-playing field between the operators in the exercise. The operators could then decide which spectrum to bid on; or
- ii. If the Authority excludes the 900 MHz band from the spectrum reallocation exercise, it should similarly exclude a certain amount of 1800 MHz from the reallocation exercise for StarHub's 2G services. This is to ensure that StarHub will not be placed at a major commercial disadvantage as a result of the Authority's spectrum reallocation exercise.

Question 2

IDA seeks views on the amount of spectrum to be made available for allocation in the 1800 MHz, 2.3 GHz and 2.5 GHz bands.

StarHub does not agree with the Authority's proposal on the amount of spectrum to be made available for 4G services. StarHub does not agree with the suggestion that mobile operators would only need 2x20 MHz (if FDD technology is used) or 20-30 MHz (if TDD technology is used) of spectrum for the nationwide deployment of 4G services.

With the launch of LTE, we expect that more mobile users will be encouraged to use video-streaming and other data-intensive applications. As observed by the Authority and other industry analysts, mobile operators are already experiencing rapid growth in mobile data usage. Mobile operators who have launched LTE have observed that the volume of mobile data usage generated by customers is similar to that generated by fixed-line broadband customers.

StarHub understands that the current LTE technology could support up to 2x20 MHz of bandwidth, but it constrains the maximum downlink data throughput to 300 Mbps using 4x4 Multiple-Input and Multiple-Output (“MIMO”) technology. To meet the anticipated growth in mobile data usage, mobile operators in Singapore would be looking at LTE Advanced (defined in 3GPP Release 10) technology, which can support beyond the 2x20 MHz of bandwidth through Carrier Aggregation. Carrier Aggregation of several LTE bands up to a total of 2x100 MHz bandwidth is required in order to support higher data throughput performance of up to 1 Gbps.

It is also imperative that the Authority recognizes the actual operating conditions on the ground, and the actual challenges that mobile operators face in deploying and providing mobile services. The actual challenges on the ground (such as difficulties acquiring the “perfect” base station locations) will mean that more spectrum is needed than performance tests in laboratory conditions would suggest.

Further, it is unclear what Quality of Service (“QoS”) standards the Authority is looking to set for the provision of 4G services. Depending on the QoS standard the Authority sets, this could impact on the amount of spectrum the mobile operators need to meet that standard.

Given the anticipated growth in mobile data, and the operating conditions and challenges that mobile operators face in actual deployment, StarHub submits that an allocation of 2x20 MHz of spectrum for the nationwide deployment of 4G services would be unrealistic and insufficient. StarHub submits that each mobile operator will need at least 4x20 MHz of spectrum to meet market and customer needs.

StarHub notes that the Authority is proposing to reserve a significant amount of spectrum. We submit that there is no need to keep the 20 MHz unpaired spectrum in the 2.3 GHz and 2.5 GHz band. In addition, it is unclear why 50 MHz of spectrum in the 2.3 GHz band is unavailable for assignment.

StarHub would respectfully submit that the Authority should re-evaluate the amount of spectrum that the industry will realistically require. StarHub would strongly argue against artificially restricting the supply of 4G spectrum (for example, by reserving spectrum for potential new entrants), as this would drive up the cost of spectrum and deploying 4G services. It is critical that each mobile operator is given sufficient spectrum to deploy nationwide 4G services, failing which customers will suffer, as the quality of the 4G services will be degraded. We also submit that it is important for the Authority to provide greater clarity as to the expected QoS standards it will require for 4G services, as this will also impact on the mobile operators’ spectrum requirements.

We would therefore urge the Authority to make available all potential frequency bands in the upcoming spectrum reallocation exercise. By doing so, all interested parties can carry out a well-informed and proper analysis and planning for their deployment of 4G services, and bid for the necessary spectrum. This approach would also avoid a situation

in which the Authority's decision to reserve some spectrum leads to operators with fragmented and/or insufficient spectrum, thereby undermining the efficient provision of 4G services.

Question 3

IDA seeks views on the benefits of an earlier start date for the full-band sharing arrangement, and what an appropriate start date might be.

While StarHub agrees that an earlier implementation of full band-sharing arrangements could benefit the Singapore operators, it is critically important for the Authority and its overseas counterparts to ensure that all parties abide by those arrangements. If the band-sharing arrangements are not agreed and enforced on a Government-to-Government basis, mobile operators providing 4G services in the 2.5 GHz band will face significant interference and service problems. StarHub already experiences on-going interference into its mobile services from neighbouring countries, and co-ordination between operators has been challenging.

Question 4

IDA seeks views on the proposed block size per spectrum lot, the number of spectrum lots, and the arrangement of the spectrum lots to be made available for reallocation.

StarHub would propose that the spectrum lot size for FDD should be 2x10 MHz, rather than 2x5 MHz. Increasing the size of the lot is needed to ensure that the mobile operators can achieve an acceptable level of performance for 4G services. The spectrum block assigned to each operator should preferably be continuous, so as to facilitate the efficient use of spectrum and cost-effective deployment of 4G services (particularly for in-building areas and MRT/road tunnels).

Question 5

IDA seeks views on its proposal for operators to co-ordinate the use of different services and not to set aside guard bands at the frequency boundaries between FDD and TDD technologies in the 2.5 GHz band.

StarHub has assessed this matter and would note that (based on the 3GPP recommendation) a minimum guard band of 10 MHz is required between FDD and TDD band. Within the TDD band, a minimum guard band of 2.5 MHz is required.

To facilitate efficient use of spectrum, StarHub would therefore propose that the Authority establishes spectrum lots 15 and 16 (2570 – 2580 MHz), and spectrum lots 23 and 24 (2610 – 2620 MHz), as the guard band between FDD and TDD in the 2.5 GHz band.

Part III: Allowable Users for the Spectrum

Question 6

IDA seeks views on its proposed definition of 4G technologies and the proposal to assess on a case-by-case basis alternative technologies to be deployed in the 4G spectrum bands.

StarHub would caution that the proposed definition does not take into consideration the practical constraints and realities in deploying 4G services. The defined targeted peak data rates would be extremely difficult to achieve in reality due to various factors affecting the performance of the 4G services. Based on the Authority's suggestion that each mobile operator will only require 2x20 MHz for the nationwide deployment of 4G services, the mobile operators would not be able to achieve the targeted peak data rates set out in the Authority's definition. Mobile operators who have insufficient spectrum also may not be able to achieve the QoS standards that may be set by the Authority.

It is also important to recognize that 4G services should not be seen as fundamentally different from 3G services. Rather, 4G is a natural evolution from the 3G/WCDMA and HSPA technologies, allowing greater performance in mobile broadband throughputs. Mobile operators who deploy LTE networks should therefore be free to continue to provide existing 2G services within the 1800 MHz band.

With 4G still evolving, StarHub believes that the Authority should not adopt a strict definition of 4G technologies and services. The mobile operators already have the incentives to adopt new technologies and infrastructure, in line with market and customer demand. The operators should therefore be given the flexibility to plan and implement the appropriate technologies and network capacity across different assigned spectrum. This is already the case for mobile operators deploying newer technologies and services in the 900 MHz and 1800 MHz PCMTS bands which were originally assigned for 2G services.

Part IV: Key Proposed Spectrum Right Conditions

Question 7

IDA seeks views on its proposal that successful bidders of 4G spectrum should meet nationwide 4G systems and service coverage requirements by the dates specified.

StarHub would respectfully submit that dates imposed by the Authority for nationwide 4G coverage are highly unrealistic. It is also unclear if nationwide 4G coverage would include in-building coverage. Furthermore, the Authority has not provided clarity on the QoS standards for 4G services, which will have a direct impact on mobile operators' spectrum requirements.

There are practical challenges and constraints in deploying nationwide mobile services (such as access to buildings and obtaining approvals from building owners for mounting of equipment). StarHub has estimated that up to a 3-year timeframe could be needed to achieve nationwide rollout for outdoor coverage, given the challenges that the mobile operators are already facing. StarHub would also expect challenges (and further delays) when seeking to provide in-building coverage for 4G services.

StarHub would also respectfully submit that a 3-year timeframe to provide 4G coverage in all MRT / road tunnels is similarly unrealistic, and fails to take into consideration our past experience with MRT / road tunnels. The Authority will understand that it has taken nearly 3-years to upgrade the infrastructure in the North-South-East-West ("NSEW") MRT line to provide 3G services, as access to the MRT tunnels is strictly limited. In addition, there are already space constraints in many Telecom Equipment Rooms and in the MRT tunnels that will hamper the deployment of 4G services. We believe that it is necessary to engage LTA and SMRT/SBS Transit to discuss the requirements for 4G, in order to establish the timeline which all parties can support for 4G coverage in all MRT lines/road tunnels.

With regard to spectrum co-ordination during national events, StarHub acknowledges that there could be a situation where the Authority wants to temporarily reallocate the 4G spectrum allocated to spectrum rights holders. However, in carrying out such reallocations, the Authority would have to act to minimize the impact on the mobile operators. The Authority will note that during national or special events, the mobile operators will also face a surge in network traffic, and would require all of their spectrum allocations to meet that surge. In addition, the mobile operators are subject to the QoS obligations set by the Authority, and they should not be penalized if the Authority's reallocation results in a failure to meet those obligations.

Part V: Proposed Auction Formats

Question 8

IDA would like to seek the industry's views on the proposed auction parameters for the 4G spectrum rights.

StarHub notes that it has always been the Authority's belief that a market-based approach of allocating spectrum via auction is a fair and transparent way to value spectrum. However, allocating spectrum by way of a highest-bid auction would further increase the cost of supplying mobile services, and could hence undermine the adoption of 4G services. This problem is further aggravated by:

- (i) The Authority limiting the amount of spectrum that will be made available, creating an artificial shortage, and driving up the cost of spectrum; and
- (ii) The fact that existing spectrum right holders are not given the first-right-of-refusal for their existing spectrum reallocation.

The lack of a first-right-of-refusal mechanism will mean that the existing right-holders may have to undertake a massive and costly migration to operate in the newly-allocated bands. The problems associated with this migration are particularly acute for in-building areas, and MRT / road tunnels, as the infrastructure used in service delivery would have to be changed out, potentially resulting in disruptions to existing services. In addition, as operators are already deploying LTE services, there is likely to be substantial live LTE traffic by 2015. To implement the change in frequencies, operators would need to switch off their existing LTE networks to permit the re-configuration of their base stations and the re-optimisation of their networks. All of these changes would impact on services to customers. StarHub does not see any merit in requiring the industry to undertake such a migration exercise.

StarHub would submit that the Authority should first assess whether the demand for the spectrum would indeed outstrip supply. If the spectrum is available to meet the demand, then the Authority and the existing mobile operators could take a collegial approach towards the allocation of the spectrum that will best meet the interest of the industry and customers. If an auction is necessary, StarHub would strongly recommend that the choice of the spectrum reallocation method should seek to minimise the cost of spectrum, and to avoid unnecessary service disruptions to customers.

With regard to the auction parameters, StarHub would propose the following:

- i. *Duration of spectrum*: StarHub has no objection to a duration date of 30 June 2030. However, given the pace of technology advancements, the mobile operators should be given the flexibility to implement and offer the

appropriate services and technologies, across the spectrum they have been allocated, in response to customer needs and market demand. In particular, operators should be free to provide 2G services in the 1800 MHz band beyond 2017.

- ii. Auction format: StarHub would strongly urge the Authority to allow mobile operators to have the first-right-of-refusal over their existing spectrum allocations. This would avoid the need for a massive and costly migration to the newly-allocated bands (which would potentially disrupt services to customers). StarHub does not believe that there is any merit in requiring the industry to undertake such migration simply due to the result of the spectrum reallocation exercise.
- iii. Spectrum lots: StarHub would propose that the spectrum lots for FDD should be 2x10MHz instead of 2x5 MHz (as noted above).
- iv. Spectrum caps: The Authority has proposed spectrum caps of 2x45MHz of FDD spectrum to ensure that at least 3 operators will be able to obtain at least 2x20 MHz FDD spectrum (which the Authority believes is sufficient to provide nationwide 4G services on a nationwide basis). As noted above, StarHub is of the view that this allocation would be insufficient, and would not allow operators to achieve the expected data throughputs for 4G. StarHub submits that each operator will need at least 2x40 MHz to deploy and support the anticipated growth in mobile services. In addition, StarHub proposes that the Authority establishes sub-caps in each of the frequency band. This is to ensure that no single operator will obtain majority or the entire spectrum of a particular band.

Part VI: New Entrant in the Wireless Broadband Services Market

Question 9

IDA would like to solicit interest from potential new entrants in the market. In addition, IDA seeks views on the proposed spectrum set-aside and nationwide 4G systems and service coverage obligations for the new entrant.

Interested parties may submit their comments on the “new entrant” rules in a confidential annex if required.

IDA would also like to seek the industry’s views on whether the reserve price for the spectrum set aside for a new entrant should differ from the spectrum to be auctioned to non-new entrants.

StarHub is very concerned with the “preferential” approach proposed for the allocation of spectrum to new entrants. We submit that this allocation would be discriminatory, and fails to give due consideration to the implications on the overall industry. StarHub does not agree that a new entrant should enjoy a customized framework for the allocation of 4G spectrum and the rollout of 4G services. We would note that:

- Any new entrant would have to be a mobile operator with a credible financial position and operational experience in the industry.
- The challenges for a new entrant in deploying 4G services are not significantly different from those the existing mobile operators would face.

Therefore, StarHub can see no justification for giving a new entrant 4G spectrum at a lower cost or in a different manner to the existing operators. The Authority should not create a distorted playing field that favours a new entrant, and which penalizes existing mobile operators (who have invested heavily over the years on mobile infrastructure and services).

Part VIII: Cross border Co-ordination

Question 10

IDA invites views and comments on the adoption of the ECC/REC/(11)05 Recommendation for cross border coordination in the 2.5 GHz band in Singapore

StarHub has no objection to the Authority’s proposal to adopt ECC/REC/(11)05 Recommendation for cross border coordination in the 2.5 GHz band in Singapore. However, as noted above, it is important to establish a robust and effective mechanism to ensure that the coordination takes place, to minimize interference.

Question 11

IDA invites views and comments on the practical measures for the deployment of 4G base stations at the border areas for the harmonised co-existence with the BSS in Indonesia.

StarHub is of the view that the proposed measures (of limiting mobile operators’ emission power and down-tilting of the base stations) will further aggravate the existing problem of Singapore customers logging-on to overseas networks. The proposed measures would also create additional challenges for the mobile operators in achieving

their QoS obligations in border areas, and would create additional complaints from customers.

StarHub believes that the cause of this problem could be overseas operators: (i) failing to adhere to their power emission limits; or (ii) sitting their mobile base stations on top of towers and mountain tops, where the overspill of mobile signals into Singapore would be more significant. If additional spectrum was made available to the mobile operators in Singapore, this would help them to manage the interference from overseas operators.

Question 12

IDA invites views and comments on the possible practical measures that the operators would implement to allow coexistence of mobile services and radar services in the adjacent band.

IDA also invites views and comments on the required mitigation parameters indicated in the ECC Report 174 and the regulatory limit proposed by IDA for the co-existence between mobile services in 2.5 GHz with S-band radars.

StarHub has no objection to follow the mitigation parameters in the ECC Report 174 and to fine-tune such parameters when the need arise.

Part IX: Use of 900 MHz and 1800 MHz Spectrum Bands for 2G Systems and Services

Question 13

IDA would like to seek the industry's views on whether IDA should: (1) allow the 2G service providers to individually decide on when to shut down their 2G networks; or (2) intervene or assist to facilitate in any aspect of a possible winding down of 2G services in Singapore in order to manage the efficient use of spectrum. Such intervention could include the possibility of IDA centrally managing the 2G spectrum made available, e.g., by specifying spectrum, to be used by the 2G service providers on a shared basis for a shared 2G network.

While StarHub agrees that the number of users on the existing 2G networks is on a decline, we are of the view that mobile operators will still need to serve a significant number of customers on the existing 2G networks even after 2017. In addition, the number of inbound roamers who are using the existing 2G networks will also remain significant for a lengthy amount of time. It would be unreasonable and self-defeating to try and force these customers onto 3G / 4G services.

It is unclear what is meant by “centrally managing the 2G spectrum made available, e.g. by specifying spectrum to be used by 2G service providers on a shared basis for a shared 2G network”. If the Authority envisages the mobile operators sharing common 2G spectrum and establishing a new 2G network, it would be untenable to require mobile operators to further invest in sun-setting 2G services. Such a requirement could also place StarHub in an even more inequitable position, given that StarHub provides 2G services in the 1800 MHz band, while the other mobile operators provide 2G services via the 900 MHz band.

StarHub would therefore respectfully submit that the Authority should allow the mobile operators to individually decide when to shut down their existing 2G networks, according to their own market needs. It would be inappropriate for the Authority to intervene to dictate a shutdown, which could result in unnecessary disruptions and costs to mobile operators and customers.

3. Conclusion

While StarHub supports the Authority's efforts to make available spectrum for 4G services, we have some key concerns over the Authority's proposed approach. Those key concerns are as follows:

- i. The Authority has not included the 700 MHz and 900 MHz bands in the spectrum reallocation exercise. The 700 MHz band is extremely important to the future of 4G services in Singapore. We submit that the Authority should either: (a) make this band available for reallocation or (b) provide greater certainty on the availability of the 700 MHz band, including the likely amount of spectrum to be made available and timeline within which it will be made available (if the reallocation is not possible in the upcoming exercise). In regard to the 900 MHz band, by excluding this band from the spectrum reallocation exercise, StarHub will be placed at a major commercial disadvantage, as the failure to include the 900 MHz band in the spectrum reallocation exercise creates a significant uncertainty for StarHub as to the continuity of our 2G services. To ensure a level-playing field, we submit that the Authority should include the 900 MHz band in the spectrum reallocation exercise, so that mobile operators will be in a better position to plan their future spectrum needs and deployment of various mobile networks and services. Alternatively, the Authority should exclude a certain amount of 1800 MHz from the reallocation exercise for StarHub's 2G services, given the very limited 900 MHz spectrum available to StarHub.
- ii. The Authority should not artificially restrict the supply of spectrum (by reserving spectrum for potential new entrant or future demand), as this would drive up the cost of spectrum and the deployment of 4G services by existing operators. It is unrealistic to assume that 2x20 MHz of spectrum bandwidth is sufficient for a nationwide deployment of 4G services. Rather, each mobile operator will need at least 4x20 MHz of spectrum bandwidth to meet the needs of customers and the market. It is critical that each operator is given sufficient spectrum to deploy nationwide 4G services, failing which the quality of 4G services will inevitably suffer.
- iii. Mobile operators will not be able to provide 4G services according to the proposed definition of 4G. The Authority should not adopt a strict definition of 4G technologies and services (which does not provide any meaningful purpose); and should not compel the mobile operators to only use the spectrum for 4G services. Rather, the mobile operators should be given the flexibility to implement and offer the appropriate services and technologies, across the spectrum they have been allocated, in response to customer needs and market demand. In particular, StarHub has deployed 2G services on its existing 1800 MHz band, and should be allowed to continue to provide these services in this band beyond 2017.

- iv. The dates proposed by the Authority for nationwide 4G coverage are unrealistic. These dates fail to take into account the practical challenges and constraints that mobile operators face. Mobile operators would need significantly longer period than the Authority has proposed to deploy nationwide 4G services.

- v. The Authority has overlooked the costs (to mobile operators, the industry and customers) that would be created through a spectrum auction. This problem is worsened as the Authority is proposing to artificially restrict the supply of spectrum that could be used for 4G services. We submit that the Authority should first assess whether the overall demand for spectrum would indeed outstrip supply for the deployment of LTE. If sufficient spectrum is available to meet demand, then the Authority and the existing mobile operators could take a collegial approach towards the allocation of the spectrum that will best meet the interest of the industry and consumers. If an auction is necessary, the choice of the spectrum reallocation method should seek to minimise the cost of spectrum. In particular, the Authority must allow mobile operators to have the first-right-of-refusal on their existing spectrum already in use. This approach would avoid the massive and costly migration, and the disruption of services to customers, that a migration to new bands would generate. StarHub does not believe that there is any merit in requiring the industry to undertake such migration simply as the result of the spectrum reallocation exercise.

StarHub is grateful for the opportunity to comment on this matter. We would also welcome the opportunity to discuss the spectrum framework for 4G mobile communication systems in Singapore with the Authority in greater detail.

StarHub Mobile Pte Ltd
8 June 2012