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19 June 2019

Dear Ms Chia,

Re: IMDA's second consultation on 5G mobile services and networks

The GSMA would like to thank the IMDA for the opportunity to submit its feedback and comments related to the above consultation.

Please do not hesitate to contact us if you have any questions regarding this submission or any other matter in which we might be of help to the IMDA.

Yours sincerely,

A blue ink handwritten signature, appearing to be "JG", with a long horizontal stroke extending to the right.

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Summary

The GSMA commends the IMDA's proposal with respect to

- Making C-band available in Singapore as this is a core band for 5G in the APAC Region. We believe that IMDA should aim to make available 80-100 MHz of contiguous spectrum per operator.
- Not charging a premium for mmWave spectrum, which is consistent with assignment practices in other jurisdictions.

GSMA's major points for concern with the proposal, amongst other views provided in the main body of the submission, include

- The high reserve price for 3.5 GHz, which is one of the highest amongst international prices so far. This is particularly of concern considering the imposed rollout obligations. The GSMA is of the opinion that the combination of both, coverage obligations and high spectrum prices may significantly skew the investment potential for the first wave of 5G implementation in Singapore.
- The specification of 5G SA network deployment. GSMA is of the view that operators are better placed to make investment and technical decisions for using their assigned spectrum for either SA or NSA equipment, depending on the specific requirements likely to emerge in the field. We recommend that IMDA should avoid imposing technology specific conditions.
- The amount of guard band required between IMT and the fixed-satellite services. The GSMA is of the opinion, based on studies from the ITU and existing technical measures from various jurisdictions, that the amount proposed by IMDA is too conservative.



Statement of Interest

The GSMA represents the interests of mobile operators worldwide, uniting nearly 750 operators with more than 350 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and internet companies, as well as organisations in adjacent industry sectors.

The GSMA engages with policymakers and regulators to advance policy discourse, contribute market research and analysis, and convey the perspectives of the mobile industry across the wide range of issues that surround the digital economy and society.

The GSMA's purpose as the mobile industry is to Intelligently Connect everyone and everything to a better future and 5G is the next major step in delivering on this goal. 5G, building upon and working together with 4G, provides the ability to connect people and things faster and more efficiently as part of a 5G era. Our mission is to ensure that mobile operators have timely and affordable access to appropriate spectrum to meet the rapidly growing demand for mobile broadband services and the GSMA has [published key 5G spectrum positions](#) which focus on the areas where governments, regulators and the mobile industry must cooperate to make 5G a success



GSMA's comments to IMDA's second consultation on 5G mobile services and networks

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

From virtual reality and autonomous cars, to industrial automation, ultra-fast broadband and smart cities, 5G will be at the heart of the future of communications. Today's most popular mobile applications, including on-demand video, also stand to benefit from 5G by ensuring continued growth and quality.

For an innovation-friendly country like Singapore, 5G represents an excellent opportunity to build on its economic, social, and environmental priorities. For example, the licensing of mmWave 5G spectrum for mobile networks is an opportunity to offer performance levels that have not been possible before. This is something only the mobile ecosystem can offer. Use cases that will benefit the most include:

- Industrial automation

Large-scale industrial automation relies on mmWaves. That is because next-generation manufacturing will produce large amounts of data; low-latency communication is also crucial.

- Remote object manipulation

Low latency and data rate requirements mean mmWave connectivity is expected to play an important role for remote object manipulation, such as advanced healthcare applications.

- Virtual and augmented reality

Thanks to low latency and peak data rate requirements, mmWaves will benefit virtual and augmented reality. For example, educational applications are likely to produce high volumes of data that will rely on mmWave 5G.

- Next-generation transport connectivity

High data volumes and high-density real-time communications require a combination of mmWave and lower bands to enhance services, especially in cities with dense traffic.



- Massive IoT

Ultra-high speeds and low latencies by using 5G is making headline news, however 5G's ability to offer connectivity on a massive scale is also a potential game changer. This is true for next-generation smart cities, logistics as well as metering.

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

After a lot of preparation, the first commercial services are already showing the promise of 5G. However, not all networks are created equally. The success of the services will be heavily reliant on national governments and regulators. Most notably, the speed, reach and quality of 5G services will be dependent on governments and regulators supporting timely access to the right amount and type of spectrum, and under the right conditions.

Regulators should aim to make available 80-100 MHz of contiguous spectrum per operator in prime 5G mid-bands (e.g. 3.5 GHz) and around 1 GHz per operator in mmWave bands (i.e. above 24 GHz).

To make the most of 5G, the mobile industry needs Singapore's support at WRC-19. A successful identification of spectrum for IMT under Agenda Item 1.13 is vital. The Item seeks to identify new mmWave spectrum above 24 GHz for IMT. Certain bands, such as 26 GHz and the 40 GHz range, already have strong multiregional support while other bands, including 66-71 GHz, also have significant traction. The identifications also need the optimal technical conditions applied; IMT use of the bands will be severely restricted.

Best practice for licensing 5G spectrum is very much the same as for previous generations. For example, national spectrum policy measures to encourage long-term heavy investments in 5G networks (e.g. long-term licences, clear renewal process, spectrum roadmap etc.) are required. In addition, inflated 5G spectrum prices (e.g. through excessive reserve prices or annual fees) should be avoided as they too risk limiting network investment and driving up the cost of services.

The GSMA has a wealth of information that delves deeper into best practice for spectrum licensing, including pricing and auction best practice. It can all be found here:

https://www.gsma.com/spectrum/spectrum_resources/



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.*

C-band is already emerging as a core band for 5G. It has the technical characteristics that will make it useful in delivering higher-speed services. It is especially useful for 5G deployment because the band has the potential to provide a large amount of contiguous spectrum that will support channels with wide bandwidth.

Coexistence with FSS:

Adjacent band compatibility between IMT and the fixed-satellite service (FSS) is a national issue and each Administration must decide how best to address it in their country. It has been thoroughly studied by the ITU and Administrations can make use of their studies when deciding the appropriate sharing criteria to adopt in terms of what guard band and power limitations, among other options. The ITU studies can be found in Report ITU-R S.2368. IMT and FSS may meet at different parts of the range, be it 3.4 GHz, 3.6 GHz, 3.7 GHz or 3.8 GHz, depending on regional and national identifications as well as national regulations.

Looking at existing technical measures from various jurisdictions the guard band with TVRO proposed by Anatel is 25MHz¹ in Brazil, while Taiwan NCC has proposed a 40 MHz guard band and 150m exclusion zone to protect FSS terminals².

Coexistence with radiolocation services:

Radiolocation services (e.g. radar) operating in the 3.3-3.4 GHz portion of the band are protected by the ITU Radio Regulations. Administrations wishing to implement IMT in 3.3-3.4 GHz must comply with limits and provisions set in footnotes 5.429B, 5.429D and 5.429F.

France and UK have implemented a 10MHz guard band and start the mobile license from 3410MHz. South Korea licensed from 3420MHz and upward to mobile operators, whereas Germany for example have decided to license for national mobile use from 3400MHz³.

¹ Coexistence conditions of LTE-advanced at 3400–3600 MHz with TVRO at 3625–4200 MHz in Brazil

² https://www.ncc.gov.tw/chinese/files/19011/4007_40876_190110_1.pdf

³

https://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/Areas/Telecommunications/Companies/TelecomRegulation/FrequencyManagement/ElectronicCommunicationsServices/FrequencyAward2018/20180613_Decision_I_II.pdf?__blob=publicationFile&v=2



Sufficient amount:

GSMA believes, in line with the mobile equipment manufacturers and the ITU, that regulators should aim to make available 80-100 MHz of contiguous spectrum per operator. Unnecessary restrictions, such as indoor usage, or large guard band, will only create harmful artificial scarcity.

Building on other markets' experience mentioned above, the GSMA submits that the 100MHz "restricted" usage on 3400-3500MHz, and 100MHz guard band on 3600-3700MHz is wasteful, and would urge IMDA to consider licensing 3400-3700MHz (300MHz) without indoor restriction. If deemed necessary, a guard band of up to 10 MHz (3400-3410 MHz) for radio-location services and up to 25 MHz (3675-3700 MHz) for FSS could be implemented.

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

The initial 5G phase timeline is sound, and we applaud IMDA will release 26 GHz and 28 GHz. We would encourage IMDA to release C-band ahead of mmWave, as the ecosystem on C-band is likely to develop sooner, and coverage will be better, making it easier for fast deployment of 5G throughout the jurisdiction. Supplementing C-band deployment with mmWave in hotspot areas is a logical step for most operators. Network optimisation is more straight forward with C-band being released ahead of mmWave.

The GSMA also recommends IMDA to continuing progressing with cross border negotiations with neighbouring countries on ASO and 700 MHz use. The 700 MHz spectrum band was auctioned in 2017, and since has become one of the widest LTE ecosystem. The ability to use it as soon as possible for 4G and eventually for 5G is critical for operators to assure wide area, and indoor coverage. We note there is emerging ecosystem that allows for carrier aggregation between mid/high-range spectrum and low band 700 MHz NR – this arrangement can extend coverage of NR on nationwide basis.

For other spectrum bands already licensed and currently in use, GSMA recommends IMDA to allow all licensed spectrum to be technology neutral, so that operators can migrate to 5G when the ecosystem and consumer market is ready.



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 refarmed to 3GPP Band 41 for future 5G services in Singapore, and the views on the associated cost and challenges.

GSMA notes there is currently extensive usage of the 2.5 GHz band for LTE. We believe operators have invested heavily to both acquire this spectrum and deploy the network. Refarming this band for 5G in the short to medium term would destroy the value and also requires enormous additional investment. Moreover, 5G NR will also include band n7, which would be an easier migration path to the existing FDD deployment.

We recommend IMDA to concentrate on bringing into use new bands such as C-band, 700 MHz and 26/28 GHz first before considering refarming this particular band.

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;

GSMA notes that in the proposal, 200 MHz are being made available for IMT use (3.4 - 3.6 GHz). From this 200 MHz, 100 MHz are for unrestricted use and the other 100 MHz for restricted indoor use. From the sole point of view of optimum spectrum blocks for IMT-2020 performance, 100 MHz per operator is recommended in the 3.5 GHz band. The question on the number of networks that should commence rolling out IMT-2020 in this limited amount of spectrum depends on the desired coverage, performance objectives and market considerations. GSMA is of the view that the aforementioned considerations (response to question 3) are important and additional spectrum, without restrictions, needs to be made available to allow multiple operators to deploy 5G services in the 3.5 GHz band.

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

As mentioned in our response to question 3, and based on experiences from other jurisdictions, a guard band of up to 10 MHz (3400-3410 MHz) for radio-location services and up to 25 MHz (3675-3700 MHz) for FSS could be implemented, if deemed necessary. This will allow a much wider spectrum band with unrestricted use, and will satisfy the recommendation of 80-100MHz of contiguous spectrum per operator in the mid-band.

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

Mobile equipment vendors are best positioned to comment on this question in more detail.



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;

In GSMA's view, all available spectrum should be released to operators, letting the operators assess the practicality and value of accessing spectrum with some form of mitigation measure. GSMA notes that IMDA could get more value from the released spectrum if a) restrictions are lifted and smaller guard bands applied or, b) if restrictions are attached in the relevant spectrum portions, these should be subject to a process of ongoing review, driven by the spectrum users. Such ongoing review would allow operators to explore, test and negotiate alternatives for maximum efficiency of use.

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

The lot sizes are in accordance with the growing ecosystem. Option B seems a favourable option (for use of wide spectrum blocks as much as possible), noting that for maximum efficiency of use, IMDA should assign the bottom block following the least restrictive Out of Band Emission limits.

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

As in our response to question 4, we would encourage IMDA to release C-band ahead of mmWave, as the ecosystem on C-band is likely to be larger, and coverage would be better, making it easier for fast deployment of 5G throughout the jurisdiction.

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;

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

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

The GSMA supports the assessment of IMDA that operators will have to deploy denser networks that are closer to the end-users (e.g., on street side furniture) and that the plan



should allow for expansion when new spectrum bands come on board. **A phased approach is therefore best suited.**

The proposal to request spectrum right holders shall deploy 5G SA networks with greater than 50% coverage within 24 months from the commencement of the 3.5 GHz spectrum right should take into consideration the time needed for planning permission approvals, as new sites are expected, and also the time required for the selection of synchronisation between the two blocks.

GSMA supports the IMDA proposals not to impose Quality of Service (“QoS”) requirements on the nationwide networks taking into account the block sizes and their restrictions. Introduction of such obligation later on should be done in discussion with the operators, once the impact of these restrictions has been measured on the deployed networks.

We recommended not considering such obligation until the additional 5G spectrum in the range 1-6 GHz is made available. Again, a block size of 80-100 MHz of contiguous spectrum per operator is the basis for the performance defined in the standards.

Question 7: *IMDA would like to seek views, comments and suggestions on the spectrum assignment framework, including:*
i) The proposed assignment approach;

On the specific spectrum assignment mechanism, operators are best placed to comment. Concerning the provision of millimetre wave spectrum as a package with 3.5 GHz, our view is that such an approach is reasonable, as long as the price and license conditions are sound.

On the approach of not charging a premium for mmWave spectrum, GSMA commends IMDA for proposing this approach, which takes into account supply-demand considerations. This is consistent with assignment practices implemented in other jurisdictions.

On the reserve price for 3.5 GHz, GSMA notes that Singapore’s price proposal is the highest amongst international prices so far. We provide the relevant comparisons in Annex 1. This aspect of the proposed assignment is of concern, especially considering that rollout obligations are being imposed (i.e. deployments greater than 50% coverage in the first 24 months). This can significantly reduce long-term economic benefit, affect



consumer uptake, impact on rollout investment plans and potentially make the rollout obligations unachievable (or at least highly burdensome for the sector)

The combination of both coverage obligations and high spectrum prices can significantly skew the investment potential for the first wave of 5G implementation in Singapore. We recommend that IMDA revise its proposed reserve price, reflecting the fact that operators will require heavy investment to achieve the rollout conditions being imposed.

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

The GSMA is of the view that the longer the duration of a licence, the greater the certainty provided for operators to undertake long-term investments in rolling out networks and in deploying new services. Investors would be reluctant to undertake investments if the licence runs for a shorter period than the expected payback period and if there is uncertainty over whether the licence will be renewed again in the future. On the basis of the expected payback period for substantial new network investment a **minimum term of 20 years** for new mobile licences would be better suited. Such a term will help support the required investments in 5G network densification.

Perpetual spectrum licences, with a minimum notice period for revocation, or a presumption of renewal can avoid uncertainty over renewal, as the result of a fixed term licence period. Longer licence terms both support and are supported by a move towards a more market-based approach to spectrum management. Longer licence terms provide the certainty for operators to take advantage of increased flexibility to introduce new technologies and be more willing to trade spectrum. The risk of long licence terms locking spectrum into outdated, inefficient use is also greatly reduced when licensees are allowed to change the use of spectrum or sell to another party that can make better use of it. The proposal of **12-15 years licence duration could be revised and clarification on the expectancy of renewal clarified** at the same time, as both elements are important for ensuring clarity of security of tenure for the sake of long-term investment.

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

On point (a) of “evaluation criteria”, IMDA suggests coverage greater than 50% within 24 months for 3.5 GHz and within 12 months for mmWave; using 5G SA only networks.

GSMA notes the value of encouraging a framework that fully supports technology neutral licensing and flexibility for network deployment. GSMA is of the view that operators are



better placed to make investment and technical decisions for using their assigned spectrum for either SA or NSA equipment, depending on the specific requirements likely to emerge in the field. IMDA should avoid imposing technology specific conditions.

We note that rules for “right of access” to sites held by privates, as well as public infrastructure will have associated costs and specific technical requirements applicable to 5G infrastructure, which will affect the ability of operators to deploy 5G within the imposed timelines across all radio sites. GSMA notes that IMDA may need to review and update its Code of Practice for Info-Communication Facilities in Buildings (COPIF”), to align it with the emerging requirements of 5G rollouts.

It is likely that the combination of obligations on 5G SA only and tight deployment timeframes may pose undue constraints on operators. Therefore, having the flexibility to deploy both NSA and SA depending on the characteristics of the radio site, its location, density of population/ facilities being covered at the location and specific requirements being imposed on a site-by-site basis by site managers will be critical for a successful rollout.

For these reasons, GSMA is of the view that imposing a 5G SA only condition as part of the spectrum award is likely to represent a rollout handicap for operators. We encourage IMDA to consider the cost-benefits of imposing such licence condition, and recommend issuing full technology neutral licences.

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

Spectrum is a scarce resource that underpins wireless services which deliver profound socioeconomic benefits. Therefore, policymakers should aim to base mobile spectrum prices at a level that no alternative user would be willing to acquire the rights at that price (i.e. opportunity cost pricing).

Recovery of fair value of this public good is an acceptable aim, as long as revenue-raising is not so excessive that consumers of mobile services, and the wider digital economy, suffer. The primary goal in all spectrum awards should be to encourage efficient spectrum use while recognising the significant investment necessary to provide high quality mobile services.

High spectrum prices are associated with more expensive, lower quality mobile broadband services with worse coverage, as well as irrecoverable losses in consumer welfare worth billions of dollars worldwide. A common policy misstep when designing awards is setting



excessively high reserve prices or annual fees rather than letting the market determine a fair price. Others include creating uncertainty by failing to publish a spectrum roadmap or artificially limiting the supply of spectrum, and auction design decisions which increase risks, such as first price rules, overly-large lot sizes and approaches that do not allow for reasonable price discovery.

IMDA is invited to consider during its benchmarking of the base price that each operator would need 80-100MHz of contiguous spectrum and, in this case, blocks of smaller sizes are being made available and some blocks have restrictions. This has a direct impact on the value of the spectrum asset being awarded.

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

Mobile operators are better placed to comment on this aspect.

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.*

Mobile operators often have voluntary infrastructure sharing arrangements to help lower the cost of extending and densifying their networks. Regulators can enable faster speeds for consumers through wider channels sizes and/or improved carrier aggregation by permitting voluntary spectrum sharing.

The various levels of infrastructure sharing should be permitted on a voluntary basis.

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



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.

This issue of synchronisation is extremely important. As mentioned by IMDA, interference can be mitigated through the specification of Block Edge Mask. However, meeting the BEM may be challenging and the use of guard band and additional filters could be required, making this solution not commercially viable and spectrally not possible; taking into account the block size (especially of 50MHz). We agree with IMDA that synchronisation should therefore be the preferred option.

The selection of the synchronisation parameters should be done taking into account the operator's views. It is therefore suggested that a working group/task force is setup with operators, mobile industry players and the government to recommend the details of the synchronisation parameters which are best suited for the need of the industrial and public applications that operators will address. This agreement can then be documented (code of conduct, regulation, etc.) and reviewed at agreed dates to discuss any necessary updates. This should apply to all TDD bands. While the millimetre-wave bands are statistically less susceptible to interference, due to the more restricted amount of spectrum available at 3.5GHz, millimetre-wave bands play a much bigger role in achieving the capacity requirements, and therefore synchronisation may be required.

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.

The proposed relaxation of the spectrum regulation for the use of spectrum by FWA services is welcomed. Specific use cases may be better addressed via FWA.



Annex 1



