7th July, 2019

Aileen Chia (Ms)
Director-General (Telecoms & Post),
Assistant Chief Executive (Connectivity & Competition Development)
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Dear Ms. Chia

Motorola Solutions thanks IMDA for the opportunity to present our views on the SECOND CONSULTATION ON 5G MOBILE SERVICES AND NETWORKS.

5G technology is expected to facilitate the digital economy and support the next generation of enterprise and industrial users to spur the success of Singapore's advanced manufacturing avatar "Industry 4.0" This next generation of broadband wireless technology will be key to Singapore's next phase of mega growth in manufacturing, smart grid, health, transportation systems, including drone applications. To support this new technology, new regulatory options would need to be adopted beyond what can be addressed in today's regulatory environment. 5G calls for a new regulatory environment where innovation can thrive.

Given Singapore's focus on enabling innovation, industrial development, trade and enterprise, the primary use case of 5G in Singapore will be based on industries and enterprises. To support this new phase of economic development, industry players are tailoring their 5G solutions to meet this new and growing needs of industrial and other verticals. In order to support these solutions, we recommend that IMDA encourage third-party industrial and enterprise users to build their own captive and dedicated 5G networks. This ensures the provision of diverse 5G services, instead of restricting usage to existing mobile operators.

With the advent of 5G technologies, and evolution towards supporting advanced capabilities such as uRLLC and mMTC, enterprises will have the option to have full control of reliable, secure and seamless high speed data and high-fidelity voice communications across their entire operation, over private broadband.

The regulatory practice so far with respect to radio spectrum identified for IMT is to designate such spectrum exclusively for public networks. However, we believe IMT

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technologies and spectrum should be equally available to meet the spectrum needs of dedicated private broadband LTE networks. It is worth noting that Private LTE concept has been well accepted and is getting a lot of traction globally.

Our response to the consultation paper is enclosed. Please do not hesitate to contact the undersigned should you require additional information or clarification.

Yours sincerely,

Bharat Bhatia
Head of International Spectrum & Regulatory, Motorola Solutions
President, ITU-APT Foundation of India
Chair, APT Task Group on Public safety and Disaster Relief (PPDR)
Chair, ITU Study Group WP5D SWG on PPDR
President ITU-APT Foundation of India[1]

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Summary of Major Points

1. 5G technology is expected to facilitate the digital economy and support the next generation of enterprise and industrial users to spur the success of Singapore's advanced manufacturing avatar "Industry 4.0" This next generation of broadband wireless technology will be key to Singapore's next phase of mega growth in manufacturing, trading and services industries.
2. To support this new technology, new regulatory option- beyond what can be addressed in today's regulatory environment – are essential.
3. 5G calls for a new regulatory environment where innovation can thrive. Given Singapore's focus on enabling innovation, industrial development, trade and enterprise, the primary use case of 5G in Singapore will be based on industries and enterprises.
4. Industry players are tailoring their 5G solutions to meet these new and growing needs of industrial and other verticals. In order to support these solutions, we recommend that IMDA encourage third-party industrial and enterprise users to build their own captive and dedicated 5G networks. This ensures the provision of diverse 5G services, instead of restricting usage to existing mobile operators.
5. The evolution towards advanced capabilities such as uRLLC and mMTC in 5G, enterprises will have the option to have full control of reliable, secure and seamless high speed data and high-fidelity voice communications across their entire operation, over private broadband.
6. The regulatory practice so far with respect to radio spectrum identified for IMT is to designate such spectrum exclusively for public networks. However, we believe that 5G technologies and spectrum should be equally available to meet the spectrum needs of dedicated private broadband LTE networks. It is worth noting that Private LTE concept has been well accepted and is getting a lot of traction globally.
7. While network slicing technology using operator networks can meet some of the industrial needs, there will remain a need for small, localised, independent, private broadband networks for specialised users including critical infrastructure, industrial, utilities and enterprises.
8. The adoption of technology neutral rules and inclusive licensing will enable all parts of the 5G ecosystem to be supported (including satellite systems, mobile broadband systems).
9. We propose a review of the current rules, into the possibility of assigning frequencies based on the administrative allocation approach, for vertical use under local/private broadband Professional Mobile Radio (PMR) regulations rules similar to those available in the 800 MHz for narrow band PMR.

10. We encourage IMDA to designate some spectrum in the band 3400-3600 MHz for localised private broadband network licensing, for small geographic areas
11. To benefit from economies of scale we recommend that IMDA consider harmonising some technical parameters for private broadband network with those used by the FCC for the Citizens Broadband Radio Service.
12. We further propose 10 MHz channelling for private broadband networks in the 3.5 GHz band and that the shared spectrum be assigned based on administrative allocation. We proposed that 20 MHz of unrestricted spectrum and 40 MHz of restricted spectrum be designated for shared use by private networks;
13. We are in favour of refarming the band 2500-2690 MHz, which now contains frequency arrangements for FDD and TDD, to one that is wholly TDD, as in 3GPP NR Band 41.

Statement of Interest

Motorola Solutions is a leading global provider of mission-critical communications. Our technology platforms in communications, software, video, and services make cities safer and help communities and businesses thrive.

At Motorola Solutions, we are ushering in a new era in public safety and security. Public safety and commercial customers globally depend on our solutions to keep them connected, from everyday to extreme moments. We serve more than 100,000 customers in more than 100 countries and have a rich heritage of innovation spanning more than 90 years.

We are incorporated in Singapore as Motorola Solutions Singapore Pte Ltd at 80 Pasir Panjang Road, #18-81 Maple Tree Business City II, Singapore 117372 and our Asia Pacific Regional Headquarters is located there.

We are incorporated under the laws of the State of Delaware as the successor to an Illinois corporation, Motorola, Inc., organized in 1928. We changed our name from Motorola, Inc. to Motorola Solutions, Inc. on January 4, 2011.

Our principal executive offices are located at 500 W. Monroe Street, Chicago, Illinois 60661.

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

Q1. Motorola Solution's Views and Comments:

1) Skills requirements and job demands in the future will expand in relation to private broadband networks in the fields of network installation & management, including cyber security for private 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

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

Q2. Motorola Solution's Views and Comments:

2i) Given Singapore's focus on enabling innovation, industrial development, trade and enterprise, the primary use case of 5G in Singapore will be based on Industries and enterprises. As such, it is critical that industry players tailor their 5G solutions across industrial and other verticals. We also recommend that IMDA encourage third-party industrial and enterprise users to build their own private and dedicated 5G networks. This ensures the provision of diverse 5G services, instead of restricting usage to existing operators.

While network slicing technology in 5G enables mobile operators to provide different sets of services for different types of users, there will remain a continued need for small, localised, independent, private broadband networks for specialised users including public safety, critical infrastructure, industrial, utilities and related. There may be a need for roaming between mobile operator's networks and the small private broadband networks.

Such inclusive licensing, moreover, enables all parts of the 5G ecosystem to be supported (including satellite systems, mobile broadband systems, etc.). We further emphasize flexibility as the key enabler of innovation in network services. We

recommend that the Government refrain from policies that restrict the deployment of available spectrum or repurposing of sites for 5G. Flexible arrangements can ensure that service providers remain responsive to changes in technology, services or usage patterns.

2ii) Technological innovations and development in 5G, and beyond, will be optimised with the availability of private and public broadband access to cater for all needs.

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.

Q3. Motorola Solution's Views and Comments:

3) With the WRC-19 identifying gigahertz of spectrum for the delivery of 5G services, MSI believes that new regulations encouraging the adoption of mobile technology across verticals to spur innovation and digital transformation across industries is key to the success of 5G network deployment. To accelerate the process, we encourage a licensing framework that enables enterprises to access mobile spectrum through localised network licensing. We encourage IMDA to designate spectrum in some part of the band 3.3-3.8 GHz (called mid band) for localised private licensing in small geographic areas. In addition we encourage the adoption of technology neutral rules to allow access to shared spectrum in the range 5-6 GHz and in millimetre wave bands where localised network licensing can be more efficient. We propose either a spectrum split between carriers and verticals in key bands where 5G is expected to be deployed, similar to that of Germany or being planned in Sweden, or localised licensing rules for all applicants with spectrum caps to limit spectrum hoarding in the mid bands. We propose a review of the current rules in the mid-band into the possibility of assigning frequencies based on the administrative allocation approach, for vertical use under local/private broadband Professional Mobile Radio (PMR) regulations rules similar to those available in the 800 MHz for narrow band PMR.

Technical parameters for the 3.5 GHz band

To benefit from economies of scale we recommend that IMDA consider harmonising some technical parameters for private broadband network with those used by FCC[2] for the Citizens Broadband Radio Service.

For example:

- Channel bandwidth of 10 MHz for private broadband network;
- Power limit of end user device at a maximum EIRP of 23 dBm/10 MHz; and

[2] CFR 47, Part 96.41

- Power limit of base stations at a maximum EIRP of 30 dBm/10 MHz in restricted spectrum and 47 dBm/10 MHz in unrestricted spectrum.

We further propose that private broadband networks be allowed to use LTE technology initially as LTE is a proven and mature technology with a roadmap to 5G.

Guard Band

Currently, the band 3400-3600 MHz is the subject of sharing studies in the APT Wireless Group (AWG) and we believe that the input document, AWG-25/INP-95 COEXISTENCE ANALYSIS BETWEEN 5G NR AND FSS IN DIFFERENT SCENARIOS IN THE 3300 – 4200 MHZ BAND, may provide insights on the size of guard band to apply for different usage scenarios.

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

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.

Q4. Motorola Solution's Views and Comments:

4i) We believe that it is prudent to wait for the conclusion of WRC-2019, when it is clear which new frequency bands have been identified for IMT and the conditions attached to the identification.

The sub 3 GHz bands are considered ideal for coverage. We believe 5G can be deployed in existing GSM/UMTS/LTE bands especially in bands currently still used for 2G/3G technology. 1.5 GHz band presents another potential coverage band for 5G. LTE will continue to be a good data coverage technology and coverage obligation should be technology neutral defined by service.

4ii) We are in favour of refarming the band 2500-2690 MHz, which now contains frequency arrangements for FDD and TDD, to one that is wholly TDD, as in 3GPP NR Band 41.

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

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

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

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

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;

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

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

Q5. Motorola Solution's Views and Comments:

5i) To optimise access to broadband connectivity in the 3.5 GHz band we are favourable to the concept of a single network providing nationwide coverage that is operated on an open access basis, like the Next Generation Nationwide Broadband Network that is in operation in Singapore. To cater to enterprises that require special features such as higher data security and reliability we propose that private networks be given access to some shared spectrum.

We propose that the open access network be provided with 80 MHz of unrestricted spectrum and 60 MHz of restricted spectrum. This leaves 20 MHz of unrestricted spectrum and 40 MHz of restricted spectrum for shared use by private networks.

5ii) As mentioned in our response to Question 3, we propose 10 MHz channelling for private broadband networks in the 3.5 GHz band.

5iv) We propose that the shared spectrum for private broadband networks be assigned administratively.

We recommend that IMDA adopt a technology and service-neutral approach towards spectrum licensing. This will ensure that operators can repurpose frequency bands easily and facilitate market adaptation to shifting 5G technologies, encouraging the efficient reuse of existing spectrum resources (a process called "refarming") to meet the growing 5G demand.

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.

Q6. Motorola Solution's Views and Comments:

6) Motorola Solutions has no Comment

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

i) The proposed assignment approach;

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

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

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

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

Q7. Motorola Solution's Views and Comments:

7) We propose that the shared spectrum for private broadband networks be assigned administratively and for periods of a minimum of a 7 year license term

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.

Q8. Motorola Solution's Views and Comments:

8) Motorola Solutions has no Comment

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.

Q9. Motorola Solution's Views and Comments:

9) We note that the CBRS Alliance[3] has published a technical specification[4] for coexistence among multiple LTE (TDD) networks. This document contains insights on the technical aspects of synchronisation.

Question 10: IMDA would like to seek your 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

[3] Motorola Solutions is a member of the CBRS Alliance (www.cbrsalliance.org)
[4] CBRS Coexistence Technical Specifications - CBRSA-TS-2001 (www.cbrsalliance.org/specifications)

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

Q10. Motorola Solution's Views and Comments:

10 -i) 5G technology is expected to facilitate the digital economy and support the next generation of enterprise and industrial users to spur the success of Singapore's advanced manufacturing avatar "Industry 4.0" This next generation of broadband wireless technology will be key to Singapore's next phase of mega growth in manufacturing, trading and services industries. Industry players are tailoring their 5G solutions to meet these new and growing needs of industrial and other verticals. In order to support these solutions, we recommend that IMDA encourage third-party industrial and enterprise users to build their own fixed wireless captive and dedicated 5G networks. This ensures the provision of diverse 5G services, instead of restricting usage to existing mobile operators.

10-ii) The regulatory practice so far with respect to radio spectrum identified for IMT is to designate such spectrum exclusively for public networks. However, we believe that 5G technologies and spectrum should be equally available to meet the spectrum needs of dedicated private broadband LTE networks. It is worth noting that Private LTE concept has been well accepted and is getting a lot of traction globally. The adoption of technology neutral rules and inclusive licensing will enable all parts of the 5G ecosystem to be supported (including satellite systems, mobile broadband systems).

We support the allocation of MNC and small block of Numbering and necessary spectrum in various frequency bands for small private and local networks.

Conclusion

5G wireless applications are expected to expand into new market segments to facilitate the digital economy, e.g. manufacturing, smart grid, health, transportation systems, including drone applications, which would bring requirements beyond what can be addressed in today's regulatory environment. The primary use case of 5G in Singapore will be based on Industries and enterprises and there is a need for an environment where innovation can thrive and new capabilities achieved.

It is essential that industry players be able to tailor their 5G solutions across industrial and other verticals and IMDA should make provisions for these players to build their own private and dedicated 5G networks.

We propose that some spectrum in the band 3400-3600 MHz be allowed for localised private broadband network licensing based on administrative allocation, as well as the adoption of technology neutral and service neutral rules, to enable all parts of the 5G ecosystem to be supported.

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=====END OF RESPONSE=====