

CONFIDENTIAL



M1 Limited

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Aileen Chia (Ms)
Director-General (Telecoms & Post)
Infocomm Media Development Authority
10 Pasir Panjang Road
#10-01 Mapletree Business City
Singapore 117438

Dear Ms Chia,

RE: PUBLIC CONSULTATION ON 5G MOBILE SERVICES AND NETWORKS

1. We refer to IMDA's consultation paper dated 23 May 2017 on the above matter.
2. M1 welcomes the opportunity to submit our comments to IMDA's public consultation on 5G mobile services and networks. 5G will not only bring fast Internet access for customers, but will also benefit a host of industrial applications and allow smarter living. Given that 5G will be an essential building block for Smart Nation, a holistic and collaborative approach among the relevant stakeholders including the government agencies, mobile operators and equipment manufacturers is necessary to facilitate 5G deployment.
3. Our comments to the consultation paper are enclosed for IMDA's consideration. Please do not hesitate to contact us should you require any further clarification on this matter.

Yours sincerely,

A handwritten signature in blue ink, appearing to read 'Wee Keng Hoon'.

Mr Wee Keng Hoon
General Manager
Regulatory

**M1'S RESPONSE TO IMDA'S PUBLIC CONSULTATION
ON 5G MOBILE SERVICES AND NETWORKS**



This paper is prepared in response to IMDA's Public Consultation document dated 23 May 2017 and represents M1's views on the subject matter. Unless otherwise noted, M1 makes no representation or warranty, expressed or implied, as to the accuracy of the information and data contained in this paper nor the suitability of the said information or data for any particular purpose otherwise than as stated above. M1 or any party associated with this paper or its content assumes no liability for any loss or damage resulting from the use or misuse of any information contained herein or any errors or omissions and shall not be held responsible for the validity of the information contained in any reference noted herein nor the misuse of information nor any adverse effects from use of any stated materials presented herein or the reliance thereon.



Introduction

1. M1 is Singapore's most vibrant and dynamic communications company, providing mobile and fixed services to over 2 million customers. With a continual focus on network quality, customer service, value and innovation, M1 links anyone and anything; anytime, anywhere.

M1's view on the Next Generation of mobile services in Singapore

2. M1 supports the development of a proportionate and stable regulatory environment as it will catalyse a sustainable and growing info-communications industry where long term planning and decisions can be undertaken.

3. M1 welcomes the opportunity to submit our comments to IMDA's public consultation on 5G mobile services and networks. 5G will not only bring fast Internet access for customers, but also benefit a host of industrial applications and allow smarter living. Given that 5G will be an essential building block for Smart Nation, a holistic and collaborative approach among the relevant stakeholders, including the government agencies, mobile operators and equipment manufacturers, is necessary to facilitate 5G deployment.



PART II: TECHNOLOGY AND USE CASES

Potential 5G Use Cases and Capabilities of 5G Technology

Question: *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?*

Question: *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.*

1. The ITU-R has identified three broad use cases for 5G, namely Enhanced Mobile Broadband (eMBB), Massive Machine-Type Communications (mMTC) and Ultra-Reliable and Low Latency Communications (uRLLC). 5G is expected to be a heterogeneous network that supports a wide range of applications and services.
2. M1 is of the view that commercial deployment of 5G network and services would likely be around 2020. We would advocate conducting early 5G technology trials in Singapore and welcome IMDA's decision to waive the frequency fees for 5G trials.
3. With regards to the current regulatory frameworks, we would like to highlight several key areas below to address new challenges faced by operators when deploying the 5G network.

Access to buildings and other facilities for 5G network deployment

4. The deployment of 5G network will involve small cells deployment within a building premise (e.g. in the common areas) and on outdoor facilities such as lamp posts and bus stops. Therefore, the availability of space, power, and ability to gain access to these locations will become more critical. The current Code of Practice for In-building Facilities ("COPIF"), which require building owners to set aside space and facilities in a building for mobile equipment deployment, was based on deployment of 3G/4G networks. As 5G network deployment is expected to be different, the current COPIF provisions will need to be reviewed to take into consideration the infrastructure and operational requirements in deploying and operating a 5G network.
5. Additionally, cooperation and support from building owners and government agencies will continue to be important to facilitate 5G deployment. M1 often encounter lengthy processes in obtaining approvals from the relevant authorities for small cells deployment on the outdoor facilities. We would suggest that such processes be reviewed and streamlined to aid the deployment 5G network and services.



Radiation / aesthetics concerns

6. With small cell deployments, where more mobile antennae will be mounted within building premises and on outdoor facilities and become more visible to the public, concerns over mobile radiation and aesthetic are likely to increase. As we move towards 5G and Smart Nation, there is a need for a holistic and co-ordinated approach among the relevant stakeholders to conduct studies and align with international practices, as well as to educate the public on their concerns. Today, such concerns are generally addressed by the authorities and mobile operators on a case-by-case basis. In a 5G environment where wireless connectivity is key, existing processes which deal with public complaints on a case-by-case will not be a tenable approach.

QoS standards framework

7. IMDA has put in place existing QoS standards based on 3G/4G networks. In view of the heterogeneous nature of 5G network and the wide range of applications it is expected to support, it is not practical to maintain technology-specific QoS standards going forward. Instead, a holistic approach in assessing the relevance and applicability of QoS standards in a 5G environment should be considered. Consequently, other regulatory Codes such as those governing service outage and network resiliency will also need to be reviewed. As 5G services could be used to support industrial applications, including mission critical services, it will be necessary for the regulatory framework to provide guidance on the various stakeholders' responsibilities and accountability in the event that there is a 5G service outage.



PART III: SPECTRUM REQUIREMENTS

8. M1 would request IMDA to make available as much spectrum as possible for 5G deployment. In a 5G environment, various spectrum bands are required to support different types of use cases. E.g. the sub-1 GHz bands are likely to be used for extensive coverage and IOT applications, while the mmWave bands are for short range and high throughput performance.

Below 1 GHz frequency bands

Question: *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?*

9. M1 is of the view that the 450 MHz, 600 MHz and 800 MHz frequency bands should be considered for 5G deployment, as there are similar interests from international bodies such as the FCC and ITU within the 470 MHz – 694 MHz spectrum band. These developments should be monitored closely for harmonization of spectrum bands for 5G across the regions, not only to avoid unnecessary interference, but also to facilitate roaming for 5G services and reduction in cost of 5G devices.

1 - 6 GHz frequency bands

Question: *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*
- 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)*

Question: *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.*

10. M1 expects the L band to be part of the specifications for 5G, with some regional administrations such as the CEPT already exploring ways to harmonise for SDL technologies. We recommend monitoring their developments closely with a view of harmonization of the spectrum bands with other countries. This will allow Singapore to leverage on the ecosystem that would be built and achieve economies of scales in 5G deployment. We estimate that access to the L band and the availability of the equipment will be around 2020.

11. M1 also supports the allocation of all of the 91 MHz of spectrum in the L band as 5G is a heterogeneous network and would require sufficient amount of different spectrum bands over a long period.



Question: *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.*

12. M1 is of the view that 4.4 - 4.99 GHz can be considered for IMT/5G, as there are similar interests from international operators in this spectrum band in the 3GPP RAN meetings.

Above 6 GHz frequency bands

Question: *IMDA would like to seek 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;*
- ii) The amount of spectrum required in the mmWave spectrum bands to meet 5G applications that will require higher bandwidths; and*
- iii) The specific mmWave bands that you consider should be a priority in Singapore for IMT services and why?*

13. The mmWave bands play an important role in providing short range and high throughput performance in 5G services. Based on the 3GPP standards, spectrum efficiency would be specified at 30bps/Hz. Therefore, to deliver a 5G service with throughput of 30 Gbps, up to 1 GHz of bandwidth is required. This can only be achieved through the mmWave band as bandwidth is readily available and their short wavelengths make it technically feasible for a small form factor for radio equipment/antenna to be deployed

14. M1 also notes that some of the identified frequency bands for 5G (specifically the 3.4 – 3.6 GHz and 24.25 – 24.45 GHz) are adjacent / in-bands with the fixed ground station and satellite services. While we support the use of these bands for 5G, frequency co-ordination with satellite operators would be extremely challenging. Bilateral arrangements between Singapore and our neighbouring countries will need to be established with co-existence parameters to be defined and co-ordinated at the governmental and regulatory level.

15. M1 would also like to highlight that given the high bandwidth requirements for 5G in mmWave bands, for such deployment to be commercially feasible, the spectrum pricing framework should be reviewed to ensure that the overall cost of spectrum will be reasonable.



Question: *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)?*

Question: *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?*

16. To facilitate the deployment and growth of 5G services, IMDA should make available as much spectrum as possible, including the 28 GHz band. While there is still a lack of support for the 28 GHz band to be opened for IMT/5G services due to other deployment such as satellite services, we note that the FCC in the US has already permitted the 28 GHz band to be used for 5G, and countries such as Japan and Korea are also closely monitoring the developments in this area. Therefore, it is likely that this band could gain global harmonisation and adoption for IMT services.

Question: *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?*

17. M1 is of the view that the mmWave bands should be released earlier than 2022 to facilitate 5G trials in both low-band and high-band frequencies. Early availability of mmWave bands will also facilitate the deployment of 5G in traffic hotspot areas, hence improving the capacity and performance in those areas. We believe this will encourage early adoption of 5G services and complement our nation's Smart Nation goals.



PART IV: USE OF LICENCE-EXEMPT SPECTRUM FOR IMT SERVICES

18. M1 supports the innovative use of licence-exempt bands to complement LTE deployment in licensed bands such as the integrated small cells / Wi-Fi. Early technology trials of standard-based technologies such as the Licensed Assisted Access (“LAA”) and LTE-Wi-Fi Aggregation (“LWA”) should be encouraged.

LAA and LTE-U

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

- i) The adoption of LBT to facilitate sharing of licence-exempt spectrum and whether there would be any implication arising from such a requirement;*
- 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.*

19. While the Listen-Before-Talk (“LBT”) protocol used by LAA appears to be a better option for deploying LTE on a Wi-Fi band, M1 would recommend detailed and controlled tests to further determine if LBT can significantly reduce the interference to Wi-Fi end users and the technical measures needed to do so. The LBT would need to be evaluated specifically in the Singapore context due to the high density of Wi-Fi deployment here.

20. We would also emphasize that the regulatory measures governing the use of licence-exempt spectrum should safeguard against new players who may rely on licensed-exempt band and MuLTEfire technology only to operate a LTE network. To facilitate efficient spectrum sharing and equitable arrangements, we believe that the use of licensed-exempt band should complement the licensed bands for 5G deployment.

21. As LTE-U operates on proprietary standards, we would recommend that companies with commercial LTE-U networks (if any) to upgrade to LAA, as the latter has been standardized in 3GPP Rel. 13 standards. Further, the adoption of LBT has been made mandatory in other jurisdictions such as the EU and Japan.



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

22. M1 would suggest that IMDA provide greater clarity on the 5 GHz license-exempt band which can be used for LAA / LTE-U trials. Where feasible, we would suggest that the LAA/LTE-U trials should not be limited to parts of the 5 GHz band. This will allow operators to learn more from the trials and explore measures to minimise impact to Wi-Fi users.

Question: *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*
- ii) The regulatory and coexistence measures that should be adopted for MuLTEfire.*

23. M1 is of the view that the use of MuLTEfire could exacerbate congestion in the license-exempt bands and adversely impact Wi-fi users. As mentioned earlier, we would advocate the use of LAA and LWA to complement LTE deployment in licensed-bands.

LTE-Wi-Fi Aggregation (LWA)

Question: *Considering that the LWA approach would not create coexistence issue with Wi-Fi users, would this approach be better suited for countries with extensive Wi-Fi usage?*

24. The LWA approach would be better suited for countries with extensive Wi-Fi usage. In addition, the LWA approach is easier to deploy as this feature is already compatible with existing 4G base stations and Wi-Fi Access Points.

25. However, further assessment of the technical approach and their co-existence with Wi-Fi networks should still be required through technical trials to determine their suitability in Singapore's environment.



Question: *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.*

26. Wi-Fi offloading is used to offload mobile users onto Wi-Fi networks to reduce the traffic load on mobile networks. Therefore, mobile users either use the Wi-Fi network or mobile network for their services. Mobile users may experience better performance when they are connected to the mobile networks due to reduced traffic load.

27. The LAA / LWA requires pairing to an existing licensed-band used by the mobile networks to provide mobile services. With the LAA / LWA, mobile users will experience higher capacity and end-to-end throughput performance, when they connect to the mobile network or Wi-Fi network. As the LAA / LWA can be configured at the network level, mobile users do not require any additional subscription or mechanism to enjoy the benefits of LAA / LWA.