TM's RESPONSES TO MCMC's PUBLIC CONSULTATION ON WIRELESS LOCAL AREA NETWORK (WLAN) IN THE 6 GHz FREQUENCY BAND

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Introduction

Telekom Malaysia Berhad ("TM") applauds the Malaysian Communications and Multimedia Commission ("MCMC") for issuing this Public Consultation ("PC") paper to seek views from the industry and general public on the Wireless Local Area Network ("WLAN") in the 6 GHz Frequency Band. In short, we will use PC Wi-Fi throughout this document in reference to the PC paper being discussed.

The emergence of "information age" where millions of innovative cyberspace applications have been developed in the past decades, had subsequently resulted with the Internet becoming ubiquitous. Wireless technologies such as Wi-Fi and cellular mobile data networks have played an extremely important role in enabling access to the Internet by anyone at anytime from anywhere. Wi-Fi however, is the fastest, low power consumption and most cost-effective way of wireless Internet connectivity, especially in areas where broadband wired connectivity is available. Wi-Fi provides higher data rate and more reliable indoor connections as compared to the cellular technology, hence, allowing people to connect to the Internet using personal devices including smartphones, laptops, tablets, smart TV etc from the comfort of their homes. The benefit of Wi-Fi connection is also extended to work places where it enables employees to gain access to the Internet and also for industrial and enterprise need of smart services by the deployment of Internet of Things ("IoT") devices connected via Wi-Fi.

TM, as the enabler of Digital Malaysia, has been actively providing Wi-Fi services to Malaysians via among others, Unifi Home/Business Broadband, Enterprise Wi-Fi, public hotspot via wifi@Unifi, several customized Smart Services offerings for our Enterprise/Government customers and Wholesale Wireless Service for 4G traffic offloading from Mobile Network Operators ("MNO"). We welcome the study on extending Wi-Fi to 6 GHz frequency band as we foresee the prospect of growth for high-speed wireless connectivity via Wi-Fi with the unfolding of future use cases and Wi-Fi's role to complement the set to take off, the National 5G network rollout.

TM is pleased to provide our views for the PC Wi-Fi for MCMC's careful considerations in the following sections. This submission is a joint submission by both Telekom Malaysia Berhad (TM) and Webe Digital Sdn Bhd (Webe).

Question 1

MCMC seeks your views and comments on the demand for spectrum for Wi-Fi in the 6 GHz frequency band.

1.1. Global Demand

The introduction of Wi-Fi 6 in 2019 is a game changer to Wi-Fi industry. As mentioned in paragraph 14 of the PC Wi-Fi, Wi-Fi 6 or also known as 802.11ax is able to deliver higher data rates, increased capacity, improved power efficiency and better performance in environments with multiple connected devices. These characteristics are important to support the growing demand for high-speed Wi-Fi driven by new devices, applications and use cases such as Augmented Reality ("AR"), Virtual Reality ("VR"), and Ultra High Definition video[1]. These new applications require significantly higher bandwidth[2] and ultra-low latency.

The global data traffic volume of Wi-Fi has witnessed substantial growth in recent years. By the year 2022, Wi-Fi may carry the majority of internet protocol[4] ("IP") global traffic soaring to reach the unbelievable high value of zettabytes (10^{21}bytes) [5]. In Malaysia itself, Internet users have reached 88.7% in 2020, a 1.3% increase from 87.4% in 2018[6] which shows that Malaysians contributed significantly to the global use of the Internet. Moreover, Cisco in its report[7] and forecast[8] disclosed that data traffic offloaded by Wi-Fi from cellular networks has increased rapidly and contributed considerable portions to the overall Wi-Fi traffic volume growth.

Undoubtedly, Wi-Fi 6 is capable to cater to the increasing demands. Wi-Fi 6 can handle speeds of up to 9.6 Gbps, three times higher than 802.11ac ("Wi-Fi 5"). However, there are challenges that require regulatory intervention as the current available 2.4 GHz and 5 GHz bands might not adequate for Wi-Fi 6 to fully unleash its capabilities. For instance, high throughput applications (e.g AR/VR) require wider channels. While Wi-Fi 6 does support 80 MHz and 160 MHz channel bandwidth, given the relatively small amount of unlicensed spectrum (i.e 2.4 GHz/5 GHz) coupled with restrictions on the use of so-called Dynamic Frequency Selection ("DFS") channels, it is not feasible to use 80/160 MHz channels, especially in high/medium density scenarios[9]. As a result, more bandwidth needed to be allocated for Wi-Fi use, supporting the extension of Wi-Fi 6 operation in 6 GHz frequency band ("Wi-Fi 6E").

[1] Paragraph 12 of PC Wi-Fi
[2] https://www.qualcomm.com/media/documents/files/vr-and-ar-pushing-connectivity-limits.pdf
[4] The IP traffic includes text, voice, images, and videos that comprises the communication needs in one's daily lives
[5] Evolution and Impact of Wi-Fi Technology and Applications: A Historical Perspective, Kaveh Pahlavan & Prashant Krishnamurthy, 2020
[6] Paragraph 11 of PC Wi-Fi
[7] APJC Cisco Knowledge Network (CKN) Presentation, Cisco, 2018
[8] Cisco Visual Networking Index (VNI) Complete Forecast Update, 2017–2022
[9] 6GHz WiFi - The Silver Bullet for Addressing the 1000x Data Challenge Using Unlicensed Spectrum, Arista White Paper, 2020

Furthermore, with an increasing number of devices per person and a growing number of high-bandwidth applications, Wi-Fi 6E will allow users to enjoy the benefits of more capacity at home. This is crucial in ensuring stringent Quality of Services ("QoS") requirements for Home Wi-Fi is met, as the Wi-Fi workload from enterprise/university/school shifts to home due to the COVID-19 pandemic. Additionally, with more enterprise applications moving to the cloud and the increasing usage of videoconference applications such as Microsoft Teams and Zoom, the need for more Wi-Fi bandwidth per user in the enterprise is also growing. Similarly, industrial IoT applications such as factory automation will mean that the deployment of a large number of sensors and remotely-operated machines, equipped with audio-visual capabilities, going beyond the typically low-bandwidth IoT sensors of today[10], made possible with Wi-Fi operation in 6 GHz.

In addition, Wi-Fi 6E technology is also integral to complement 5G technology provided by its 5G-like characteristics (i.e high throughput, low latency, and high capacity) and in providing seamless connectivity across technologies.

Obviously, Wi-Fi 6E will bring enormous benefits of 6 GHz spectrum to consumers, device manufacturers, and service providers as the band is being made available globally[11]. According to a new study commissioned by Wi-Fi Alliance®, in 2021, the global economic value provided by Wi-Fi will reach $3.3 trillion USD and is expected to grow to almost $5 trillion by 2025. Market adoption of Wi-Fi 6 will grow to 2.2 billion shipments in 2021, including nearly 340 million Wi-Fi 6E products which are capable of operating in the 6 GHz band[12]. More numbers on Wi-Fi by categorization are shown in the figure below;

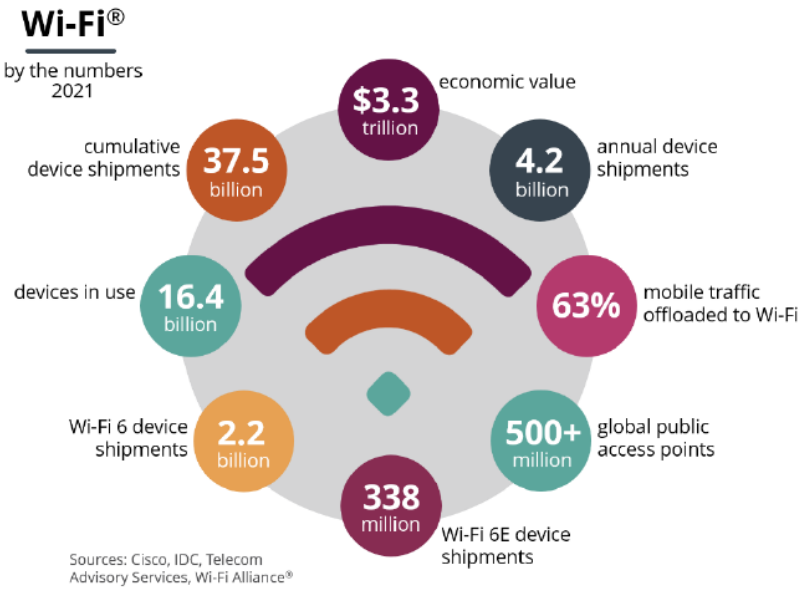

Figure 1: Wi-Fi by the numbers 2021, Source: Wi-Fi Alliance®

[10] 6GHz WiFi - The Silver Bullet for Addressing the 1000x Data Challenge Using Unlicensed Spectrum, Arista White Paper, 2020

[11] https://www.wi-fi.org/news-events/newsroom/wi-fi-alliance-delivers-wi-fi-6e-certification-program

[12] Global economic value of Wi-Fi® to reach $5 trillion in 2025, Wi-Fi Alliance®, 2021

1.2. TM's Observation

As far as TM's products are concerned, since the introduction of Unifi services (2009), TM has offered Wireless Router with Wi-Fi features that are aligned with the latest industry standards at that point of time such as 802.11n ("Wi-Fi 4"), Wi-Fi 5 and the latest is Wi-Fi 6. We believe with the introduction of new spectrum band (i.e 6 GHz) for Wi-Fi 6E, consumer will definitely benefit from it but on condition the user end device (e.g. cell phones, tablets, laptops, smart tv, etc.) are widely made available in the retail market. It is expected that the demand for Wi-Fi 6E for home Wi-Fi will increase significantly with the arrival of smart devices supporting digital lifestyle. Additionally, based on roadmap shared by various chipset maker, we noticed that some of them have plans to develop Consumer Wireless Router product using Wi-Fi 6E in their product roadmap.

On the other hand, our Enterprise and Government customers are showing interests for future-proof Wi-Fi services i.e ensure the Wi-Fi devices supplied are of up-to-date specifications and IoT-enabled for future usage. Wi-Fi will be complementing the 5G network in supporting the Government aspiration in MyDIGITAL[13] initiatives. They are aware of the latest technology and looking forward to adopt advance technology once it is available. In addition, it is expected that, economic sector will benefit from the Wi-Fi 6E Enterprise IoT due to its capability to run data efficiently e.g. for heavy smartboards, stream 4-8K videos, or even robotic-assisted solution.

[13] https://www.epu.gov.my/sites/default/files/2021-02/malaysia-digital-economy-blueprint.pdf

Question 2

MCMC seeks your views and comments on the emerging technologies utilising the 6 GHz frequency band.

2.1. 5G New Radio-Unlicensed ("NR-U")

As stated in paragraph 17 of the PC Wi-Fi, the 3G Partnership Project ("3GPP") is developing 5G NR-U in the 6 GHz frequency band. NR-U brings to 5G a variety of options for flexibly utilizing unlicensed spectrum and 3GPP Release 16 is the first global cellular standard that supports both license-assisted and standalone use of unlicensed spectrum. The specifications allow devices to access up to 400 MHz and 100 MHz of unlicensed spectrum bandwidth in the downlink and uplink, respectively[14] as shown in Figure 2 below;

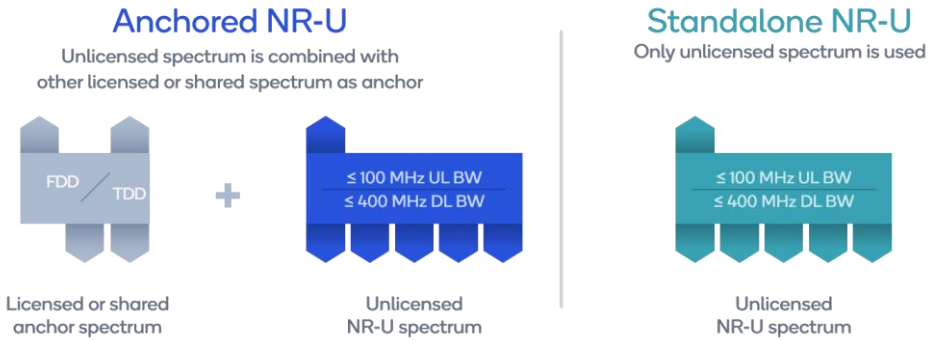

Figure 2: 3GPP Release 16 on 5G NR-U, Source: Qualcomm

In the United States ("US"), the Federal Communications Commission ("FCC") has made available 1200 MHz of bandwidth in the 6 GHz band for Wi-Fi and other unlicensed technologies such as 5G NR-U[15] in 2020. To support this recent rulemaking and development by FCC[16], 3GPP has identified band n96 to support 5G NR-U in the 6 GHz frequency band. FCC has also introduced the automated frequency coordination ("AFC") in managing the coexistence between unlicensed services within the said band (i.e Wi-Fi 6E) as depicted in Figure 3. We welcome Regulator to further discuss with FCC in understanding further the AFC system.

[14] https://www.qualcomm.com/news/onq/2020/06/11/how-does-support-unlicensed-spectrum-nr-u-transform-what-5g-can-do-you

[15] https://www.fcc.gov/document/fcc-opens-6-ghz-band-wi-fi-and-other-unlicensed-uses-0

[16] FCC's Unlicensed Use of the 6 GHz Band Report and Order and Further Notice of Proposed Rulemaking ET Docket No. 18-295; GN Docket No. 17-183 report

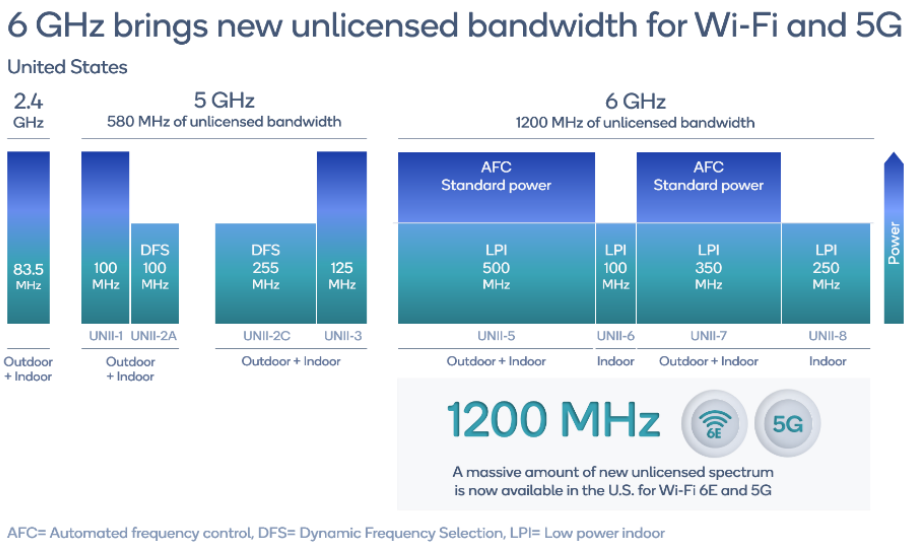

Figure 3: FCC adoption of 6 GHz for unlicensed, Source: Qualcomm

Nevertheless, as known today, there is minimal development in this 5G NR-U technology. It is well aware that the 5G NR-U is an evolution of the License Assisted Access ("LAA") where it will be using the same method to access the unlicensed spectrum. However, we are unable to find any successful deployments of LAA in this region.

2.2. International Mobile Telecommunications ("IMT")

As MCMC highlighted in paragraph 18 of the document, there are two decisions that will be considered in the WRC-23 radio conference in regards to introducing IMT in this frequency band.

"The frequency band of 6425 MHz to 7025 MHz is being studied for the potential identification of IMT in Region 1, whereas the frequency band of 7025 to 7125 MHz is being studied for the potential global IMT identification"

We recognized that the 6425 MHz to 7025 MHz is only for Region 1 National Administrations to decide. The 7025 MHz to 7125 MHz provides opportunity to identify 100 MHz of spectrum for IMT for all regions. As Malaysia is in Region 3, only 100 MHz will be made available for IMT use should WRC-23 recommending the IMT identification in 6 GHz spectrum band.

International Telecommunication Union ("ITU") published a report[17] on the feasibility studies in introducing IMT in the frequency bands above 6 GHz. We noted that it does not provide the comprehensive study on the actual 6 GHz frequency band. The technical studies provide the understanding of the spectrum characteristic using the IMT technologies in the 6 GHz frequency band. The report further elaborates the technology advancement needed that will support the introduction of IMT in the 6 GHz frequency band. However, to date, no specifications or equipment exist, and significant questions remain about theoretical IMT use.

[17] Report ITU-R M.2376-0, Technical feasibility of IMT in bands above 6 GHz, ITU, 2015

Furthermore, previous studies conducted between IMT and the FSS in the 6 GHz did not support coexistence[18]. Whether Advanced Antenna Systems turns out to be the solution that allows previous views to be significantly changed, is to be determined.

2.3. Fixed Service-Unlicensed Microwave Backhaul

We are cognizant that there are fixed services mainly microwave backhaul links that are currently operational in the country. We believe the backhaul links are essential in providing long distance backhaul services connectivity beyond 10 kilometres. Presently, there are emerging technologies in 5 GHz and 6 GHz backhaul that would be able to transmit long distance and high throughput beyond 300Mbps. This will provide an alternative to the fibre when fibre backhaul solution is not feasible. In addition to that, it also provides cost savings in deploying the backhaul network as compared to the deployment via fiber, VSAT and the need to build or rent additional tower for a microwave repeater sites. Furthermore, the existing features of Dynamic Frequency Selection and Listen-Before-Talk available on most of the equipment may contribute in avoiding interference to other services.

We strongly believe the combination of the above and IMT small cells, will result to an emerging concept in rural broadband to serve the rural communities. The 5 GHz and 6 GHz backhaul links would be an alternative in replacing the need to use current fiber, VSAT and backhaul repeater sites. As this technology can go beyond 15 kilometres and reaches the rural sites, the IMT services (4G or 5G) to the rural community can be realized with the use of 5 GHz and 6 GHz spectrum band as backhaul service.

2.4. Fixed Wireless Access ("FWA")

There are also potentials of FWA technology (non-IMT BWA[19]) as an alternative solution for rural broadband connectivity to support Jalinan Digital Negara ("JENDELA") and Sarawak Multimedia Authority's Linking Urban, Rural and Nation ("SALURAN")[20] programmes. We understand the competitive cost structure in deploying this architecture would allow Federal Government and State Government to coordinate the federal or state funded rollout in ensuring populated rural areas have an access to the broadband services.

[18] DSA Comments to the Public Consultation on "WLAN use in the 6 GHz band"-RSM, NZ
[19] BWA: Broadband Wireless Access
[20] https://www.sma.gov.my/modules/web/pages.php?mod=news&sub=news_view&menu_id=&sub_id=&nid=73&m=6&y=2021

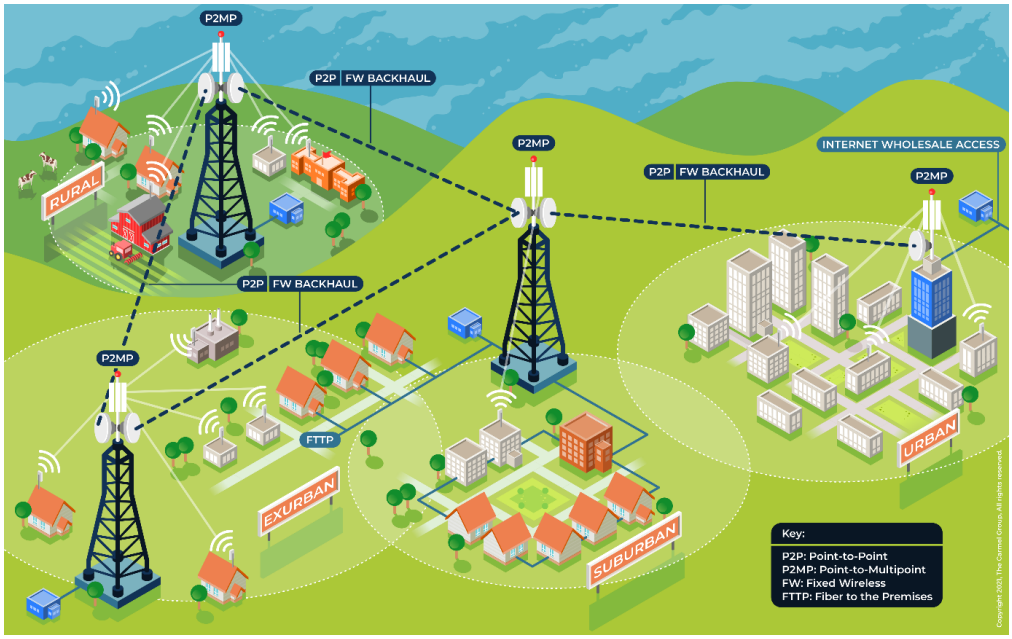

Figure 4 FWA in the United States. Source: WISPA

The 6 GHz frequency band would pave the way in realising Malaysia agenda to digitize the nation in to become a competitive and caring nation respected in by other countries. As there are many services and technologies utilizing the 6 GHz frequency band available currently, we believe further studies need to be conducted by MCMC together with industry stakeholders in ensuring fair and equitable allocations for multiple technologies to coexist with each other in supporting MCMC's JENDELA and Sarawak's SALURAN programmes.

2.5. Other Emerging Technologies (will benefit from Wi-Fi 6E/6 GHz band for unlicensed use)

Other than the above, new technologies that are envisaged to benefit the most with the adoption of Wi-Fi 6E are technologies that require enhance broadband, machine to machine communication and ultra-reliable low latency communication as the following:

a. Artificial Intelligence
b. Biotechnology
c. Robotics
d. Unmanned aerial systems (drones)
e. AR/VR, Holographic Video Conference, and 4K/8K multi-screen video
f. IoT
g. Digital lifestyle applications and devices (i.e smart office configuration, smart projector/TV, connected electronic devices and home/kitchen appliances)

Question 3

MCMC seeks your views and comments on the frequency range within the 6 GHz frequency band that could be considered for Wi-Fi under the Class Assignment in Malaysia. Should MCMC consider allowing Wi-Fi to operate in the entire 1200 MHz (5925 MHz to 7125 MHz frequency band) or only in the 500 MHz (5925 MHz to 6425 MHz frequency band)?

To us, allocating the entire 1200 MHz (5925 MHz to 7125 MHz frequency band) for unlicensed use is the best option for MCMC to consider rather than considering only a part of the 6 GHz spectrum band. The full allocation of 6 GHz spectrum band will bring the opportunity for more effective spectrum use allowing support for new applications as well as laying the foundations for innovation. We have several reasons to support this recommendation as outlined below;

i. Meeting projected demand for WLAN/Wi-Fi use

As per elaborated in response to Question 1, the characteristic of Wi-Fi 6 has sparked unprecedented demands in Wi-Fi use given its ability to deliver higher data rates, increased capacity, improved power efficiency and better performance in environments with multiple connected devices. For instance, it can be seen from data and statistics that in light of Covid-19 pandemic, demand for internet access has increased tremendously as people shifted to remote working, online schooling and e-commerce. Broadband speeds at residential area also increase dramatically and resulted with bottleneck as the use of home Wi-Fi access points with multiple devices connected to it become priority for every household. This accumulated to considerable amount of Wi-Fi bandwidth requirement, hence full band of 6 GHz is essential to meet this increasing demand.

Moreover, the full 6 GHz band for WLAN/Wi-Fi use is key to enabling the rapid expansion of 5G networks. As more consumers began to use more data-intensive devices, they rely more on Wi-Fi offload—both for affordability and QoS. WLAN/Wi-Fi are expected to carry offload data from cellular 5G technologies (total data offload to unlicensed going from 74% to 79% in 2022[21]). This will lower the costs of network deployment for mobile operators and most importantly, it will also lower costs for consumers.

Wi-Fi also catalyses wireless innovation and new use cases such as AR/VR for people and companies. With access to the 6 GHz band, Wi-Fi is also set to play a pivotal role in the further automation of manufacturing plants and other parts of industry. In South Korea, Taiwan, the US and other advanced manufacturing hubs, businesses increasingly regard Wi-Fi as an effective and efficient way to both monitor and remotely control machinery and other assets. Development of more advanced

[21] Cisco Systems, Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2017-2022

industrial and enterprise IoT applications are also expected to be rapidly accelerated by adopting Wi-Fi operation in full 6 GHz band.

Technically, opening up the entire 1200 MHz for the Wi-Fi use will enable access to contiguous and wider channelling, full advantage of new Wi-Fi features such as Spatial Reuse, Target Wake Time ("TWT"), orthogonal frequency division multiple access ("OFDMA") that Wi-Fi 6 has to offer, lessen the risk of interference between Wi-Fi services and also able to support multiple devices connectivity. Additionally, allowing Wi-Fi operation in full 6 GHz band is crucial to support Wi-Fi 7 or 802.11be devices which currently under development. Wi-Fi 7 devices feature 320 MHz wide channels and with 1200 MHz bandwidth, three non-overlapping 320 MHz channels will be able to be supported. In contrast, only one 320 MHz channel is possible if 500 MHz is made available for WLAN/Wi-Fi which will further limit the Wi-Fi 7 capability.

ii. More efficient use of the spectrum

Permitting Wi-Fi to operate in the entire 1200 MHz provides countless opportunities in offering extra capacity for advanced applications and increasing demands of Wi-Fi while protecting and still allowing the incumbent services to thrive[22]. Built on IEEE 802.11 standards, Wi-Fi has demonstrated its ability to coexist with and protect other spectrum users by imposing the appropriate coexistence conditions and interference mitigations. Allowing 6 GHz band sharing with the existing services will significantly increase spectrum efficiency. Furthermore, the introduction of unlicensed devices will not necessitate a spectrum clearance process which would likely be complex and expensive (this is expected to happen if large part of 6 GHz band is allocated for IMT). In the US, the FCC had declined the request of repurposing significant portions of the 6 GHz band for exclusive, flexible use licenses and relocating affected incumbent services to other frequency bands. This is due to commercially viable IMT deployments require exclusive access to spectrum. Wi-Fi Alliance® in its response[23] to a public consultation issued by Radio Spectrum Management ("RSM"), New Zealand stated that "*IMT networks cannot accept interference from or avoid causing interference to the incumbent operations in the 6425-7125 MHz band. It is, therefore, unrealistic to expect that ubiquitously deployed IMT networks can avoid interfering with and tolerate interference from other, incumbent operations in the 6425-7125 MHz band. Relocation of incumbents to another frequency band, even if a frequency band is available, may not be economically viable and would require extensive transition periods (e.g., years)*".

[22] https://docs.fcc.gov/public/attachments/DOC-363490A1.pdf Unlicensed Use of the 6 GHz Band Report and Order and Further Notice of Proposed Rulemaking ET Docket No. 18-295; GN Docket No. 17-183, April 2020

[23] Consultation Submission - WLAN use in the 6 GHz band, Wi-Fi Alliance ®, RSM, NZ

iii. **Addressing digital divide and gaining economic benefits**

Wi-Fi hotspots and local area networks can be installed at rural points of community activities or homes located in remote areas as recognized by the ITU-D Study Group on Broadband development and connectivity solutions for rural and remote areas in its annual deliverable 2019-2020 report[24]. The ITU-D Study Group recommended that Wi-Fi technologies are very effective if the backbone landing is not far from the locality and can be used to create a mesh network. According to the report, in India[25], several rural areas have been connected using Wi-Fi, as a last-mile connectivity solution. While in Zimbabwe[26], Wi-Fi technology has been deployed for its community information centers by using the universal services fund. In Latin America, more than 19 universal service projects in the countries of the Pacific Alliance rely on Wi-Fi to deliver affordable broadband to rural and underserved[27]. Obviously, in rural and remote areas, cost efficiency could be achieved by adopting Wi-Fi standard given the lower cost of coverage for low-population density areas and lower cost of terminals.

Wi-Fi is a highly cost-effective wireless access technology. Firstly, it operates in unlicensed frequency band, where there are no licensing fees involved. Secondly, Wi-Fi costs of licensing of the necessary intellectual property for Wi-Fi chipset is 3x lower than that of 5G while the entire 5G cellular modem cost is 50x the cost of a Wi-Fi chipset[28]. Thus Wi-Fi manufacturers and Internet Service Provider ("ISP") will benefit from enormous economies of scale. Subsequently, much lower cost is transferred to the end users.

iv. **Availability of Wi-Fi 6E chipsets and products**

Wi-Fi Alliance® has begun certifying Wi-Fi 6E devices[29], extending the Wi-Fi operation in 6 GHz. In 2021, nearly 340 million of Wi-Fi 6E devices are entering the market hence fuelling up the momentum of global adoption of Wi-Fi 6E. According to Dynamic Spectrum Alliance Limited ("DSA") in its response[30] to the public consultation issued by RSM, New Zealand "*Wi-Fi 6E chipsets and products are already available with more than 30 certified devices operating in the 1200 MHz of the 6 GHz band. Last December,*

[24] Annual deliverable: "Broadband development and connectivity solutions for rural and remote areas". Question 5/1 Telecommunications/ICTs for rural and remote areas. ITU-D
[25] Presentation by Mohit Bansal at the workshop on broadband development in rural areas hosted by the Question 5/1 Rapporteur Group,25 September 2019
[26] Presentation by Batsirayi Mukumba at the workshop on broadband development in rural areas hosted by the Question 5/1 Rapporteur Group, 25 September 2019
[27] https://mobile-magazine.com/wireless-networks/unlocking-potential-wi-fi-and-spectrum-sharing
[28] Source: Eric McLaughlin, General Manager Wireless Solutions Group, Intel during the WBA Congress in Frankfurt in September/October 2019
[29] https://www.wi-fi.org/news-events/newsroom/wi-fi-alliance-delivers-wi-fi-6e-certification-program
[30] DSA Comments to the Public Consultation on "WLAN use in the 6 GHz band"-RSM, NZ

the US FCC certified the first Wi-Fi 6E chipset and its first 6 GHz Wi-Fi device. Wi-Fi 6E products have being announced at this year's (virtual) Consumer Electronics Show. On January 14th, Samsung announced a new mobile phone that incorporated a Wi-Fi 6E client. In light of this momentum, the research firm IDC has forecast that more than 316 million Wi-Fi 6E devices will enter the market in 2021 and shipments will rise rapidly over the next three years".

With the above rapid developments, it is expected the Wi-Fi 6E ecosystem will be ready in no time and continue to grow at an accelerated pace in the coming months.

v. **Rapid global adoption**

There is considerable global momentum to make the entire 6 GHz band available for license-exempt use. In the Americas, the US, Brazil, Canada, Chile, Peru, Costa Rica, Honduras, and Guatemala have already permitted license-exempt use across the entire 6 GHz band. Mexico, and Colombia had consultations that proposed to make the entire 1200 MHz available for license-exempt use. Other Administrations that have permitted license-exempt use across the entire 6 GHz band include the Republic of Korea and Saudi Arabia. The global progress of Wi-Fi operation in 6 GHz frequency band can be seen from the Figure 6 below;

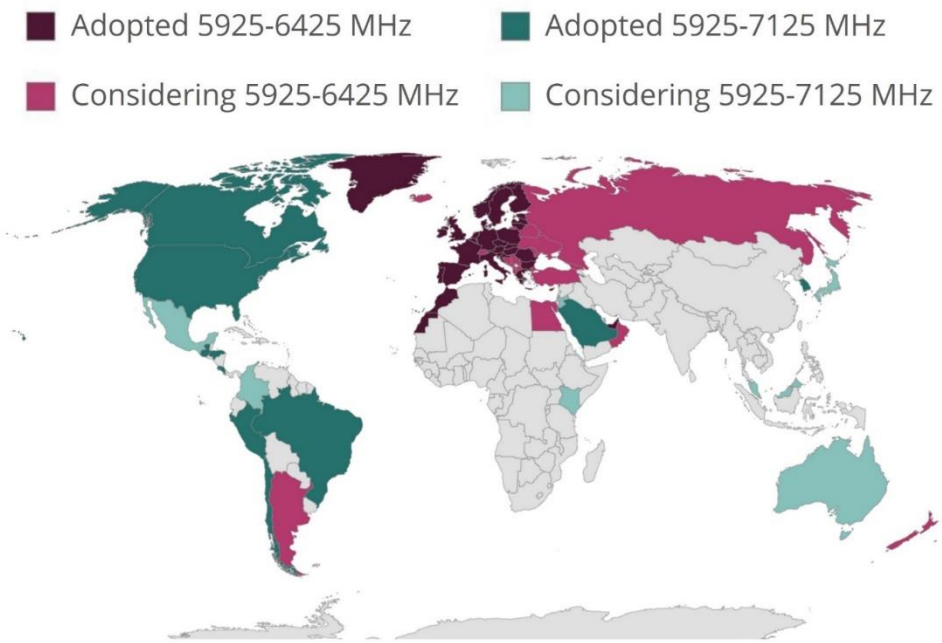

Figure 5 Global Progress on Wi-Fi in 6 GHz Adoption, Source: Wi-Fi Alliance®

In addition, based on what has been implemented or studied in the US, European Union ("EU") and South Korea[31], it is possible to allocate the entire range of 1200 MHz (5925 MHz to 7125 MHz) for indoor, and the 500 MHz (5925 MHz to 6425 MHz) for outdoor with the appropriate mitigation such as transmit power limitation, to avoid any interference with other systems within the same frequency range.

Overall, given the facts highlighted above, TM would like to suggest the following;

I. MCMC should consider **opening up the entire 1200 MHz band for unlicensed use** especially Wi-Fi as **coexistence is feasible while ensuring protection to the incumbent services;** and

II. MCMC to **conduct assessment for Wi-Fi in 6 GHz frequency band in Malaysia environment** to ensure smooth adoption of Wi-Fi in 6 GHz band in Malaysia

[31] Paragraph 19 of PC Wi-Fi

Question 4
MCMC seeks your views and comments on: i. the coexistence between Wi-Fi and incumbent services (i.e. fixed service and fixed-satellite service); and ii. the potential interference mitigation between these services.

4.1. Coexistence between Wi-Fi and Incumbent Services

TM is of the view that coexistence between Wi-Fi and Fixed Service ("FS") i.e terrestrial microwave links ("MW") and Fixed Satellite Service ("FSS"), is technically feasible under certain conditions, as long as the Wi-Fi is operating under Class Assignment ("CA") with pre-determined operational conditions and the appropriate interference mitigation between the services is in place. It is well aware that FS and FSS deployment are mostly at outdoor, point-to-point and operate with high transmitting power, hence it is likely that Wi-Fi will be the affected party if the coexistence between these services is not properly managed. Nevertheless, MCMC should also consider according the protection of existing and primary allocation of FS/FSS as the highest priority should Wi-Fi 6E is allowed to operate in 6 GHz frequency band. Without the appropriate coexistence and interference mitigation in place, it is feared that the existing TM's MW and FSS transmission may also be affected to the extent that the existing MW/FSS are required to vacate the spectrum. We estimated if the existing MW and FSS services in 6 GHz needed to be migrated out to other spectrum, the activity will incur an estimated migration cost that is not less than RM 58 Million.

In order to ensure a smooth implementation, we propose a detailed study in Malaysia environment be conducted by MCMC to determine the most effective protection criteria or methodology for the protection of incumbent services. MCMC may refer to the process carried out in the EU through European Conference of Postal and Telecommunications Administrations ("CEPT") may serve as a guide for such studies in Malaysia. CEPT has published several documents such as Electronic Communications Committee ("ECC") Report 302, CEPT Report 73, ECC Report 316, CEPT Report 75, ECC Decision (20)01 and Decision (EU) 2021/1067 for reference to the coexistence environment.

4.2. Potential Interference Mitigation

As for the potential interference mitigation, we reiterate the suggestion for MCMC to conduct similar studies by CEPT in the Malaysia environment, with reference to the available ECC/CEPT reports. Likewise, Malaysia also may refer to studies by Asia-Pacific Telecommunity ("APT") countries such as South Korea for more alike environment.

In principle, Wi-Fi should only be allowed to operate within limited area and transmit power in order to avoid causing harmful interference to incumbent services. The findings from the

CEPT studies[32] for Wireless Access System ("WAS")/ Radio Local Area Network ("RLAN") operating in frequency range 5925-6425 MHz concluded the followings;

FS vs WAS/RLAN

i. Sharing between the FS and WAS/RLAN is feasible with appropriate technical conditions and regulatory models;
ii. High-power indoor and outdoor deployments may require additional technical and or regulatory solutions like databases used for coordination, i.e a geo-location method that aims at detecting a spatial closeness between victim and interferer; and
iii. Low-power indoor WAS/RLAN access points and very low power portable devices that can operate outdoors could coexist with FS

FSS vs WAS/RLAN

i. Sharing between FSS and WAS/RLANs is feasible with limitations on higher power outdoor usage; and
ii. There is risk of excess interference should higher power outdoor usage increase significantly beyond the specified baseline parameters. This concern and potential risk could be addressed by controlling the usage of higher power WAS/RLAN devices operating outdoors and indoors

Note: Although the studies by CEPT focus only on frequency range 5925-6425 MHz, MCMC could further expand the studies for up to 7125 MHz range in Malaysia environment by using similar study methodology. We believe the study will produce useful outcome for Wi-Fi adoption in 6 GHz in Malaysia.

In addition, we suggest the exclusion zones to be introduced for the FS and FSS. For example, exclusion zones need to be established for Satellite Earth Stations which are located at Cyberjaya, Kuantan and RTM Angkasapuri to ensure Wi-Fi is not deployed within a specified radius.

MCMC may also replicate the adoption of AFC[33] by the US FCC to facilitate shared access by unlicensed and licensed services in 6 GHz frequency band. However, we propose that the AFC's efficiency to be proven and validated by the MCMC before being used to protect FS/FSS in the Malaysia environment.

[32] CEPT Report 73, ECC Report 302
[33] http://dynamicspectrumalliance.org/wp-content/uploads/2019/03/DSA_DB-Report_Final_03122019.pdf

Question 5

MCMC seeks your views and comments on the potential technical and operational conditions to be imposed if the 6 GHz frequency band is introduced for Wi-Fi under the Class Assignment. Should part of the frequency band be limited to indoor operation? Should standard power devices operating under the Automatic Frequency Coordination (AFC) system be adopted in Malaysia?

In line with the CA requirement, the potential technical and operational conditions to be imposed for Wi-Fi in 6 GHz frequency band must be able to limiting the Wi-Fi deployment area, allowable transmit power as well as providing protection to the existing services in the same band. To achieve these objectives, we propose MCMC to conduct detailed studies on the coexistence and interference mitigation between Wi-Fi and FS/FSS in Malaysia environment. MCMC may refer to the studies conducted by EU/CEPT and consider the information from the document of Decision (EU) 2021/1067 as follows;

Low power indoor ('LPI') WAS/RLANs devices

Parameter	Technical conditions
Permissible operation	Restricted to indoor use, including in trains with metal-coated windows (note 1) and aircraft. Outdoor use, including in road vehicles, is not permitted.
Category of device	An LPI access point or bridge that is supplied with power from a wired connection has an integrated antenna and is not battery powered. An LPI client device that is connected to an LPI access point or another LPI client device and may or may not be battery powered.
Frequency band	5 945-6 425 MHz
Maximum mean equivalent isotropically radiated power ('e.i.r.p.') for in-band emissions (note 2)	23 dBm
Maximum mean e.i.r.p. density for in-band emissions (note 2)	10 dBm/MHz
Maximum mean e.i.r.p. density for out-of-band emissions below 5 935 MHz (note 2)	-22 dBm/MHz

Note 1: Or similar structures made of material with comparable attenuation characteristics.
Note 2: The mean e.i.r.p. refers to the e.i.r.p. during the transmission burst which corresponds to the highest power, if power control is implemented.

Table 1 Low power indoor ('LPI') WAS/RLANs devices

Very Low Power (VLP) WAS/RLAN devices

Parameter	Technical conditions
Permissible operation	Indoors and outdoors. Use on Unmanned Aircraft Systems (UAS) is not permitted.
Category of device	The VLP device is a portable device.
Frequency band	5 945-6 425 MHz
Maximum mean e.i.r.p. for in-band emissions (note 1)	14 dBm
Maximum mean e.i.r.p. density for in-band emissions (note 1)	1 dBm/MHz
Narrowband usage maximum mean e.i.r.p. density for in-band emissions (note 1) (note 2)	10 dBm/MHz
Maximum mean e.i.r.p. density for out-of-band emissions below 5 935 MHz (note 1)	- 45 dBm/MHz until 31 December 2024 (note 3)

Note 1: The mean e.i.r.p. refers to the e.i.r.p. during the transmission burst which corresponds to the highest power, if power control is implemented.

Note 2: Narrowband (NB) devices are devices that operate in channel bandwidths below 20 MHz. NB devices also require a frequency hopping mechanism based on at least 15 hop channels to operate at a value of in-band power spectral density (PSD) above 1 dBm/MHz.

Note 3: The appropriateness of this limit shall be subject to review by 31 December 2024. In the absence of justified evidence, a value of -37 dBm/MHz shall apply from 1 January 2025.

Table 2 Very Low Power (VLP) WAS/RLAN devices

Note: Although the studies by CEPT focus only on frequency range 5925-6425 MHz, MCMC could further expand the studies for up to 7125 MHz range in Malaysia environment by using similar study methodology. We believe the study will produce useful outcome for Wi-Fi adoption in 6 GHz in Malaysia.

Additionally, we are also of the opinion that standard power devices should not be introduced until the AFC method or other methods of protection to the FS/FSS have been proven and validated by the MCMC.

Question 6
What other key issues need to be considered in introducing Wi-Fi in the 6 GHz frequency range?

6.1. Roadmap for Wi-Fi 6E Adoption

We propose MCMC to outline a clear roadmap on Wi-Fi 6E adoption to prepare consumers (end users), industry and ISP accordingly in embracing this new technology. The roadmap should take into consideration the following key issues;

i. Wi-Fi 6E devices ecosystem readiness – there should be forecast on the Wi-Fi 6E devices availability in Malaysia market. MCMC to consider the Wi-Fi 6E devices ecosystem maturity before any announcement of mass rollout;
ii. Wi-Fi 6E interoperability/backward compatibility with legacy Wi-Fi devices – Wi-Fi expansion to 6 GHz should be able to resolve congestion issues of the legacy Wi-Fi devices operating in 2.4 GHz and 5 GHz;
iii. Readiness of both parties (i.e ISP and the end users) – supply (devices/CPE availability) vs demand (digital lifestyle e.g. AR/VR, 4K/8K –higher resolutions video). Perhaps MCMC may conduct a focus group survey to gauge the Rakyat's willingness to spend more on new gadgets or readiness in upgrading lifestyle towards applying IoT concept or smart home concept;
iv. Technical assessment on co-existence and interference mitigation in a multi-devices Wi-Fi environment – Wi-Fi currently co-exist with other unlicensed devices under Short Range Devices ("SRD") category. In the future, billions of devices are expected to be connected to the 6 GHz band. Hence, a thorough technical assessment is required to ensure harmonious coexistence and acceptable QoS is maintained; and
v. Address overlapping channels issues as faced in current deployment– MCMC to study and assess the requirement to restrict certain channels for certain use and spell out in the CA. This is to address interference and concerns the customers have been facing in current Wi-Fi deployment in 2.4 GHz and 5 GHz frequency band.

6.2. Incumbent services are crucial for rural/remote connectivity

We urge MCMC to ensure protection to incumbent services is the highest priority should adoption of Wi-Fi 6E realized. Both FS and FSS are crucial for rural and remote connectivity especially in supporting JENDELA aspirations.

Conclusion

TM's response to this PC is based on the national and global facts as well as current trends related to WLAN/Wi-Fi. TM is of the view that a full allocation of 6 GHz band (5925-7125 MHz) for unlicensed use is crucial and necessary to realize the economic and social benefits of new wireless technologies provided appropriate coexistence mitigations and protection to existing services are in place.

We strongly encourage MCMC to focus on enabling the deployment of Wi-Fi 6E services in Malaysia by allocating the entire 1200 MHz bandwidth of the 6 GHz spectrum band in order to ensure the advanced and innovative services could be delivered to Malaysia businesses, governmental services and consumers. We urge MCMC to complete the consultation process and finalize policy decisions on spectrum band 6 GHz to enable an update in the SRD schedule of the CA document at the earliest opportunity.

The summary of TM's responses for each question is as per Table 3 below;

Question	Comment and Proposed Recommendations
Question 1	*MCMC seeks your views and comments on the demand for spectrum for Wi-Fi in the 6 GHz frequency band.* I. New advanced applications such as AR/VR II. Increased internet usage and broadband speeds requirement due to Covid-19 situation III. Increased cellular traffic offload to Wi-Fi IV. Digital lifestyle; require high throughput and low latency characteristic such as smart devices and appliances V. Demand in Enterprise IoT VI. Wi-Fi 6E complement 5G technology VII. Nearly 340 million of Wi-Fi 6E products enter global market in 2021
Question 2	*MCMC seeks your views and comments on the emerging technologies utilising the 6 GHz frequency band.* I. 5G NR-U II. IMT (licensed 5G) III. Fixed Service-Unlicensed Microwave Backhaul IV. FWA V. Other Emerging technologies (will benefit from Wi-Fi 6E/6 GHz for unlicensed use): a. Artificial Intelligence b. Biotechnology c. Robotics d. Unmanned aerial systems (drones)

Question	Comment and Proposed Recommendations
	e. AR/VR, Holographic Video Conference, and 4K/8K multi-screen video f. IoT g. Digital lifestyle applications and devices (i.e smart office configuration, smart projector/TV, connected electronic devices and home/kitchen appliances)
Question 3	*MCMC seeks your views and comments on the frequency range within the 6 GHz frequency band that could be considered for Wi-Fi under the Class Assignment in Malaysia. Should MCMC consider allowing Wi-Fi to operate in the entire 1200 MHz (5925 MHz to 7125 MHz frequency band) or only in the 500 MHz (5925 MHz to 6425 MHz frequency band)?* I. MCMC should consider opening up the entire 1200 MHz band for unlicensed use especially Wi-Fi as coexistence is feasible while ensuring protection to the incumbent services II. MCMC to conduct assessment for Wi-Fi in 6 GHz frequency band in Malaysia environment to ensure smooth adoption of Wi-Fi in 6 GHz band in Malaysia
Question 4	*MCMC seeks your views and comments on:* *i. the coexistence between Wi-Fi and incumbent services (i.e. fixed service and fixed-satellite service); and* *ii. the potential interference mitigation between these services.* For Question 4 (i): I. Coexistence between Wi-Fi and FS i.e MW and FSS, is technically feasible under certain conditions, as long as the Wi-Fi is operating under CA with pre-determined operational conditions and the appropriate interference mitigation between the services is in place II. MCMC must consider according the protection of existing and primary allocation of FS/FSS as the highest priority should Wi-Fi 6E is allowed to operate in 6 GHz frequency band For Question 4 (ii): I. Usage of Low Power Wi-Fi6E for indoor and Very Low Power for outdoor II. Exclusion zones III. AFC
Question 5	*MCMC seeks your views and comments on the potential technical and operational conditions to be imposed if the 6 GHz frequency band is introduced for Wi-Fi under the Class Assignment. Should part of the frequency band be limited to indoor operation? Should standard power devices operating under the Automatic Frequency Coordination (AFC) system be adopted in Malaysia?*

Question	Comment and Proposed Recommendations
	I. The potential technical and operational conditions to be imposed for Wi-Fi in 6 GHz frequency band must be able to limiting the Wi-Fi deployment area, allowable transmit power as well as providing protection to the existing services in the same band. In reference to CEPT studies, MCMC can consider the following conditions; a. Indoor: Low Power (max EIRP of 24 dBm) b. Outdoor: Very Low-Power (max EIP of 14 dBm) Note: MCMC could further expand the studies for up to 7125 MHz range in Malaysia environment by using similar study methodology II. Standard power devices should not be introduced until the AFC method or other methods of protection to the FS/FSS have been proven and validated by the MCMC.
Question 6	*What other key issues need to be considered in introducing Wi-Fi in the 6 GHz frequency range?* I. Roadmap for Wi-Fi 6E Adoption a. Wi-Fi 6E devices ecosystem readiness (for Malaysia Market) b. Wi-Fi 6E interoperability/backward compatibility with legacy Wi-Fi devices c. Readiness of both parties (i.e ISP and the end users) d. Technical assessment on co-existence and interference mitigation in a multi-devices Wi-Fi environment e. Address overlapping channels issues as faced in current deployment II. Incumbent services are crucial for rural/remote connectivity. Protection to incumbent services is the highest priority should adoption of Wi-Fi 6E realized.

Table 3 High Level Summary of TM's Responses