TM's RESPONSE TO MCMC's PUBLIC INQUIRY (PI) ON ALLOCATION OF SPECTRUM BANDS FOR MOBILE BROADBAND SERVICE IN MALAYSIA

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Introduction

Telekom Malaysia Berhad ("TM") expresses its appreciation to the Malaysian Communications and Multimedia Commission ("MCMC") for issuing this Public Inquiry paper to seek views from the industry and general public on the allocation of the 700MHz, 2300MHz and 2600MHz spectrum bands.

Internet is a right of every citizen[1]. Today, as the Internet Service becomes a commodity and technologies evolve, consumers access the internet anytime, anywhere, across multiple devices regardless of the technology or infrastructure behind it. Consumers need and want seamless internet connectivity that is fast, reliable and low price wherever they go. Shifting consumer preferences towards wireless access via small screens will drive internet consumption, whether they are at home or in the office. Even on a fixed connection, consumers access the internet via WiFi. Going into the future, addressing consumer needs and preferences should be taken into account as we work towards shaping and building the provision of Internet Access to all of Malaysia's population.

In anticipation of the Industrial Revolution 4.0 (IR 4.0) and implementation of 5G wireless technology, Malaysia has to take a drastic approach to improving its wireless connectivity, especially for mobile broadband. The basic supply side economics of individual mobile rollouts and multiple overlapping networks can no longer work. Every generation (from 2G to 3G to 4G) of mobile technology costs billions to rollout, and the time of development between the different generations is getting shorter. Hence industry players have less time to recoup sunk costs of their billion ringgit rollouts. To the detriment of the nation, this leads to passing increasing costs to end consumers and/or delays in adopting the next generation of mobile technology e.g. 5G.

Moreover, wireless will take on a whole new future in an IR 4.0 world with 5G. The dynamics of wireless usage will largely be driven by masses of connected devices as the Internet of Things (IoT) gains popularity and low latency use cases that will control critical services. This new world will bring about new opportunities in areas such as health, public safety and etc that are needed, especially in the rural areas. Fast broadband, in particular, can drive more advanced applications such as data analytics, IoT and artificial intelligence not just for businesses but also can support

[1] https://www.thestar.com.my/news/nation/2018/08/04/internet-access-for-all-vows-gobind-move-expected-to-result-in-lower-broadband-prices-and-higher-spe#FluSwyWuyPD6Fb8z.99

improved public service delivery and the growing demands of households. Hence, it is crucial for the spectrum to be allocated wisely to ensure that it maximizes its benefit to the Rakyat. Splitting the spectrum bands to many operators is neither efficient nor economical for the country. The allocation of the whole spectrum to TM as the national InfraCo is needed to achieve economies of scale to effectively serve the nation and at the same time is not an arrangement that is detrimental to the country. A single national InfraCo will avoid duplication of infrastructure and networks, thus reducing the total cost of ownership for the industry. It will enable competitive, quality and low price products/services for the Rakyat which will encourage service providers to be more focused and creative in offering innovative solutions and services to consumers as infrastructure expansion and maintenance is taken care by the national InfraCo. In the end, the Rakyat will benefit from lower subscription costs, better coverage and a variety of service offerings.

TM as the National Telecommunications Infrastructure Provider (NTIP) with 5G (InfraCo)

TM intends to be the fully converged National Telecommunications Infrastructure Provider for 5G (InfraCo) and will provide all service providers equal and fair opportunity to use its network through regulated Open Access Wholesale Service arrangements. The InfraCo model will result in significant improvements in network coverage, quality and low prices to the Rakyat. TM will be the key enabler and driver of national initiatives, especially to facilitate faster adoption of IR 4.0 which will help to develop the Malaysian digital economy.

Why TM?

TM has the most extensive fiber coverage nationwide with more than 540,000 km fiber and core capacity which will serve as the necessary backbone to the 5G network in the near future. Since the massive roll-out of the High Speed Broadband (HSBB) network in 2008, TM invested aggressively in its fiber network. TM had invested as much CAPEX compared to the three major mobile operators combined. Furthermore, TM has proven its dependability, experience and capability in delivering large national infrastructure under HSBB1, HSBB2 and SUBB over the past 10 years, repeatedly delivering ahead of time, under budget and to the expected quality and specifications promised.

Malaysia maintains a highly open and competitive market with more than 300 Network Facility Provider (NFP) and Network Service Provider (NSP) license holders, yet very few are willing to make the necessary huge investments required to build a Fixed network. Most are unwilling to

enter the business due to relatively low returns and high risks. The limited few companies that do invest, however, tend to focus only on urban areas. On the contrary, TM does not cherry pick and has instead rolled out its broadband network nationwide for the benefit of all, including those in rural and secondary cities. Furthermore, TM has always made its network open and available to other operators to access seek from, proving that we have the experience to run a national InfraCo and support wholesale operations. We have enabled other operators to serve the Rakyat without the risks of significant upfront investments.

In addition, TM has a long track record in building and operating national mission-critical infrastructure and services. TM currently operates several key national assets and services such as 1GovNet, SchoolNet, MERS999, radio towers for Civil Aviation Authority of Malaysia, Global Maritime Distress & Safety Systems, Royal Malaysian Police Net and Broadcasting infrastructure for Malaysia, all of which are critical infrastructure and services of national importance to the nation.

On the fixed broadband side, TM is pleased to share that it has already covered 95% of the 8.8mil households in Malaysia through a mix of copper and fiber network. TM has already proven itself in fixed services and is very much dedicated to doing the same for wireless services.

Presently, TM has close to 4,000 radio access sites to serve both its retail and enterprise customers. This infrastructure is readily available to be leveraged on for immediate roll out of wireless network that can cater for large scale data and communications traffic, provided sufficient spectrum is available for use. Currently, this proves to be challenging due to unavailability of the right spectrum as well as insufficient bandwidth. The current allocated spectrum is not suitable to provide acceptable service quality necessary to serve the nation as TM's total allocated spectrum is small as compared to other mobile operators. Specifically, even though TM has a total allocation of 70 MHz, TM can only effectively use 40 MHz. This is due to interference on the 850 MHz band resulting in only half or 2x5MHz available for use and on the 2600 MHz band resulting in restrictions to ubiquitous network rollout.

TM, in taking up the role to be the National Telecommunications Infrastructure Provider with 5G (InfraCo), requires 700MHz, 2300MHz and 2600MHz spectrum to effectively roll-out affordable and high quality wireless service to the Rakyat. We believe meeting NFCP targets will support narrowing the digital gap by digitalizing the rural economy and generate a constructive

environment through implementations of new technologies such as 5G[2]. As a result, new business models will emerge which will lead to more high paying job opportunities and career prospects as well as improving living standards.

TM's recent effort to support the Government under the interim SchoolNet project (which we delivered on time within a very short timeline) in order to serve the targeted 10,000 schools, serves as a jumpstart towards this ambition. This accords the necessary economies of scale for TM to subsequently offer this as a wholesale service to other providers using regulated rates by MCMC.

As the final product, TM will strive to provide the Rakyat with ubiquitous broadband service that is served over fixed and mobile networks either via wholesale and retail services. The country will enjoy high quality and low price especially those in the rural and underserved areas through efficient utilization of existing infrastructure and elimination of cost duplication in rolling out nationwide low-band and mid-band LTE and 5G infrastructure. TM has proven its commitment to resolve the issues of fiber coverage face by the Streamyx customers to offer the unifi Air as a quick win resolution to these customers who reside in TM's LTE coverage areas. To date, a total 33.1k Streamyx has been identified to be migrated to unifi Air coverage areas. The introduction of unifi Air is a testament of TM efforts in delivering seamless connectivity to all Malaysians with fiber-like speeds offered through a wireless solution on top of the fiber solution.

We have recently joined hand with Kementerian Pembangunan Luar Bandar (KPLB) to implement wireless internet connection to more than 15,000 kampung registered with KPLB. This will be a catalyst to spur digital economy and knowledge-based economy in the rural area. This also serve as a proof for TM not only to focus on urban areas, but also to expand wireless internet footprints in the suburban and rural areas in order to get those areas connected to the main stream.

It should be noted that TM is the only telco that having army reserve known as 56 Rejimen Pakar Semboyan Pakar Telekom (Askar Wataniah) (56RPST(AW)) to ensure the safety and operability of the telecommunication network not only during peace, but also during emergencies, distress,

[2] https://www.malaymail.com/news/malaysia/2019/08/28/gobind-rm21.6b-national-connectivity-plan-to-provide-equal-internet-access/1785009

natural calamities and others of that nature. The 56RPST(AW) was applauded for its sterling services with distinction as commended Ketua Pegawai Semboyan ATM.

TM has always been at the forefront of each telecommunication technology evolution in the nation. With the above long, proven track record and existing capabilities, we believe the appointment of TM as the single National Telecommunications Infrastructure Provider with 5G (InfraCo) will ensure smooth telecommunications roll-out towards 5G readiness for Malaysia. Subsequently, TM as InfraCo provider will be the key enabler and driver of national initiatives which will continuously benefit the Rakyat.

With the above strategic intent that succinctly line-up the way forward of our commitment on the use of the spectrum, TM is pleased to provide our response for the Public Inquiry for MCMC's careful considerations in the following section.

Note: This submission is a joint submission by both Telekom Malaysia Berhad (TM) and Webe Digital Sdn bhd (Webe).

Background

The 700 MHz, 2300 MHz and 2600 MHz bands are being utilized for mobile broadband service on 4G LTE globally. However, of late, there has been growing interest to utilize the bands for 5G. This observation is consistent whether within new spectrum band auctions or within countries where existing spectrum is technology agnostic and the bands can already be used for 5G deployments.

Hence, having sufficient spectrum for 5G deployment is a key success factor for 5G technology adoption. The most common band for 5G deployment is band n78 at 3.5 GHz. This is followed jointly by band n77 at 3.7 GHz, band n258 at 26 GHz and band n260 at 39 GHz. According to GSMA, the potential availability of C band spectrum at 3.3-3.8 GHz band for 5G is likely around 2020-21[3]. In April 2019, the preliminary recommendation by the Spectrum Working Group of the 5G Task Force was to allocate the 3.3-3.4 GHz band for limited indoor use, the 3.4-3.8 GHz for 5G usage, and the 3.8-4.2 GHz for satellite usage. A guard band would be implemented between the 5G and satellite usage.

In Malaysia, select bands will be prioritized for 5G deployment and made available from 2021 and a similar band allocation is being considered. As a result, 5G and fixed satellite service (FSS) operating on the C band will require implementation of interference mitigation techniques. This might slow down the progress of 5G deployment on C bands and availability for use could be delayed to 2022-2023. Other select bands include millimeter wave spectrum at 26 GHz and 28 GHz which will be critical for high capacity use cases as up to 800 MHz block allocations would be made available for use. However, at this early stage, implementations of Fixed Wireless Access (FWA) on millimetre wave spectrum still faces challenges when it comes to modelling accuracy.

The timeline for 5G spectrum that goes into the future and beyond 2022 means that the outcome of the spectrum assignments of the 700 MHz, 2300 MHz and the 2600 MHz bands in Malaysia will be of critical importance to the future of Malaysia. The outcome can be designed to trigger digital transformation of Malaysia at a much faster rate through implementation of 5G or it can keep Malaysia at status quo for another 4-5 years. As 5G will work to enable other emerging technologies such as big data, artificial intelligence, augmented/virtual reality and autonomous vehicles, 5G can potentially drive contribution towards Malaysia's economic growth and digital economy transformation.

Summary of TM's views:

1. **Consideration for the spectrum allocation of the 700 MHz, 2300 MHz and 2600 MHz bands needs to take into account pairing of band use as spectrum in Malaysia is technology agnostic and the bands can already be used for 5G deployments.**
2. **If the bands take into account use for 5G, the outcome can trigger digital transformation of Malaysia at a much faster rate allowing Malaysia to leap into the future.**

[3] Roadmap for C-band spectrum in ASEAN, 2019
https://www.gsma.com/spectrum/wp-content/uploads/2019/08/GSMA_Roadmap-for-C-band-spectrum-in-ASEAN_WEB.pdf

TM's Response to the Questionnaires

Spectrum Band	Questions 1 and 2
700 MHz	1. MCMC would like to seek views on the proposed allocation plan for the 700 MHz band, in particular on: I. Award mechanism II. Timeline for assignment
	2. MCMC would like to seek views on the optimum spectrum block per operator for assignment of the 700 MHz band.

The bands available for 700 MHz are listed in **Table 1**. Development of the devices to support 5G is still early stage. So far, no 5G devices support band n12 and n83 and the 5G devices that support band n28 are still only modules. 5G devices that support for 700 MHz includes but is not limited to the 5G CPE 2.0 (Sub-6 GHz) - Indoor & Outdoor CPE from Huawei, the Samsung Galaxy S10 smartphone and the Gosuncn Welink GM800/GM801/GM850A/GM860A modules[4].

Table 1: Bands available on the 700 MHz band spectrum

700 MHz							
NR FR1 Band	**Band Alias**	**Uplink (UL) Operating Band** **BS Receive / UE Transmit**	**Downlink (DL) Operating Band** **BS Transmit / UE Receive**	**Bandwidth**	**Duplex Mode (Spacing)**	**5G Channel Width - Trials/ Build Out/ Active Status**	**Device Availability**
n12	700a	699 MHz - 716 MHz	729 MHz - 746 MHz	17	FDD (30 MHz)	N/A	4G: 1,294 5G: 0
n28	APT 700	703 MHz - 748 MHz	758 MHz - 803 MHz	45	FDD (55 MHz)	10 MHz	4G: 1,450 5G: Modules
n83	UL 700	703 MHz - 748 MHz	-	45	SUL	N/A	4G: 0 5G: 0

Source: http://niviuk.free.fr/nr_band.php, GSA, Frost & Sullivan

Question 1 (I) – Award mechanism

Of a total of 25 countries sampled globally that awarded the 700 MHz band spectrum between 2008 and 2019 (refer to **Appendix 1**), 20 countries or 80% of local industry regulators in respective countries have opted for assigning the 700 MHz band by spectrum assignment through auction. Spectrum assignment through tender (beauty contest) is rare with only a handful of countries such as Japan, British Virgin Islands, Peru and Chile having opted for this award mechanism between 2012 and 2016. Columbia is expected to award in 2019-2020.

Although the global general preferred award mechanism has been spectrum assignment through auction, unless spectrum bands are priced at the right price, implementation of auction determined fees runs the risk that efficient outcomes may not be realized. Apart from inviting less competition and innovative technologies into the market, spectrum auctions impacts detrimentally on rollout progress and retail pricing. For example, high spectrum fees charged for

[4] 5G Device Ecosystem, 2019
https://gsacom.com/

3G licenses had resulted in 3G having a slower than expected rollout in a number of the countries that had paid most for their 3G licenses[5]. Analysis by NERA of 325 spectrum band releases across 60 countries from 2000-2016 shows that high spectrum fees are correlated with lower levels of investment in 4G LTE and higher prices for mobile data[6].

Due to high prices paid for spectrum assignment through auction, usually no or minimum network coverage obligations or requirements had been imposed. However, in an increasing number of markets, network coverage and service quality obligations are increasingly being considered on auctions for new spectrum bands as well as on renewals of existing spectrum bands. Mexico was an early example of where it was part beauty contest and part auction. That is, to qualify for the auction, bidders in Mexico were required to submit a business plan stating proposed prices, investments and network coverage plans. Recently, Telenor was required to provision network coverage along main highways and Telia was required to provision network coverage within designated railway sections as part of the license conditions in Norway in 2019.

The change comes as realization sets in that revenue is received directly and indirectly through tax payments, technology investments and job creation. Countries benefit more from the value to society created through having an affordable national mobile broadband service network. To encourage better network coverage and service quality than required by the license terms, local industry regulators can reward mobile operators for doing so. This can be achieved through **taxation models, deferment models or by rebating**.

As an example of taxation, Brazil in 2015 introduced Law 6962 to provide a tax break on mobile services as compensation for network infrastructure investment in rural areas which cover 14% of the population[7]. The tax reduction focuses on the ICMS tax i.e. a state level value-added tax on sales and services. In Rio, the current ICMS rate for telecommunication services is 25%. As an example of deferment, Nkom in Norway introduced a new arrangement such that payment of parts of the auction fee for two years can be postponed should the mobile operator commit to invest NOK 250 million (or US$ 28.9 million) in new and improved network coverage within the first two years[8]. **Table 2** shows Norway as having a bigger challenge if compared to Malaysia with less population spread out across a larger land size.

Table 2: Comparison of basic metrics between Norway and Malaysia

	Population	Rural Population	Land Size	4G Population Coverage in %	Blended ARPU	
Norway	5.4 million	18%	385,203 km²	92%	NOK 324	US$36
Malaysia	32.6 million	24%	330,803 km²	92%	MYR 46	US$11

Sources: https://www.worldometers.info, https://www.dosm.gov.my, https://data.worldbank.org, Frost & Sullivan research

[5] The Real Cost of Spectrum Auctions, 2009
https://www.mobilemarketingmagazine.com/real-cost-spectrum-auctions
[6] Impact of excessive spectrum prices, 2017
https://www.nera.com/content/dam/nera/publications/2017/ASMC_APAC_Spectrum_pricing-Hans_Ihle.pdf
[7] Closing the coverage gap Digital inclusion in Latin America, 2016
https://www.gsma.com/publicpolicy/wp-content/uploads/2016/09/GSMA2015_Report_ClosingTheCoverageGap-DigitalInclusionInLatinAmerica.pdf
[8] Auction # 28 (700 MHz and 2.1 GHz bands), 2017
https://eng.nkom.no/technical/frequency-auctions/auctions/planned-completed-auctions/allocation-of-the-700-mhz-band

Countries that opt for spectrum assignment through tender (beauty contest) tend to price spectrum more conservatively. Tenders are typically tied to more stringent license conditions e.g. network coverage requirements that are either geographic or population based and service quality base lines. Common objectives include to improve on mobile broadband speeds, achieve network coverage in areas of their countries that would otherwise not be prioritized by mobile operators and improve national technology development.

For example, network coverage obligations in Chile as a result of spectrum assignment through tender (beauty contest) in 2014 included coverage of 98% of the population, 800 km of roads, remote areas covering 1,281 districts and 500 municipal schools subsidized by the government. Chile followed international best practices and allowed each mobile operator to fulfill their network coverage obligations using any spectrum band. Network coverage obligations were not tied to the specific bands in the award, which resulted in Chile achieving the highest levels of 4G LTE coverage in its region at the time[9]. According to the 5G Americas Latin American 4G LTE Penetration Index in Q4 2016, penetration rate was 30.8% compared to the 22.5% average for Latin America and Chile ranked third in Latin America for 4G LTE service adoption[10]. License conditions further specified facilitation at discounted pricing of MVNOs, domestic roaming and wholesale data communications at national and international level[11].

Mostly the 700 MHz band spectrum will support 4G LTE or designated use as a technology neutral spectrum but some countries are starting to use the band to implement 5G.

Switzerland stands out for use of 700 MHz band spectrum specifically for 5G from the outset. 5G in Switzerland is planned to be used to facilitate the internet of things (IoT), eHealth applications, image processing using virtual/augmented reality, self-driving vehicles and agriculture applications[12]. Swiss agriculture produces almost 70% of its domestic food consumption and contributes to 0.7% of Gross Domestic Product (GDP) in 2017[13]. The scenario envisioned is that of a farmer tending cattle using a 5G connection to contact suppliers, place orders, and use the new veterinary telemedicine services. TDC, the market leader with 42% market share in 2018 in Denmark, has plans for 5G on 700 MHz by end of 2020[14].

Over in the UK, 700 MHz will be auctioned in 2020 and available from Q2 2020. Meanwhile, there are trials being funded by the local government under the 5G Testbed and Trial program and UK-wide 5G strategy to study new approaches to deployment of connectivity in rural areas, particularly in agriculture, tourism, renewable energy and manufacturing. In particular, 5G is being trialed in some of the most remote and challenging environments under the 5G RuralFirst initiative[15] to spur new business models within these verticals and white space below 1 GHz that

[9] Effective Spectrum Pricing in Latin America: Policies to support better quality and more affordable mobile services, 2018
https://www.gsma.com/spectrum/wp-content/uploads/2018/03/Effective_Spectrum_Pricing_in_Latin_America_full_report_ENG_web.pdf
[10] 5G Americas - Spectrum Allocation in 700 MHz and 2.5 GHz in Latin America, 2017
http://webcache.googleusercontent.com/search?q=cache:rJOX61YHAclJ:www.5gamericas.org/files/1315/0843/7824/700_MHz_y_25_GHz_Oct_2017_Final-EN.pdf+&cd=11&hl=en&ct=clnk&gl=my
[11] 4G Americas 700 MHz Spectrum Processes in Latin America, 2015
http://webcache.googleusercontent.com/search?q=cache:z48WdWycyn4J:www.5gamericas.org/files/8314/4051/7653/4G_Americas_700_MHz_Spectrum_Process_Lat_Am.pdf+&cd=2&hl=en&ct=clnk&gl=my
[12] Swiss regulator raises $379 million in 5G spectrum auction, 2019
https://www.rcrwireless.com/20190208/5g/swiss-regulator-raises-379-million-5g-spectrum-auction
[13] Switzerland GDP and Economic Data, 2017
https://www.gfmag.com/global-data/country-data/switzerland-gdp-country-report
[14] TDC hoovers up Danish spectrum in latest auction, 2019
http://telecoms.com/496632/tdc-hoovers-up-danish-spectrum-in-latest-auction/
[15] About 5G RuralFirst, 2019

will result in rural solutions for the smartphone supply chain. Switzerland, Denmark and the UK are examples of how the EU is driving prioritizing of 700 MHz for wide area 5G deployments[16].

The U.S. has already licensed the 600 MHz band for this purpose and has further approved the Sprint and T-Mobile merger in July 2019 to encourage 5G and broadband deployment in rural areas. T-Mobile's 4G LTE deployment on 600 MHz is 5G ready with 5G planned for launch on 600 MHz as soon as compatible smart phones become available in 2H 2019.

In Malaysia, the agriculture sector contributed RM 96.0 billion or 8.2% to the GDP in 2017 with oil palm being a major contributor at 46.6% followed by other agriculture at 18.6%.[17] Companies such as Fusionex and LintraMax are working on helping the oil palm industry leverage on new technologies such as Industry 4.0 (IR 4.0), the internet of things (IoT), artificial intelligence, machine learning (ML) and Big Data Analytics to improve business processes, optimize yield, improve overall quality and productivity[18] as well as use cloud based systems and integrated biometric devices to monitor crop evacuation efficiency to improve freshness and reduce backlog and therefore losses. 5G availability in rural and remote areas would be the enabler of mass deployment within the oil palm industry.

In Malaysia, the last AIP published for the 700 MHz band in 2017 specified population coverage targets for mobile broadband service at 95% and 98% by 2022 and 2025 respectively. As build out of network coverage is already relatively mature, umbrella coverage provided using the 700 MHz band can free up spectrum on other bands to cater for capacity expansion where needed. To get the spectrum, competition will likely be more intense on commitments towards number of sites and transmitters within Zone 3 (rural areas with population density of 20-65 per km^2) and Zone 4 (remote areas with population density of 19 per km^2 and below). As comparison, Malaysia has a population density of 95 per km^2 and the Universal Service Provision (USP) program in Malaysia covers underserved areas with population density of 80 per km^2 or less or where public cellular services are not sufficiently available.

Therefore, Zone 3 and Zone 4 in Malaysia cover some of the most poorly connected areas that can benefit from 5G. In rural and remote areas in Malaysia, job opportunities are less, income levels are lower and there are more people to cater for per household or per living quarters. The median income for rural areas in 2017 was RM 1,400 while the median income for urban areas was much higher at RM 2,260[19]. The household size in rural areas is 4.7 persons per household versus 3.8 persons per household in 2019[20]. Employment in the informal sector was 244 thousand in rural areas in 2017 compared to 1.12 million in urban areas. The CAGR for employment in the informal sector within rural areas between 2015 and 2017 was registered as a decline of 23.6%.[21] Thus, while the 700 MHz band is able to facilitate network coverage of rural and remote areas based on the suitability of the band for hard to reach areas and rural locations, it also creates a challenge for mobile operators to monetize and recover investments in network deployment and rollout. To achieve an optimal outcome, the consideration should thus be both on the supply and demand side.

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https://www.5gruralfirst.org/what-is-5gruralfirst/

[16] 5G Spectrum GSMA Public Policy Position, 2019
https://www.gsma.com/spectrum/wp-content/uploads/2019/07/5G-Spectrum-Positions.pdf

[17] Selected Agricultural Indicators, Malaysia, 2018
https://www.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=72&bul_id=UjYxeDNkZ0xOUjhFeHpna20wUUJOUT09&menu_id=Z0VTZGU1UHBUT1VJMFlpaXRRR0xpdz09

[18] Fusionex Set to Transform Palm Oil Industry through AI and Industry 4.0 Technology, 2019
https://www.fusionex-international.com/Latest-News-Announcements/Fusionex-Set-to-Transform-Palm-Oil-Industry-through-AI-and-Industry-4-Technology-2019

[19] https://www.dosm.gov.my/v1/uploads/images/BPTMS/Gaji %26 Upah 2017/INFOGRAFIK BI NEW.png

[20] https://www.dosm.gov.my/v1/uploads/images/Infographics/Indikator Demografi Terpilih/BI - Page 2.PNG

[21] https://www.dosm.gov.my/v1/uploads/images/Articles/LaborForce/Informal Sector/2017/info_4_Eng.jpg

On the demand side, education and healthcare industries can benefit the most within rural areas from 5G deployment and rollout. The issue with education in rural areas is the lack of facilities in terms of access to internet, road accessibility and just basic amenities. For example, in Sarawak, there are 1,020 or 70% out of 1,454 schools that are not in good condition. A total of 415 of them are categorized as being in critical condition. Of 8270 schools within 1BestariNet, only 12% of schools enjoy bandwidths of 30 Mbps or faster[22]. As such, improving broadband access within education in rural areas was one of the targets under the 11th Malaysia Plan.

For healthcare, even though Malaysia has a good primary healthcare system, the rural areas still lack certain facilities and manpower such as doctors. For example, per capita densities of primary care clinics and workforce are higher in urban areas. There are 2.2 clinics and 15.1 providers per 10,000 population in urban areas as compared to 1.1 clinics and 11.7 providers per 10,000 population in rural areas. Based on these statistics, there is objective and quantifiable evidence of an uneven distribution of healthcare services throughout Malaysia. With approximately 44% of the population living in rural areas, 5G can improve access to education and healthcare in rural areas. At a broader level, 5G can support achievement of NFCP targets such as fibre network passes 70% of schools, hospitals, libraries, police stations and post offices by 2022[23].

On the supply side, Malaysia's objective for use of the 700 MHz band spectrum is to achieve the NFCP targets and ensure improvement in QoS. The band is particularly suitable due to lower site count and better network coverage in rural areas or towards cell edges as it needs to complement nationwide fiber availability via HSBB, HSBB2 and SUBB. **The combination of 5G and nationwide fibre will be the catalysts for new opportunities and business models that will drive economic growth and development, particularly in rural areas**.

NFCP targets have been included in **Table 3** for ease of referencing. Specifically, within the NFCP, the following targets have been specified for rural areas:

a. 20% of premises passed in rural areas with up to 500Mbps by 2020
b. 100 rural e-commerce fulfilment centres by 2020
c. 20Mbps in 50% of households in rural areas by 2020

The puzzle that the Malaysian government needs to solve with spectrum is a telecommunications (fixed/mobile) operator issue and not strictly only a mobile operator issue as mobile network coverage will only effectively facilitate last mile connectivity. **Table 4** shows our reference to the "mobile front end" as part of a telecommunications network diagram. Beyond the "mobile front end", mobile operators are dependent on external parties e.g. to supply fiber connectivity for transmission and core network, to supply international internet gateway connectivity, to supply submarine cable connectivity for roaming and IDD to the rest of the world and to supply local content web hosting. Without any or all of these components, mobile operators will not be able to serve consumers adequately and effectively.

To this end, TM is well positioned as it is already serving the needs of mobile operators in Malaysia. Apart from having >540,000 fibre optic cables, it also has:

- >500 domestic and international carriers and service providers (100 domestic customers and 400 international customers)
- 28 Points of presence (PoPs) throughout the globe (9 in Malaysia)
- 4 international cable landing stations and 7 domestic cable landing stations
- 3,800km submarine cables connecting Peninsular & East Malaysia and >20 submarine cable systems spanning over 190,000km[24] connecting to 60 countries

[22] https://frogasia.com/en/1bestarinet/
[23] https://www.nfcp.my/
[24] TM Annual Reports 2016-2018

- Local content web hosting and international internet gateway connectivity

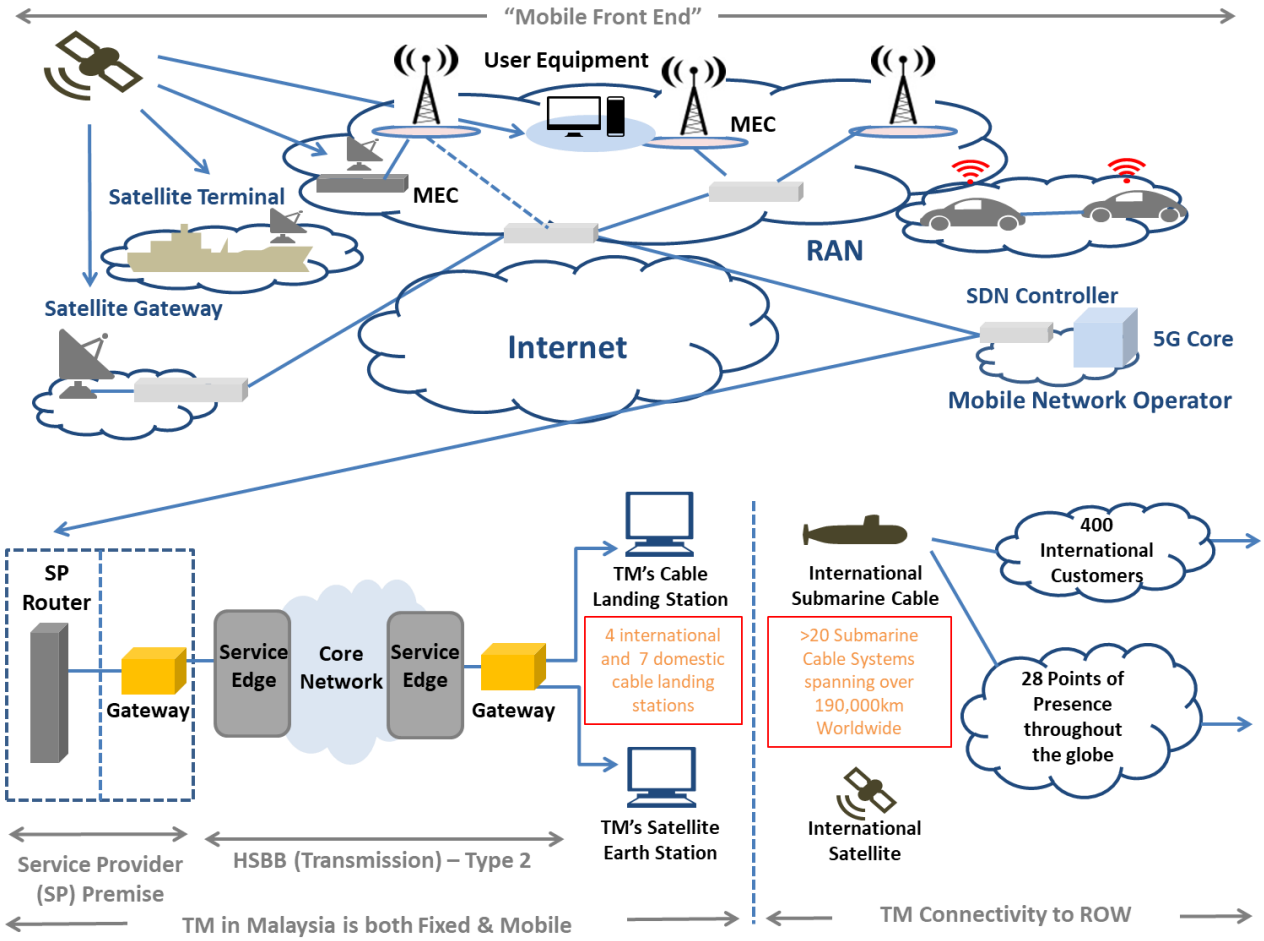
Table 3: NFCP Targets versus achievements

	Ensure optimum deployment of digital infrastructure	Provision of affordable services and improve quality to drive the digital economy	Promote competition
NFCP Targets	1. Average speed of 30 Mbps in 98% of populated areas by 2023 2. 100% premises passed in State Capitals and selected high impact areas with up to 500 Mbps by 2020 3. 20% of premises passed in sub-urban and rural areas with up to 500Mbps by 2020 4. Fibre network passes 70% of schools and government offices, hospitals and police stations near schools by 2022 5. Gigabits availability in selected industrial areas and to all State Capitals by 2023 6. Phasing out of copper network by 2025 7. Assessment of technical standards that should be mandated for infrastructure deployment by 2019 8. Allocation of 700MHz by 2019 and reallocation of 2300MHz and 2600MHz by 2020 9. Mobile coverage along Pan Borneo highway upon completion 10. Submarine Cable Landing Centres ('SCLC') in Sabah & Sarawak to link directly to international cables by 2020 11. Policy position on 5G related issues by 2019	12. Entry level fixed broadband package at 1% of Gross National Income ('GNI') by 2020 13. Double the speed at half the price by 2019 14. Yearly publication of Quality of Service Report	15. Extension of liberalisation in key strategic activities by 2019 **Participation in the digital economy** 16. 100 rural e-commerce fulfillment centres by 2020 17. Quality of Service for courier service by 2019

Source: MCMC

When it comes to content, TM is supportive of continuously expanding its global and domestic infrastructure to support the National Key Economic Area (NKEA) on Communications, Content and Infrastructure (CCI) sector which emphasizes on building up Malaysia's value-add in advanced services, especially content creation as well as distribution and broadcasting with the aim of turning Malaysia into a regional centre for digital content. A key project is the Content Localization Initiative (CLI) by TM which is designed to locate content nearer to our customers for better browsing and streaming experience and at the same time reduce the dependencies on international link capacity requirement. This is achieved through collaboration with major content providers such as Microsoft, Facebook, Amazon, Google, Netflix, Akamai and many more on both Content Delivery Network (CDN) as well as Local Peering arrangement. TM have invested and localized 6.4Tbps of content to date in order to improve our use experience and support the national agenda in making Malaysia the regional content hub.

Table 4: "Mobile Front End" as part of Telecommunications Network Diagram



Source: https://www.tm.com.my, Frost & Sullivan research

Just optimizing the "mobile front end", mobile operators coming together can potentially yield total cost of ownership (TCO) of 15-30% and reduce CAPEX by up to 60%.[25]

Thus, to bring better cost efficiencies to the Rakyat, a study on how a wholesale network implementation or InfraCo can benefit Malaysia was thus commissioned. In particular, we sought to understand how wholesale networks can be structured to achieve the Malaysian government's objectives of developing the rural areas to bridge the urban rural digital divide. The findings have been included within this submission below.

For the 700 MHz band, Mexico proposed in 2016 to set up a single wireless network that would offer open-access and wholesale-only utilizing 90 MHz of spectrum at 700 MHz. The objective was to introduce more competition into a market that had been dominated by America Movil, which operates both in the fixed and mobile services segments and has roughly two-thirds of mobile subscriptions in Mexico. To improve rural area coverage, the license condition requires 85% population coverage by 2025 with obligation to cover 4.7 million users in places with fewer than 10,000 inhabitants. The Altán Redes multinational consortium launched in March 2018 initially with 32% population coverage. However, as sign up by major mobile operators was optional based on existing access regime, it took over a year before MXLINK was finally launched by Airbus in May

[25] Sharing networks, driving growth, 2017
https://www.itu.int/en/itunews/Documents/2017/2017-06/2017_ITUNews06-en.pdf

2019 as a secure mobile virtual network operator (SMVNO) for Mexican public-safety and defense authorities.

A similar wholesale network was set up in Poland in 2018 but since sign up by major mobile operators was optional based on existing access regime, it is also struggling to find support amongst major mobile operators[26].

Key success factors of wholesale networks include that there needs to have **functional separation** between wholesale and retail functions, willingness by wholesale network to sell 5G wholesale services in unbundled form to other mobile operators and service providers, resale by mobile operators should be subject to the same terms as that obtained from the wholesale network and use of the right spectrum band. **To achieve the desired outcome, the wholesale network needs to be facilitated with the full 90 MHz of spectrum, required to pay only 10 % of the licensee's annual fees and access to the national fiber optic network.**

To date, the 5G Taskforce has found that 5G use cases in Malaysia may not bring about sufficient volume to justify multiple overlapping 5G networks. However, 5G use cases in Malaysia may have sufficient volume for a wholesale network. Thus, implementing a wholesale network for 5G will be more cost effective. This is especially so if the wholesale network was run by the same company that supports the Malaysia as the National Telecommunications Infrastructure Provider (NTIP) for fibre thus enabling Malaysia to exploit economies of scale and lower the average cost for mobile broadband and other innovative services provisioning. We highlight that TM already has greater than 45% of Subscriptions of Ports Available nationwide.

To benefit the Rakyat, Malaysia should consider a National Telecommunications Infrastructure Provider for 5G (InfraCo) and TM is best to take up that role as InfraCo due to existing supply of infrastructure beyond "mobile front end" already on wholesale basis. TM is ready to be regulated under Open Access Wholesale Service arrangements to ensure that the other mobile operators benefit from low costs to resell 5G network slices to businesses (B2B), especially in rural areas. In combination with existing wholesale rates on fibre and attractive rates on international internet connectivity and submarine cables, the overall TCO would be lowered (as there would not be infrastructure duplication) and result in an optimal outcome for Malaysia. Some services that can be cost effectively offered, especially within rural areas include veterinary and public health telemedicine services as well as interactive educational programs.

Summary of TM's Views for Question 1(I):

1. **As incentive for better network coverage and service quality than required by the license terms, local industry regulators can reward auction winners through taxation models or by rebating.**
2. **Mostly the 700 MHz band will support 4G LTE or designated use as a technology neutral spectrum but some countries are starting to use the band to implement 5G. The EU is driving prioritizing of 700 MHz for wide area 5G deployments and T-Mobile in the U.S. is 5G ready on 600 MHz.**
3. **The combination of 5G and nationwide fibre can catalyze new opportunities and business models that will drive economic growth and development, particularly in rural areas. TM already has greater than 45% of Subscriptions of Ports Available nationwide.**
4. **Just optimizing the "mobile front end", mobile operators coming together can potentially yield TCO of 15-30% and reduce CAPEX by up to 60%.**

[26] Exatel proposes wholesale 5G network model, 2019
https://www.telecompaper.com/news/exatel-proposes-wholesale-5g-network-model--1284521

5. **To benefit the Rakyat, Malaysia should consider a National Telecommunications Infrastructure Provider for 5G (InfraCo) and TM is best to take up that role as InfraCo due to existing supply of infrastructure beyond mobile front end already on wholesale basis.**
6. **To achieve the desired outcome, the wholesale network needs to be facilitated with the full 90 MHz of spectrum, required to pay only 10 % of the licensee's annual fees and access to the national fiber optic network.**

TM proposes that:

1. **An InfraCo be set up and be made subject to regulation under Open Access Wholesale Service arrangements. TM is best to take up that role as InfraCo due to existing supply of infrastructure to mobile operators (beyond mobile front end) already on wholesale basis.**
2. **With TM as InfraCo, the Spectrum Assignment (SA) should be directly allocated to the InfraCo to expedite 5G by 6-9 months since the tender process can be avoided.**
3. **The spectrum fee should be lowered for an InfraCo.**
4. **Regardless, there should be a waiver on the annual fee components for 2 years as this coincides with the rollout period of the said 700 MHz network based on commitments within Zone 3 and 4. The example in Norway where auctions fees are higher but payment of parts of the auction fee for two years can be postponed is used as justification. Also, there should be a tax incentive as in the case of Brazil.**

Question 1 (II) – Timeline for assignment

Of the 20 countries sampled (refer to **Appendix 1**), the most common duration for the spectrum assignment at 700 MHz is 15 years. Out of 20 countries, 9 countries or 45% opted for 15 years and 9 countries or 45% opted for a term greater than 15 years i.e. between 17 to 25 years. Only Sweden which only has 28.5% of its geography comprising of non-water or forest has license duration of between 20-25 years. As a comparison, the maximum license duration is 22 and 20 years for both 2300 MHz and 2600 MHz respectively. Thus, the license duration can be extended to 20 years and a clause can be inserted into the license to allow for review of the license terms to cater for shifting consumer preferences and new developments in technology.

As a reference within the Malaysian context, Regulation 17 of Part IV of Communication and Multimedia (Spectrum) Regulation 2000 states that a spectrum assignment shall be valid for a period of 20 years or such lesser period as may be specified in the spectrum assignment.

New Zealand is the only country in the Asia Pacific region that has awarded the 700 MHz band spectrum for 20 years. The Nordic countries with exception of Finland, which issued license durations of 17 years in 2016, consistently awarded the 700 MHz band based on license durations of 20 years between December 2018 and June 2019.

We are of the opinion that the license duration for 700 MHz band spectrum can be extended to 20 years to maximize the benefit of the spectrum to the Rakyat. A clause for review can be inserted into the license terms to cater for contingencies. Extending the license duration can increase certainty about the arrangements with the 700 MHz band and this can induce further ecosystem investments.

With TM as InfraCo, should the Spectrum Assignment (SA) be directly allocated to the InfraCo to expedite 5G, the timeline can be brought forward by 6-9 months since the tender process can be avoided. Regardless, we are of the opinion that the timeline for the band allocation via tender needs to be brought forward. The 700 MHz band spectrum needs to be made available for use

earliest from 2nd Quarter 2020. This means that the process that commences in the 4th Quarter of 2019 needs to target completion by 1st Quarter of 2020.

TM proposes that:

1. **With TM as InfraCo, should the Spectrum Assignment (SA) be directly allocated to the InfraCo to expedite 5G, the timeline can be brought forward by 6-9 months since the tender process can be avoided.**
2. **Regardless, the timeline for the 700 MHz band should be brought forward to enable use from 2nd Quarter 2020.**
3. **The Spectrum Assignment (SA) duration should be extended to 20 years to be in line with CMA maximum duration. A longer duration can increase certainty about arrangements with the 700 MHz band and increase investments within the ecosystem.**

Question 2 - Optimum spectrum block per operator

Of the 18 countries sampled (refer to **Appendix 4**), the most common channel bandwidth allocated was 2x10 MHz or a total 20 MHz. Allocations of 700 MHz band spectrum have not always been to all mobile operators within the same country and can be of differing channel bandwidths. The largest channel bandwidth allocations have been in Singapore and Brazil. The allocations in Brazil were up to 50 MHz bandwidth for a single mobile operator with its award being tied to the country's strategic goals of improving mobile broadband with higher speeds, expanding fiber networks and improving in-country technology development. **In Mexico, the wholesale network utilizes the full 90 MHz of spectrum.**

TM proposes that:

1. **With TM as InfraCo, the optimum spectrum block per operator for the 700 MHz band spectrum should be entire available 2x40 MHz to enable faster speeds and Qos through 5G ready mobile networks. The Mexico wholesale network example where the full 90 MHz is utilized is used as justification.**

Spectrum Band	Questions 3 and 4
2300 MHz	3. MCMC would like to seek views on the proposed allocation plan for the 2300 MHz band, in particular on: I. Award mechanism II. Timeline for assignment
	4. MCMC would like to seek views on the optimum spectrum block per operator for assignment of the 2300 MHz band.

The bands available on 2300 MHz are listed in **Table 5**. Development of the devices to support 5G is still early stage. 5G devices that support for 2300 MHz includes but is not limited to the 5G CPE (Outdoor CPE) from Jaton Tec, 5G CPE 2.0 (Sub-6 GHz) - Indoor & Outdoor CPE from Huawei, the Samsung Galaxy S10 smartphone and the Gosuncn Welink GM800/GM801/GM850A/GM860A modules[27].

Table 5: Bands available on the 2300 MHz band spectrum

2300 MHz							
NR FR1 Band	**Band Alias**	**Uplink (UL) Operating Band** **BS Receive / UE Transmit**	**Downlink (DL) Operating Band** **BS Transmit / UE Receive**	**Bandwidth**	**Duplex Mode (Spacing)**	**5G Channel Width - Trials/ Build Out/ Active Status**	**Device Availability**
n40	TD 2300	2300 MHz - 2400 MHz	2300 MHz - 2400 MHz	100 MHz	TDD	40 MHz	4G: 4,449 5G: Module & Indoor Outdoor CPE

Source: http://niviuk.free.fr/nr_band.php, Frost & Sullivan

Question 3 (I) - Award mechanism

Of a total of 7 countries sampled globally that awarded the 2300 MHz band spectrum between 2012 and 2019 (refer to **Appendix 2**), 6 countries or 86% of local industry regulators in respective countries have opted for assigning the 2300 MHz band by spectrum assignment through auction. Spectrum assignment through tender (beauty contest) is rare with this award mechanism used only in Hong Kong in 2012. Brazil is expected to award in 2020.

Since the earliest band spectrum for 5G on C band and millimeter wave can be made available and effectively used is earliest by 2022[28], alternate means to expedite 5G technology adoption in Malaysia needs to be explored. This includes exploring use of existing available spectrum. Leveraging on the 2300 MHz band could be an avenue for Malaysia to expedite implementation

[27] 5G Device Ecosystem, 2019
https://gsacom.com/
[28]Roadmap for C-band spectrum in ASEAN, 2019
https://www.gsma.com/spectrum/wp-content/uploads/2019/08/GSMA_Roadmap-for-C-band-spectrum-in-ASEAN_WEB.pdf

of 5G. The band should be looked upon as important to spur growth of 5G technology. In the EU, Sweden through PTS is planning to award the 2300 MHz band spectrum (2300-2380MHz) to mobile operators in late 2019 or early 2020.

Within Asia Pacific, South Korea has already assigned a total of 477 MHz of low band spectrum for mobile, including 57 MHz in the 2300 MHz band. Australia has also already assigned a total of 690 MHz of low band spectrum for mobile, including band spectrum in the 700 MHz and 2300 MHz bands**. The attraction to the 2300 MHz band spectrum is the potential to offer a bandwidth of up to 100 MHz, which is required for 5G use cases that need bandwidth of at least 80-100 MHz to offer superior performance over that achievable with 4G LTE**. As comparison, the available bandwidth in Malaysia is 90 MHz.

In view of the facts that we have presented above, we do not support the plan by MCMC to vacate and reassign the 2300 MHz band. We support the removal of any regional distinctions (Peninsular/Sabah and Sarawak) with assignments to be made on a nationwide basis. We are of the opinion also that MCMC needs to revisit the spectrum allocation bandwidth for the 2300 MHz band taking into account the objective of incentivizing mobile operators to enhance speeds and QoS as well as that 5G is of national interest and of great importance to Malaysia and 5G needs to be enabled through a supportive spectrum strategy and roadmap. From this perspective, we urge that MCMC to reassign the 2300 MHz band back to the existing nationwide license holders due to past significant investment in this band by incumbents. With the removal of the regional distinction, there will be a vacant available block that requires a single nationwide owner. This block can be reassigned to active incumbents such as TM to ensure efficient use of spectrum.

Summary of TM's Views for Question 3 (I):

1. **The timeline for 5G on C band and millimeter wave might be delayed. Alternate means to expedite 5G technology adoption in Malaysia needs to be explored.**
2. **Leveraging on the 2300 MHz band could be an avenue for Malaysia to expedite implementation of 5G.**
3. **The attraction to the 2300 MHz band is the potential to offer a bandwidth of up to 100 MHz, which is required for 5G use cases that need bandwidth of at least 80-100 MHz to offer superior performance over that achievable with 4G LTE. The available bandwidth in Malaysia is 90 MHz.**
4. **5G is of national interest and of great importance to Malaysia and needs to be enabled through a supportive spectrum strategy and roadmap.**

TM proposes that:

1. **We urge that MCMC to reassign the 2300 MHz band back to the existing nationwide active license holders who has made significant investment in this band. With the removal of the regional distinction, there will be a vacant available nationwide block which can be assigned to TM to ensure efficient use of spectrum.**
2. **Unutilized spectrum should be re-assigned to the existing nationwide active license holders to maximize benefit to the Rakyat.**

Question 3 (II) – Timeline for assignment

Of the 6 countries sampled (refer to **Appendix 2**), due to insufficient sample size duration, the license duration for spectrum assignment at 2300 MHz ranged from 10 to 22 years. As a comparison, the maximum license duration is 25 and 20 years for both 700 MHz and 2600 MHz respectively.

As a reference within the Malaysian context, Regulation 17 of Part IV of Communication and Multimedia (Spectrum) Regulation 2000 states that a spectrum assignment shall be valid for a period of 20 years or such lesser period as may be specified in the spectrum assignment.

Thus, the license duration can be extended to 20 years and a clause can be inserted into the license to allow for review of the license terms to cater for shifting consumer preferences and new developments in technology.

We are of the opinion that the license duration can be extended to 20 years and allocated via spectrum assignment (SA) by 2nd Quarter of 2020 for use earliest from 3rd Quarter 2020 to maximize the benefit of the spectrum to the Rakyat. A clause for review can be inserted into the license terms to cater for contingencies. Extending the license duration can increase certainty about the arrangements with the 2300 MHz band and this can induce further ecosystem investments. Also, 5G is of national interest and of great importance to Malaysia and the 3.5 GHz band spectrum beneficial for 5G outdoor use will only be available from 2022-2023. We highlight that the C-band is currently in use by ubiquitous FSS deployments e.g. Television receive-only (TVRO) and very small aperture terminals (VSATs).

TM proposes that:

1. **With TM as InfraCo, should the Spectrum Assignment (SA) be directly allocated to the InfraCo to expedite 5G, the timeline can be brought forward by 6-9 months since the tender process can be avoided.**
2. **Regardless, the timeline for the band should be brought forward to enable use from 3rd Quarter 2020.**
3. **The Spectrum Assignment (SA) duration should be extended to 20 years to be in line with CMA maximum duration. A longer duration can increase certainty about arrangements with the 2300 MHz band and increase investments within the ecosystem.**
4. **To ensure successful implementation of 2300 MHz band spectrum, we urge MCMC to ensure timely clearing and channelizing of the band well in advance of the completion of the spectrum allocation process.**

Question 4 - Optimum spectrum block per operator

Of the 6 countries sampled (refer to Appendix 5), the most common channel bandwidth allocated was 1x30 MHz or a total 30 MHz. Allocations of 2300 MHz band spectrum have not always been to all mobile operators within the same country and can be of differing channel bandwidths. Largest channel bandwidth allocations have been in UK and Denmark with 40 MHz and 60 MHz respectively.

O2 in UK has acquired 40 MHz of 2300 MHz band spectrum for additional 4G network enhancements and for use of **Carrier Aggregation with other LTE-Advanced bands**, which enables

them to use several bands at once in order to improve mobile broadband speeds[29]. TDC in Denmark has acquired 60 MHz out of the available 100 MHz bandwidth within the 2300 MHz band. They shared that this is an important step for them towards fulfilling their plan to deploy 5G across the country by 2020[30]. For them, deployment of 5G will be nationwide and it will initially be used to create more capacity in the 4G network and in the longer term also to support capacity requirements of the 5G network.

Thus, local regulators such as MCMC need to take into account that **mobile operators need the use of multiple bands to increase mobile broadband speeds and to implement 5G**. The current proposed allocation of 1x30 MHz is not an efficient allocation of spectrum.

TM proposes that:

1. **We propose that the optimum allocation of spectrum blocks should be 60 MHz for 5G and 30 MHz for 4G LTE. The Denmark example is used as justification for the block size at 5G as this will enable faster speeds and Qos through 5G ready mobile networks.**
2. **Unutilized spectrum should be re-assigned to the existing nationwide active license holders to maximize benefit to the Rakyat.**

[29] O2 to Upgrade 1000 UK Sites with 2.3GHz Based 4G Mobile Spectrum, 2019
https://www.ispreview.co.uk/index.php/2018/04/o2-to-upgrade-1000-uk-sites-with-2-3ghz-based-4g-mobile-spectrum.html

[30] TDC takes lion's share in Danish spectrum auction, 2019
https://www.mobileeurope.co.uk/press-wire/tdc-takes-lion-s-share-in-danish-spectrum-auction

Spectrum Band	Questions 5 and 6
2600 MHz	5. MCMC would like to seek views on the proposed allocation plan for the 2600 MHz band, in particular on: I. Award mechanism II. Timeline for assignment
	6. MCMC seeks suggestions on approaches to mitigate interference between FDD and TDD blocks to facilitate efficient spectrum utilization in the 2600 MHz band.

The interest in band 41 of the 2600 MHz band spectrum for 5G is due to the wide bandwidth available of 100 MHz if compared to band 7 and band 38. The bands available on 2600 MHz are listed in **Table 6**. Development of the devices to support 5G is still early stage. So far, no 5G devices support band n38 and the 5G devices that support band n7 are still only modules. 5G devices that support for 700 MHz includes but is not limited to the 5G CPE 2.0 (Sub-6 GHz) - Indoor & Outdoor CPE from Huawei, the Samsung Galaxy S10 smartphone, the GM800/GM801/GM850A/GM860A modules and GW2000 (Hotspot)/GW3000 (Indoor CPE)/GW5000 (Outdoor CPE) from Gosuncn Welink, Z6 Pro (Phone) from Lenovo, V50 (Variant 2) from LG, Mate 20X 5G from Huawei, Axon 10 Pro and 5G Indoor CPE (MC801) from ZTE, 5G Hub (Hotspot) from HTC and 5G CPE (Outdoor CPE) from Jaton Tec [31]. Comparatively, much more manufacturers have been focusing on the 2600 MHz band as compared to the 700 MHz and the 2300 MHz bands.

Table 6: Bands available on the 2600 MHz band spectrum

2600 MHz							
NR FR1 Band	**Band Alias**	**Uplink (UL) Operating Band** **BS Receive / UE Transmit**	**Downlink (DL) Operating Band** **BS Transmit / UE Receive**	**Bandwidth**	**Duplex Mode (Spacing)**	**5G Channel Width - Trials/ Build Out/ Active Status**	**Device Availability**
n7	2600	2500 MHz – 2570 MHz	2620 MHz – 2690 MHz	70 MHz	FDD (120 MHz)	-	4G: 7,939 5G: Modules
n38	TD 2600	2570 MHz – 2620 MHz	2570 MHz – 2620 MHz	50 MHz	TDD	-	4G: 3,434 5G: 0
n41	TD 2500	2496 MHz – 2690 MHz	2496 MHz – 2690 MHz	194 MHz	TDD	100 MHz	4G: 3,300 5G: 15 incl. CPE, USB *5 incl. phone & hotspot

Source: http://niviuk.free.fr/nr_band.php, GSA, Frost & Sullivan

[31] 5G Device Ecosystem, 2019
https://gsacom.com/

Question 5 (I) – Award mechanism

Of a total of 21 countries sampled globally that awarded 2600 MHz band spectrum between 2008 and 2019 (refer to **Appendix 3**), 20 countries or 95% of local industry regulators in respective countries have opted for assigning the 2600 MHz band by spectrum assignment through auction. 3 of which were multi-band awards. France was the only country that was observed to have utilized a hybrid tender. The local regulator specifically evaluated bids from bidders based on the terms of the MVNO access, commitment to accelerate 4G LTE rollout in the most sparsely populated parts of France as well as financial aspects and commitments towards to the license[32].

The existing implementation of the 2600 MHz band spectrum in Malaysia follows global practices and ITU-R 1036 recommendations (Option 1). It utilizes a combination of Band n7 (2500-2570 MHz paired with 2620-2690 MHz) and Band n38 (2570-2620 MHz) with 70 MHz on FDD having a duplex separation distance of 120 MHz and 50 MHz on TDD. 5 MHz guard bands were installed at 2570-2575 MHz and 2615-2620 MHz. Allocated spectrum channels have been 2x10 MHz on FDD and 20 MHz on TDD. Spectrum sharing has resulted in use of 2x20 MHz on FDD being common and FDD-TDD interference is experienced.

A study by Empiris found that 4G LTE networks implemented using 2600 MHz bands with 2x10 MHz spectrum channels will cost twice as much to deploy as services with 2x20 MHz spectrum channels.[33] The optimum performance on the 2600 MHz band is achieved with blocks of 2x20 MHz contiguous spectrum channels. There have been some variations in implementations of the 2600 MHz band. The following are some of the variations observed:

a. **The size of the guard band can be altered to avoid interference**. Guard bands in the EU ranges from 5 MHz to 10 MHz depending on local allocations.

b. **The size of the allocated bands can be altered.** For example, Chile utilized the full 194 MHz with 76 MHz for FDD and 42 MHz for TDD [34]and Norway ensured that there was adequate paired spectrum with 2x40 MHz spectrum channels for two mobile operators. The country allowed the market to determine whether further spectrum at TDD or FDD was required as there was option for either 2x10 MHz at FDD or 20 MHz at TDD[35].

c. **New entrants were paired with low band spectrum**. The 2600 MHz spectrum auction in 2010 saw Tele2 in the Netherlands, a market successful MVNO, crystalize its future as a mobile operator when it obtained 2x20 MHz of 2600 MHz band for FDD [36]. Together with the

[32] Spectrum value of 800MHz, 1800MHz and 2.6GHz, 2012
https://www.ofcom.org.uk/__data/assets/pdf_file/0016/51208/spectrum-value.pdf
[33] The 2.6GHz Spectrum Band An Opportunity for Global Mobile Broadband, 2012
https://www.gsma.com/spectrum/wp-content/uploads/2012/07/Spectrum-The-2-6GHz-band-Opportunity-for-global-mobile-broadband-English.pdf
[34] The 2.6 GHz Spectrum Band, 2009
https://rysavyresearch.files.wordpress.com/2017/08/2009_12_gsma_2_6_ghz_report.pdf
[35] Fixed or flexible? A survey of 2.6GHz spectrum awards, 2010
https://www.dotecon.com/assets/images/dp1001.pdf
[36] Tele2 wins mobile license in 2.6 GHz auction in the Netherlands, 2010
https://www.tele2.com/media/press-releases/2010/tele2-wins-mobile-license-in-26-ghz-auction-in-the-netherlands

interference free 2x10 MHz channel spectrum at 800 MHz that it won in 2011, it reached 99% of the population with 4G LTE coverage in 2013.

d. **Option 1 could have been completely avoided.** Two countries i.e. the U.S. and China, have opted for the flexibility offered on Option 3 and have allocated the entire 194 MHz on band n41 (2496-2690 MHz) for TDD. The populations within these large geography markets help to overcome the issue of country specific mobile devices through economies of scale.

The outcome of spectrum auctions globally for the 2600 MHz band spectrum show that there is a stronger demand and willingness to pay for the value for paired spectrum than there is for unpaired spectrum amongst mobile operators. The reason for this is that FDD systems have several advantages over TDD systems, especially when it comes to cost of mobile network, interference and end user devices. In fact, the prices paid on spectrum trading in Norway in 2007 revealed that the value of unpaired 2600 MHz band spectrum had declined post auction.

Unlike FDD systems, TDD systems do not benefit from larger duplex separation distance and operate frequencies much closer to each within the same mobile network. This means that implementation needs to have very precise timing and synchronization to avoid self-interference (i.e. optimization intra-network is necessary) and typically requires 31% to 65% more base stations depending on whether it is a 1:1 or 1:2 TDD system. From the perspective of end user devices, the number of devices supporting band 7 and band 38 was 7,939 and 3,434 respectively as at November 2018. Support for band 41 is not much better at 3,300. Here, FDD too has the advantage of backward compatibility with existing FDD networks through least expensive mass market terminals.

Although 5G technology is still nascent, the fact that **there is still no 5G device support for band 38** and the 2 licensees in the market do not have sufficient volume to effect change means that the award mechanism for 2600 MHz needs to be reviewed to ensure that use of spectrum enables cost effective 5G deployment. Malaysia needs to not only ensure certainty with regards to band arrangements but also needs to consider the longer term impact of early decisions made in order to enable achievement of national agendas. It is well understood that the potential contribution towards a country's economic growth and digital economy transformation should be the incentive for the Malaysian government and industry regulator to push for faster internet speeds brought about through 5G.

The 2600 MHz band is important to spur growth of 5G technology. China Mobile has allocated the 2600 MHz band spectrum to provide 5G in a move by the Chinese government to enable 5G adoption in China and make it competitive with others. Thailand is considering the 2600 MHz band in order for 5G spectrum costs not to burden mobile operators and is in the process of recalling unused bandwidth of 190MHz on the 2600MHz band to prepare spectrum bandwidth for the 5G auction. **Quantifiable evidence support this strategic direction as auction prices for 5G spectrum licenses (not just on 2600 MHz band) in 20 countries have been observed at only 25% of the average for 4G licenses**[37].

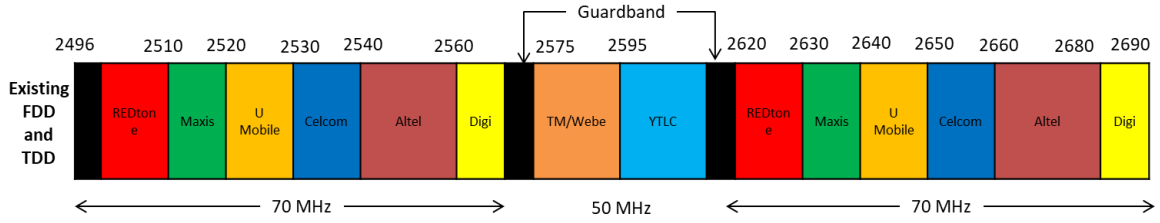
In the U.S., Sprint has an active 5G status with band n41 at 2500 MHz and channel bandwidth of 100 MHz. With 24% 4G LTE population coverage rolled out, Sprint has introduced 5G-NR with Massive MIMO (64x64) on 2500 MHz coexisting it with its current LTE-Advanced network in the

[37] Huawei: 2600MHz best option for 5G, 2019
https://www.bangkokpost.com/business/1651040/huawei-2600mhz-best-option-for-5g

band. According to Sprint, this increases data capacity by a factor of up to 10 compared to 4G[38]. Following the approval for the merger between Sprint and T-Mobile obtained in July 2019, the merged entity will work towards 5G and broadband deployment in rural area. T-Mobile's 4G LTE deployment on 600 MHz is 5G ready with 5G planned for launch on 600 MHz as soon as compatible smart phones become available in 2H 2019.

In view of the facts that we have presented above, we support Malaysia's plan to reassign the 2600 MHz band through spectrum assignment (SA) direct conversion. However, reassignment should not be based on actual utilization but instead based on usage by actual spectrum license holder. Unutilized spectrum by actual spectrum license holder should be re-assigned to maximize benefit to the Rakyat. **Table 7** shows the existing 2600 MHz band spectrum allocation in Malaysia. However, not all license holders are active.

Table 7: Existing 2600 MHz band spectrum allocations



Taking into account that 5G is of national interest and of great importance to Malaysia, 5G needs to be enabled through a supportive spectrum strategy and roadmap. We strongly urge MCMC to consider the necessary interference mitigation techniques e.g. use of receiving filters, proposed in the next section to enable 5G ready mobile networks and to address existing interference issues. **We note also that it is possible to allocate up to the entire band to the InfraCo based on the implementation of 100 MHz band by Sprint in the U.S**.

Summary of TM's views for section 5(I):

1. **The Spectrum band plan particular pairing of spectrum bands between low and mid bands is critical to enable cost efficient rollouts by mobile operators.**
2. **5G will enable faster internet speeds that can contribute towards Malaysia's economic growth and digital economy transformation. The spectrum allocation thus needs place more emphasis on facilitating 5G.**
3. **Malaysia will not be alone in planning the 2600 MHz spectrum frequency for 5G. China and Thailand has decided on this approach. Up to 100 MHz can be allocated to the InfraCo based on the implementation of 100 MHz bandwidth by Sprint in the U.S.**
4. **We support Malaysia's plan to reassign the 2600 MHz band through spectrum assignment (SA) direct conversion. However, reassignment should not be based on actual utilization but instead based on usage by actual spectrum license holder. Unutilized spectrum by actual spectrum license holder should be re-assigned to maximize benefit to the Rakyat.**
5. **We strongly urge MCMC to consider the necessary interference mitigation techniques e.g. use of receiving filters, proposed in the next section to enable 5G ready mobile networks and to address existing interference issues.**

[38] Sprint's 5G network is here, and it's completely different from what Verizon and AT&T are doing, 2019 https://www.theverge.com/2019/5/30/18645663/sprint-5g-network-now-available-atlanta-dallas-houston-kansas-city-verizon-at-t

TM proposes that:

1. **MCMC proceed with plan to reassign the 2600 MHz band through spectrum assignment (SA) direct conversion. However, reassignment should not be based on actual utilization but instead based on usage by actual spectrum license holder.**
2. **We strongly urge MCMC to consider the necessary interference mitigation techniques e.g. use of receiving filters, proposed in the next section to enable 5G ready mobile networks and to address existing interference issues.**
3. **An allocation of 80 MHz bandwidth should be allocated to the InfraCo. Unutilized spectrum by actual spectrum license holder should be re-assigned to InfraCo to maximize benefit to the Rakyat. The example of Sprint in the U.S. where they were allocate 100 MHz for nationwide rollout is used as justification.**

Question 5 (II) – Timeline for assignment

Of the 19 countries sampled (refer to **Appendix 3**), the most common duration for the spectrum assignment at 2600 MHz is 15 years. Out of 19 countries, 11 countries or 86% opted for 15 years and 7 countries or 37% opted for a term greater than 15 years i.e. between 16 to 20 years. As a comparison, the maximum license duration is 22 and 20 years for both 2300 MHz and 2600 MHz respectively.

As a reference within the Malaysian context, Regulation 17 of Part IV of Communication and Multimedia (Spectrum) Regulation 2000 states that a spectrum assignment shall be valid for a period of 20 years or such lesser period as may be specified in the spectrum assignment.

We are supportive of Malaysia's approach of awarding the 2600 MHz band spectrum for a total duration of 15. However, we need to take into account also that **5G is of national interest and of great importance to Malaysia and the fact that 2600 MHz is best paired with 700 MHz for 5G**.

Since we have proposed to bring forward the 700 MHz band allocation timeline, we are now also proposing to bring forward the 2600 MHz band allocation. Both timelines should be in alignment due to effective pairing of low band for coverage with mid band for capacity. We, therefore, propose that the conversion process of the 2600 MHz band be brought forward to enable use from 2nd Quarter 2020.

The Spectrum Assignment (SA) duration should be extended to 20 years to be in line with CMA maximum duration. A longer duration can increase certainty about arrangements with the 2600 MHz band and increase investments within the ecosystem.

TM proposes that:

1. **We propose that the conversion process of the 2600 MHz band be brought forward to enable use from 2nd Quarter 2020. The timeline for the 700 MHz band needs to be in alignment with the timeline for 2600 MHz band.**
2. **The Spectrum Assignment (SA) duration should be extended to 20 years to be in line with CMA maximum duration. A longer duration can increase certainty about arrangements with the 2600 MHz band and increase investments within the ecosystem.**
3. **To ensure successful implementation of 2600 MHz band, we urge MCMC to ensure timely clearing and channelizing of the band well in advance of the completion of the tender (beauty contest) for spectrum allocation.**

Question 6 - Suggestions on approaches to mitigate interference

It is known that TDD systems and FDD systems cause mutual interference issues that can be so severe that they cannot operate next to each other[39]. Also, TDD terminals can receive interference from other non-synchronised TDD systems and/or FDD terminals operating anywhere between block #1 and block #24[40]. TM and other mobile operators face this issue here in Malaysia.

ITU only specifies broadly the approach e.g. reasonable deployment of stations, set protection bands, isolation of antennas, antenna polarization, use of adaptive antennas, improvements of transmitter and receivers and power control and switching of mobile stations.

To be more effective at spectrum management, local regulatory bodies such as MCMC need to drive effective resolution of interference issues e.g. reconstruction of spectrum allocation and implementing specific approaches/solutions, and follow up with strict enforcement of regulations when and where necessary.

Specifically, to enable co-existence between LTE-FDD and LTE-TDD systems, if the two systems are using an adjacent frequency carrier, spatial separation between the eNodeBs of the two systems will be needed, otherwise the two systems will interfere with each other. To avoid interference, it is recommended that the eNodeBs of FDD and TDD systems should not be placed together if both are using the adjacent frequency carriers[41]. This is because some of the physical data and control channels will experience severe adjacent channel interference resulting in inability of the system to demodulate correctly.

Next, to overcome external interference i.e. interference that occurs when the LTE bands are illegally used by other systems or there are spurious emissions, blocking and intermodulation interference, there is need to develop regulatory documents for frequency management and it needs to be strictly followed. Interference coordination for deployed networks should be conducted when necessary. Mobile operators need to strengthen communications and coordination on planning and operation of radio stations.

The only other alternative to these measures will be to use wider guard bands and reduce available spectrum allocation for mobile operator deployment, which will be less favorable and will not maximize the use of spectrum within industry.

TM proposes that:

1. **To mitigate interference specific approaches/solutions e.g. use of receiving filters, need to be studied, mandated for use and enforced as part of proper spectrum management.**

[39] The 2.6 GHz Spectrum Band, 2009
https://rysavyresearch.files.wordpress.com/2017/08/2009_12_gsma_2_6_ghz_report.pdf
[40] On the impact of interference from TDD terminal stations to FDD terminal stations in the 2.6 GHz band, 2008
https://pdfs.semanticscholar.org/40ed/ea1da066145fde5d47d74b1f18b0fb35a864.pdf
[41] Spectrum Management for 4G-LTE, 2016
https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/SiteAssets/Pages/Events/2016/Oct-CandI2016/CAICT2016/Session%206-2%20Frequency%20Management%20for%204G-LTE-%E6%96%B9%E7%AE%AD-final.pdf

Spectrum Band	Question 7
Spectrum Price	7. MCMC would like to see views on the appropriate range (per MHz) for SA fees (price component and annual fee component) and the rationale for the proposed fees, for the following spectrum bands: I. 700 MHz, II. 2300 MHz and; III. 2600 MHz.

Spectrum fees can be justified from the perspective of the need to efficiently utilize scarce spectrum and the need to finance spectrum management activities. Fee-exempt licensing typically leads to inefficient use of spectrum. However, while spectrum fees can be justified, spectrum pricing needs to take into account the local cost versus benefit analysis, especially since spectrum fees are no longer on a by service basis but increasingly moving towards on an open licensing basis to accommodate converging services[42].

In arriving at the right cost structure that will enable adoption of next generation mobile technology such as 5G, **the total spectrum costs need to be taken into account when spectrum has been designated as technology neutral**. Most mobile operators will utilize a combination of spectrum bands to offer nationwide coverage while at the same time cope with continuously increasingly capacity. Low bands are mostly paired with mid bands with low bands catering to coverage requirements and mid bands catering for capacity requirements. However, with 5G upcoming, there will also be the need for the high bands alongside the already heavy investment needed for 5G infrastructure as well as R&D in partnership with ecosystem players.

Major mobile operators in Malaysia such as Maxis, Celcom, Digi and U Mobile have already committed RM 2.07 billion to RM 2.79 billion for spectrum at 900 MHz, 1800 MHz and 2100 MHz. These companies allocate between 2.4% and 4.6% of blended ARPU per subscriber to spectrum fees for spectrum at 900 MHz, 1800 MHz and 2100 MHz on a monthly basis, which amounts to RM1.09 to RM1.85 per subscriber per month. As a percentage of mobile service revenue, these companies already allocate between 2.3% to 5.1% per year.

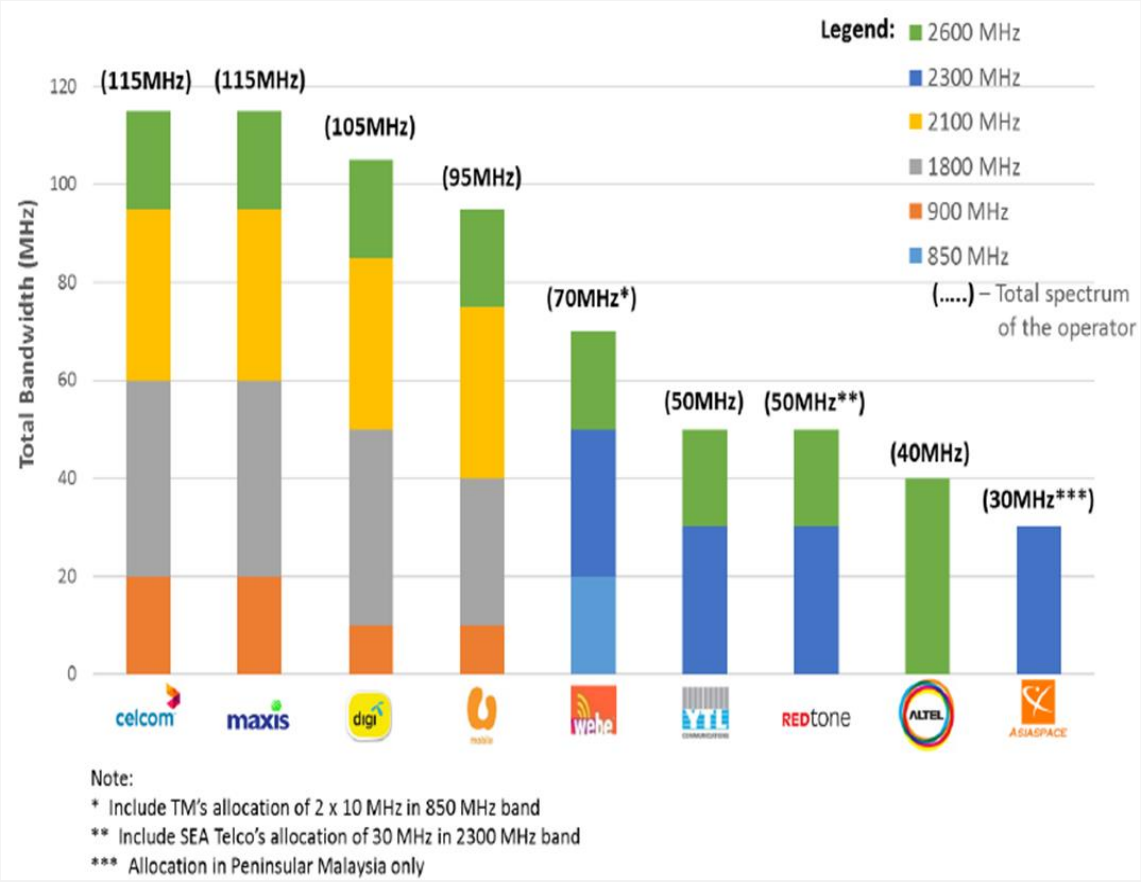
Table 9 and 10 show spectrum holdings by mobile operators and amount already paid for 900 MHz, 1800 MHz and 2100 MHz bands versus the mobile services revenue for 2018. The impact of additional spectrum fees for 700 MHz, 2300 MHz and 2600 MHz will be felt by the consumers. **Table 10** shows data to support that when a mobile operator has insufficient subscribers, the spectrum fees take up a disproportionate amount of the mobile services revenue impacting profitability. The spectrum fee as percentage of mobile services revenue for U Mobile is approximately two times that of Digi with 5.1% versus 2.6% respectively. With the addition of spectrum at 700 MHz (2x5 MHz), 2300 MHz (10 MHz) and 2600 MHz (10 MHz), there will be higher commitments to spectrum fees and this will have further implications on mobile operator profitability. **Table 11** illustrates this point as a concept for additional 700 MHz and 2600 MHz. Spectrum fees as a percentage of mobile service revenue is estimated to increase to 3.4% - 7.9% from 2.3% - 5.1% per year. Some assumptions were made on the block size to be acquired.

Further analysis of the spectrum holdings by mobile operators against mobile services revenue and number of subscribers indicate inefficient use of spectrum. There are some mobile operators that are not active due to inability to obtain the right spectrum at the right price. While spectrum

[42] Economic of Spectrum as Resource, 2016
https://www.itu.int/en/ITU-D/Regional-Presence/AsiaPacific/Documents/Events/2016/Nov-SM-Economics/Presentations/Day%201%20-%20Session%202_Fard%20(Economics%20of%20spectrum).pdf

sharing by way of third party authorization is encouraged and spectrum trading is allowed, we are of the opinion that unutilized spectrum should be re-assigned and premiums incurred during spectrum trading based on need basis should be avoided to maximize benefit to the Rakyat. Therefore, we seek adherence to traditional spectrum management regulation that requires spectrum to be used by licensees or returned to the local licensing authority.

Table 9: Spectrum holdings by mobile operators



Sources: Public Inquiry on Allocation of spectrum bands for mobile broadband service in Malaysia, July 2019

Table 10: 900MHz, 1800 MHz and 2100 MHz spectrum fee commitments versus mobile service revenues in 2018

	Bandwidth /Spectrum	Price Component + Annual Fee Component	License Validity Period	Total Spectrum Fee over 15 years	Mobile Service Revenue (FY18)	Spectrum Fee as % of Revenue	# of Subscribers (as at Dec-18)	Spectrum Fee as % of Blended ARPU
Celcom	2x10 MHz, 900 MHz 2x20 MHz, 1800 MHz	RM 816.75 mil + RM 70.25 mil x 15 years	July 2017 to June 2032	RM 2.79 bn	RM 6.12 bn	3.0%	9.08 mil	3.6% of RM 48
	2x15 MHz, 2100 MHz	RM118.4 mil + RM 50 mil x 16 years	April 2018 to April 2034					
Maxis	2x10 MHz, 900 MHz 2x20 MHz, 1800 MHz	RM 816.75 mil + RM 70.25 mil x 15 years	July 2017 to June 2032	RM 2.79 bn	RM 8.07 bn	2.3%	10.89 mil	2.4% of RM 59
	2x15 MHz, 2100 MHz	RM118.4 mil + RM 50 mil x 16 years	April 2018 to April 2034					
Digi	2x5 MHz, 900 MHz 2x20 MHz, 1800 MHz	RM 598.55 mil + RM 51.48 mil x 15 years	July 2017 to June 2032	RM 2.29 bn	RM 5.92 bn	2.6%	11.66 mil	2.7% of RM 41
	2x15 MHz, 2100 MHz	RM118.4 mil + RM 50 mil x 16 years	April 2018 to April 2034					
U Mobile	2x5MHz, 900 MHz 2x15 MHz, 1800 MHz	RM 503.41 mil + RM43.31 mil x 15 years	July 2017 to June 2032	RM2.07	RM 2.73 bn	5.1%	6.2 mil	4.6% of RM 40
	2x15 MHz, 2100 MHz	RM118.4 mil + RM 50 mil x 16 years	December 2007 to March 2027					

Sources: Mobile operator annual reports and interviews, Frost & Sullivan research

Table 11: 700 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2600 MHz spectrum fee commitments versus mobile service revenues in 2018

	Bandwidth /Spectrum	Price Component + Annual Fee Component	License Validity Period	Total Spectrum Fee over 15 years	Mobile Service Revenue (FY18)	Spectrum Fee as % of Revenue	# of Subscribers (as at Dec-18)	Spectrum Fee as % of Blended ARPU
Celcom	2x10 MHz, 900 MHz 2x20 MHz, 1800 MHz	RM 816.75 mil + RM 70.25 mil x 15 years	July 2017 to June 2032	RM 2.79 bn	RM 6.12 bn	4.5%	9.08 mil	5.3% of RM 48
	2x15 MHz, 2100 MHz	RM118.4 mil + RM 50 mil x 16 years	April 2018 to April 2034					
Maxis	2x10 MHz, 900 MHz 2x20 MHz, 1800 MHz	RM 816.75 mil + RM 70.25 mil x 15 years	July 2017 to June 2032	RM 2.79 bn	RM 8.07 bn	3.4%	10.89 mil	3.6% of RM 59
	2x15 MHz, 2100 MHz	RM118.4 mil + RM 50 mil x 16 years	April 2018 to April 2034					
Digi	2x5 MHz, 900 MHz 2x20 MHz, 1800 MHz	RM 598.55 mil + RM 51.48 mil x 15 years	July 2017 to June 2032	RM 2.29 bn	RM 5.92 bn	4.1%	11.66 mil	4.2% of RM 41
	2x15 MHz, 2100 MHz	RM118.4 mil + RM 50 mil x 16 years	April 2018 to April 2034					
U Mobile	2x5MHz, 900 MHz 2x15 MHz, 1800 MHz	RM 503.41 mil + RM43.31 mil x 15 years	July 2017 to June 2032	RM2.07	RM 2.73 bn	7.9%	6.2 mil	7.3% of RM 40
	2x15 MHz, 2100 MHz	RM118.4 mil + RM 50 mil x 16 years	December 2007 to March 2027					

Sources: Mobile operator annual reports and interviews, Frost & Sullivan research

Question 7 (I) – Range for SA fees for 700 MHz

Based on data points collected (refer **Appendix 7 and 10**), benchmarks available are mostly for spectrum assignment via auction. Back of the envelope calculations, analysis and modeling of data points from global auctions held between 2000 and 2019 resulted in an estimation of spectrum fees for 700 MHz in Malaysia. We note a variance of +/- 60% due to differences in spectrum pricing for small versus large mobile operators.

We are of the opinion that the lump sum payment plus 15 years of annual fees amounting to RM 493.94 million[43] that was proposed by MCMC in the last AIP published for the 700 MHz band in 2017 is on the high side. Furthermore, since most mobile operators will opt for 15 equal annual payments, the total payable for the 700 MHz spectrum increases by 40.9% to RM 694.6 million.

As pricing for spectrum assignment through tender (beauty contest) is typically more conservative due to license obligations emphasizing network coverage and services offered within rural and remote areas, the range for spectrum assignment fees for the 700 MHz band should be much lower than the benchmark against auction prices, by up to 60%. Therefore, annual fees for the first two years should be waived as it coincides with the build out stage of the network utilizing the spectrum band and tax incentives/rebates should be considered.

Question 7 (II) – Range for SA fees for 2300 MHz

Based on data points collected (refer **Appendix 7 and 11**), benchmarks available are mostly for spectrum assignment via auction. Back of the envelope calculations, analysis and modeling of data points from global auctions held between 2005 and 2019 resulted in an estimation of spectrum fees for 2300 MHz in Malaysia. We note a large variance of due to low number of data points.

We estimate that spectrum fees for the 2300 MHz band for a 15 year license in Malaysia should be 20-25% of spectrum fees for the 700 MHz band since pricing at higher bands is cheaper than lower bands and the value in the market for the 2300 MHz band is lower compared to the 2600 MHz band. The total lump sum payment plus 15 years of annual fees should therefore not exceed this benchmark and in fact can be lowered by up to 40% since the range for spectrum assignment fees for the 2300 MHz band should be much lower than the benchmark against auction prices.

Question 7 (III) – Range for SA fees for 2600 MHz

Based on data points collected (refer **Appendix 9 and 12**), benchmarks available are mostly for spectrum assignment via auction. Back of the envelope calculations, analysis and modeling of data points from global auctions held between 2005 and 2019 resulted in an estimation of spectrum fees for 2600 MHz in Malaysia.

We estimate that spectrum fees for the 2600 MHz band for a 15 year license in Malaysia should be 30-40% of spectrum fees for the 700 MHz band since pricing at higher bands is cheaper than lower bands. The total lump sum payment plus 15 years of annual fees should therefore not exceed this benchmark and in fact can be lowered by as much as up to 80% since the range for spectrum assignment fees for the 2600 MHz band should be much lower than the benchmark against auction prices.

[43] Applicant Information Package No. 1 of 2017

Summary of TM's views for section 7(I) :

1. The spectrum fee needs to take into account that there will be more bands upcoming for 5G, the annual population growth rate in Malaysia is decreasing and wholesale networks on 700 MHz are required to pay a much lower spectrum fee. **Technology neutral spectrum means that total spectrum fees for all bands acquired need to be considered.** Additional 700 MHz and 2600 MHz band spectrum will result in spectrum fees as a percentage of mobile service revenue estimated to increase to 3.4% - 7.9% from 2.3% - 5.1% per year.

2. For the 700 MHz band, we are of the opinion that the lump sum payment plus 15 years of annual fees amounting to RM 493.94 million44 that was proposed by MCMC is on the high side. **The spectrum assignments fees for the 700 MHz band should be much lower than the benchmark against auction prices, by up to 60%.** Therefore, annual fees for the first two years should be waived as it coincides with the build out stage of the network utilizing the spectrum band and tax incentives/rebates should be considered.

3. We estimate that spectrum fees for the 2300 MHz band for a 15 year license in Malaysia should be 25% of spectrum fees for the 700 MHz band. The total lump sum payment plus 15 years of annual fees should be lowered by as much as up to 40% since the range for spectrum assignment fees for the 2300 MHz band should be much lower than the benchmark against auction prices. **The spectrum assignment fees for 2300 MHz should be reduced by 85% of the price of the 700 MHz band.**

4. We estimate that spectrum fees for the 2600 MHz band for a 15 year license in Malaysia should be 40% of spectrum fees for the 700 MHz band. The total lump sum payment plus 15 years of annual fees should be lowered by as much as up to 80% since the range for spectrum assignment fees for the 2600 MHz band should be much lower than the benchmark against auction prices. **The spectrum assignment fees for 2600 MHz should be reduced by 92% of the price of the 700 MHz band**.

TM proposes that:

1. **Technology neutral spectrum means that total spectrum fees for all bands acquired need to be considered.**
2. **The spectrum price for the 700 MHz, 2300 MHz and 2600 MHz spectrum bands should be reviewed downwards**
    a. **700 MHz – lower than AIP price released in 2017 by up to 60%.**
    b. **2300 MHz – lower than AIP price released in 2017 by up to 85%.**
    c. **2600 MHz – lower than AIP price released in 2017 by up to 92%.**
3. **To compensate for license obligations on 700 MHz, annual fees for the first two years should be waived as it coincides with the build out stage of the network utilizing the spectrum band and tax incentives/rebates should be considered.**

[44] Applicant Information Package No. 1 of 2017