THE REPUBLIC OF THE UNION OF MYANMAR

MINISTRY OF TRANSPORT AND COMMUNICATIONS

Nay Pyi Taw

IMT & 5G Spectrum Roadmap (Revised Spectrum Roadmap 2016)

Meet the Needs Over next 5 Years

Xxxx February, 2020

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1. INTRODUCTION

1.1 Background

On 8 April 2016, following extensive public and industry consultation then Ministry of Transport and Communications released a "***Spectrum Roadmap: Meet the Needs Over the Next 5 Years"*** *("2016 Spectrum Roadmap").*

As three years had passed since the release of Spectrum Roadmap, Post and Telecommunications Department ('PTD') decided that it is important to assess its appropriateness of the 2016 Spectrum Roadmap going forward and what changes (if any) are needed especially in relation to IMT spectrum.

On 8 March 2019, the PTD released a Consultation Paper "*Review of IMT Aspects of Myanmar's Spectrum Roadmap"* and PTD also sought the public comments by issuing consultation paper entitled Myanmar's IMT and 5G Spectrum Roadmap preliminary positions on 25th June, 2019 which is taking moves as to release further IMT Spectrum in Myanmar. The PTD is pleased to advise that some 17 responses were received including mobile network operators (MNOs), regional wireless broadband providers, other Ministries, vendors and other industry stakeholders. Prior to this the PTD released a paper in January 2019 on the *Spectrum Optimisation of the 850 MHz band* in respect of which public comments were due 28 February 2019. Responses on the 850 MHz band were folded into the broader IMT Spectrum Roadmap Consultation process as some of the responses covered the same issues.

While certain decisions may be linked to the World Radio Conference (WRC-19) scheduled for later in 2019, the PTD's overall view is that the very high proportion of smartphone penetration in Myanmar and the continuing challenges to deploy fixed network infrastructure in Myanmar arguably means that the PTD needs to release more IMT spectrum in comparative terms in order to underpin the country's digital economy and improve connectivity.

We also note the demand for the release for more IMT spectrum from a number of key industry stakeholders. While it is not possible to meet all of those

demands given the competing needs of spectrum users, we have attempted to balance those requests. The PTD's objectives include support for a competitive market for IMT services, the promotion of innovation in Myanmar by continuing to embrace technology neutrality and ensuring crossborder co-ordination with our neighbouring countries.

1.2 Scope of IMT and 5G Spectrum Roadmap

The scope on the IMT Spectrum Roadmap follows the following order, namely:

(i) Proposed release of more IMT spectrum in Myanmar (see section 2);

(ii) Proposed IMT spectrum releases (see section 3);

(iii) Proposed release of 5G spectrum (see section 4);

(iv) The special case of the change of the band plan for 2.6 GHz band (see section 5); and

(v) Approach to the Unlicensed spectrum bands (see section 6)

2. PROPOSED RELEASE OF MORE IMT SPECTRUM IN MYANMAR

2.1 Current IMT spectrum released and ITU Region 3 comparisons

The 2016 *Spectrum Roadmap* envisaged the release of a number of IMT spectrum bands in Myanmar during the first four years of the Roadmap, including the 2.6 GHz, 1800 MHz, and 700 MHz bands and the optimization of the 850/900 MHz band.

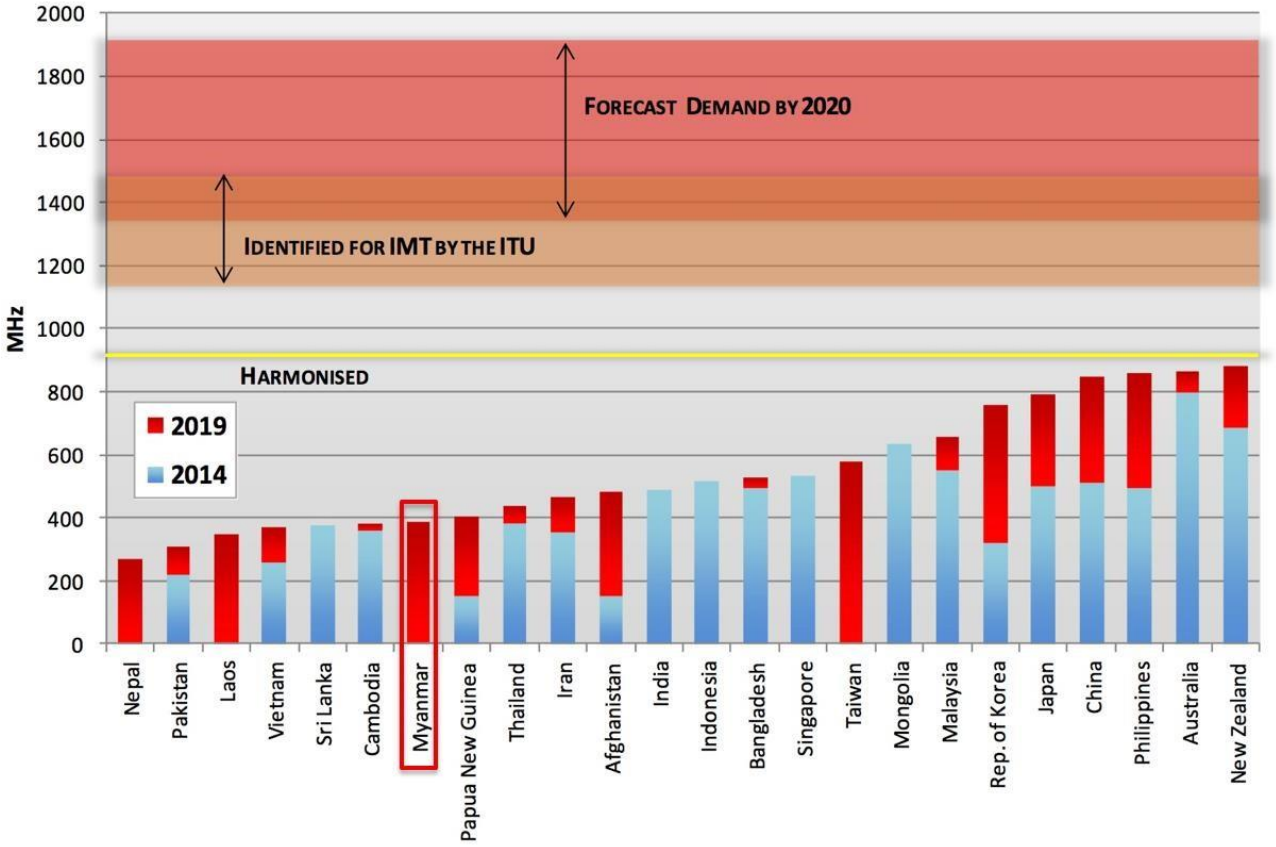
As at April 2019, Myanmar has released almost 400 MHz in IMT spectrum (See Exhibit 1) and already has allocated more IMT spectrum than Vietnam, Cambodia, and Lao PDR and is close to Thailand (see Exhibit 2 over). However, a number of ASEAN markets (especially Thailand, Indonesia, Malaysia and Vietnam) are in the process or seeking to release significantly more IMT spectrum in the next 12 months. Also, Myanmar's total IMT spectrum allocations are lower

than ASEAN exemplars in the Philippines, Malaysia and Singapore as well as northern Asian exemplars such as South Korea and Japan.

Exhibit 1: Summary on Spectrum Licences of Four (4) mobile Spectrum Operators in Myanmar

Frequency Band	Licensee	Technology	Uplink (MHz)	Downlink (MHz)	BW (MHz)
450 MHz	MPT	CDMA	453.375 - 457.125	463.375 – 467.125	2 x 3.75
850 MHz	MPT	CDMA	825-827.5	870-872.5	2 x 6.25
			828-832.5	873.75-877.5	
900 MHz	MPT	2G/3G	905-915	950-960	2 x 10
	Ooredoo	3G	890-895	935-940	2 x 5
	Telenor	2G/3G	895-900	940-945	2 x 5
	TIM (Mytel)	2G/4G (LTE)	900-905	945-950	2 x 5
EGSM	Ooredoo	2G	885.6-887.8	930.6-932.8	2 x 2.2
	Telenor	2G	887.8-890	932.8-935	2 x 2.2
	TIM (Mytel)	2G	882.8-885.6	927.8-930.6	2 x 2.8
1800 MHz	MPT	4G (LTE)	1730 – 1750	1825 - 1845	2 x 20
	Ooredoo	4G (LTE)	1765 - 1785	1860 - 1880	2 x 20
	Telenor	4G (LTE)	1710 - 1730	1805 - 1825	2 x 20
	TIM (Mytel)	2G/4G (LTE)	1750 - 1765	1845 - 1860	2 x 15
2100 MHz	MPT	3G/4G (LTE)	1935 - 1950	2125 - 2140	2 x 15
	Ooredoo	3G/4G (LTE)	1950 - 1965	2140 - 2155	2 x 15
	Telenor	3G/4G (LTE)	1965 - 1980	2155 - 2170	2 x 15
	TIM (Mytel)	4G (LTE)	1920 - 1935	2110 - 2125	2 x 15

Exhibit 2: Spectrum licensed for IMT services in Region 3



Source: LSTelcom, *Analysis of the World-Wide Licensing and Usage of IMT Spectrum*, 5 April 2019, page 16

Globally all major markets are releasing significant blocks of 5G pioneer band spectrum in *inter alia* the 3.5 GHz and mmWave bands and planning for the release of additional spectrum to support IMT services and their respective digital economies. As such there remains much to do to ensure that Myanmar IMT spectrum are in front of the demand curve. The very high proportion of smartphone penetration in Myanmar and the continued slowness to deploy fixed network infrastructure arguably means that the PTD needs to release more IMT spectrum in comparative terms in order to underpin the country's digital economy and strengthen its global connectivity.

2.2 Proposed timing for the release of additional IMT spectrum in Myanmar

In 2019, the challenge is to release IMT spectrum in Myanmar at reasonable prices in a way which reflects the new spectrum management paradigm that:

(i) larger contiguous blocks of IMT spectrum are needed with release of 5G NR;

(ii) in overall terms, especially post WRC-19, the total of IMT spectrum needed by an individual mobile network operator (MNO) and the market in overall terms will significantly rise; and

(iii) MNO need to have confidence to make long term investments in digital infrastructure in the knowledge that they have sufficient IMT spectrum to support both 4G and 5G service offerings.

Myanmar can avoid the challenges that other countries are facing in relation to legacy spectrum management decisions if it takes good decisions now in relation to the release of future IMT spectrum. Being later to the global mobile revolution has its advantages! Having said that, the release of too much IMT spectrum in advance of public demand in Myanmar may also not be sensible and/or efficient in spectrum management terms.

It is also critically important for Myanmar's spectrum allocations to be harmonised and timed regionally so that Myanmar consumers are able to acquire affordable smartphones and other devices. With these factors in mind, subject to industry demand, the PTD preliminary proposed release schedule for available IMT spectrum in Myanmar is shown in Exhibit 3 below.

Exhibit 3: Proposed Release Schedule of additional IMT Spectrum in Myanmar

The proposed release schedule for available IMT spectrum in Myanmar should be finally endorsed by the Ministry then 350 MHz of IMT spectrum[1] would be released to the market in 2020 (of capacity spectrum which is more useful in urban areas). A further 90 MHz (of sub-1 GHz coverage spectrum) would be released in 2021. In essence, IMT spectrum availability in Myanmar by end of 2021 would double to approximately 830 MHz (if all of the spectrum was allocated) allowing industry to make the necessary investments in Myanmar's digital future.

In overall terms, such a release of IMT spectrum would be consistent with the ITU *Guidelines for the Preparation of National Wireless Broadband Masterplans for Asia Pacific Region,* October 2012, which recommended that the minimum spectrum allocated and in use for cellular mobile services should be at least 760 MHz by 2020 and preferably 840 MHz.[2] However, it would be lower than the targets set in ITU Report ITU-R M.2290-0. That report prepared in advance of WRC-15,[3] defined the future spectrum requirements estimate for cellular mobile services below 6 GHz as 1,340 MHz for lower user density settings and 1,960 MHz for higher user density settings.

In specific terms, the PTD would note that:

- Capacity spectrum (namely the 2.6, 2.3 and 3.5 GHz bands ie n41, n40 and n77/78) including spectrum capable of being used for the deployment of 5G services has been prioritised for release in 2020. This spectrum will be very useful in urban areas,[4] can substitute for traditional fixed line services and will provide certainty to MNOs to make network and infrastructure investment for future 5G services;

[1] Plus any mmWave spectrum allocations if in demand.
[2] Available at www.itu.int/ITU-D/tech/broadband_networks/WirelessBDMasterPlans_ASP/Masterplan%20guidelines%20EV%20BAT1.pdf See page 45.
[3] ITU-R, M.2290-0 (01/2014), *Future spectrum requirements estimate for terrestrial IMT*, Geneva
[4] This includes Yangon, Mandalay, Nay Pyi Taw, Taunggyi, Mawlamyine, Bago, Myitkyina, Monywa, Pathein and Pyay. As well as Yangon and Mandalay, some of these markets are experiencing very rapid growth (eg Myitkyina, Taunggyi, and Bago).

- 120 MHz of 3.5 GHz spectrum (namely 3400 to 3520 MHz) with a conservative guard band at this time of 105 MHz can be released in Myanmar. This allow the PTD to offer pioneer 5G mid-band spectrum to operators from 2020;
- Coverage spectrum (namely the 700 MHz band (n28)) has been timed for 2021 following the likely regional release of this band in a number of ASEAN markets, namely Malaysia and Singapore (2019/2020), and Thailand and Vietnam (2020). The launch of APT700 services in these other ASEAN markets will greatly accelerate the availability of affordable Band 28 smartphones and other devices in Myanmar. In addition, the release of this IMT band in 2021 will allow the MNOs who successfully secure this spectrum to decide whether to deploy 4G and/or 5G services in this band;
- If there is demand then further capacity band spectrum (namely the 1500 MHz, 4.8 GHz and further mmWave spectrum)[5] could be offered to the market in 2022 and 2024 respectively. In addition, further 3.5 GHz spectrum could be released post 2023 following the likely determination of the optimal guard band in the C-Band given studies now being undertaken by the GSMA, GSA and ASEAN regulators such as the NBTC (in Thailand) and the ARFM (In Vietnam);
- By 2023, the 850 and 900 MHz spectrum bands can be replanned prior to the expiry of the current E-GSM licences and the switch-off of legacy CDMA networks;
- If there is demand for other 5G spectrum including in the mmWave bands and the 4.8 GHz band (n79) this would be undertaken in 2024; and
- Lastly, decisions about the release of 600 MHz would be post 2025 post Myanmar undertaking its analogue to digital television switchover etc.

The PTD considers that it is critical that Myanmar acknowledge that the long term move from 2G/3G services to 4G/5G services requires a rethinking in relation

[5] Namely n50/51, n79, n257 and n258.

to the optimal spectrum allocation processes for IMT spectrum. While 5G NR technology supports bandwidths 10, 15, 20, 30, 40, 50, 60, 70, 80, 90 and 100 MHz, dual connectivity and carrier aggregation, larger block sizes are preferred to obtain the maximum benefit from the technology. Myanmar as it has not yet allocated a number of spectrum bands should therefore take such factors into account rather than following the traditional approach which resulted in MNOs each having fragmented IMT spectrum holdings over a number of bands. This is inefficient and means more costly capex and opex.

Therefore, the PTD also considers that it should allocate capacity spectrum in larger block sizes in order to take advantage of new technologies.

3. PROPOSED IMT SPECTRUM RELEASES

3.1 Proposed release of IMT capacity spectrum in 2020

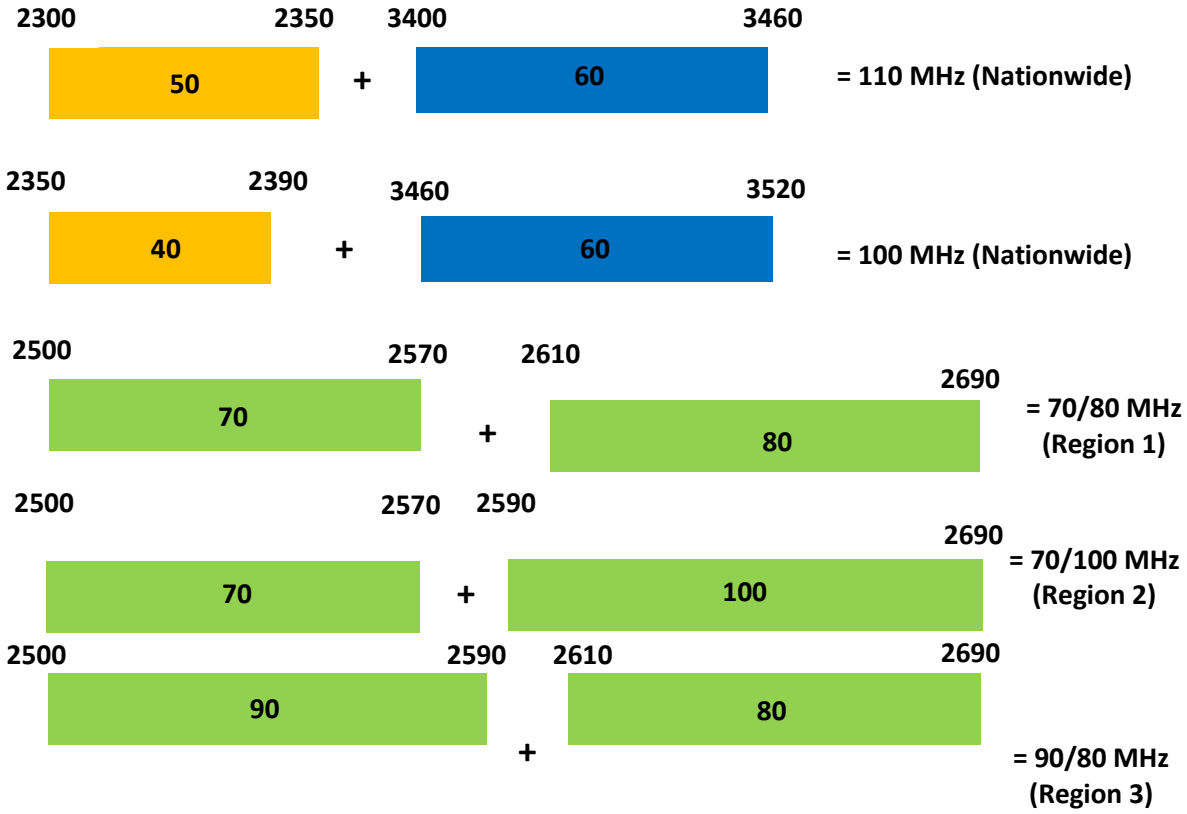
During the first consultation there was broad support among the MNOs for a multi-band spectrum allocation in the 2.3, 2.6 and 3.5 GHz bands when it makes sense to allocate this spectrum. MNOs saw the benefits of being allocated larger, contiguous spectrum blocks in at least one of the bands. It is also seen as important as this will improve the efficiency of their deployed networks.

Given the change to how regulators should optimally allocate spectrum in a 5G NR environment and the support from key industry stakeholders for a multi band spectrum allocation process of capacity spectrum in Myanmar the PTD also wishes to embrace such an approach. This is notwithstanding there was no consensus on the optimal timing.

The PTD's preliminary position is that it will in early 2020, auction the 2.3, 2.6 and 3.5 GHz spectrum (or offered by a beauty contest with price being a criterion depending on the level of demand) in four lots as shown in Exhibit 4 below. In this proposed arrangement, the 2.3 GHz band of 90 MHz would be split into 2 lots (of 50 and 40 MHz) and it would be bundled together with 60 MHz of 3.5 GHz

spectrum. In addition, the 2.6 GHz band (now converted to Band 41 which is discussed later in this report) would be split into totally 150 MHz in Region 1 and 170 MHz in Region 2 & 3.

Exhibit 4: Proposed Capacity Spectrum for release in 2020



+700 MHz (2 x 45 MHz) + 60 MHz @ 3.5 GHz + 4.8-4.9 GHz

From the PTD's perspective, such an approach ensures that all successful bidders would be able to use the spectrum for both 4G/5G almost immediately. Specifically:

(i) The winners of Lot 1 and 2 would be able to deploy 4G/5G on the 2.3 GHz spectrum which has an excellent 4G ecosystem and deploy 5G immediately in the pioneer 5G band of 3.5 GHz. The winners of these lots would also be able to utilise the LTE-NR sharing combinations where the UL direction of some low frequency bands (e.g. 700, 800, 900, 1800 and 2100 MHz) is paired with the 3.5 GHz band;

(ii) The winners of Lot 3 and 4 would be able to deploy 4G/5G immediately utilising the 2.6 GHz given the current availability of network equipment which supports this TDD Band 41.[6]

Such an approach results in all Myanmar operators, not withstanding the lack of substantial C-Band spectrum given satellite use in Myanmar being able to deploy 5G services at their commercial convenience. At this time given the lack of 5G iPhones and the inclusion of affordable 5G chipsets in smartphones it is likely that 5G devices will not be numerous until mid to late 2020. However, all equipment vendor contracts could be written with flexibility and certainty for Myanmar MNOs.

If the PTD's preliminary position is adopted Myanmar's total IMT spectrum allocation increases by 350 MHz, an almost doubling. This is both a benefit and a challenge. While the winners would have optimal allocations for deploying future 4G and 5G systems in Myanmar, do they have the capacity to pay for so much additional spectrum?

Two options are possible, at first instance to address this issue. The first option is that the successful winners have an extended period to pay for the spectrum – for example 5 or 10 years, similar to Indonesian spectrum auctions and what is proposed in Thailand in relation to upcoming 700 MHz spectrum auction. The second option is similar to Myanmar's successful 1800 MHz spectrum allocation where the winning bidders must take, say a minimum of 40 MHz initially, and then have a 3 year option period to exercise their option to acquire the remaining spectrum otherwise it returns the PTD for reallocation.

3.2 Proposed release of 700 MHz spectrum in 2021

As the release of key IMT spectrum needs to be considered in demand terms, it is important to note during the first consultation process generally there was a

[6] See Section 6 for suggested way forward on the 2.6 GHz band including the regional 2.6 GHz spectrum licensees.

view that there is no immediate requirement for additional coverage spectrum (in part because of the acquisition of E-GSM spectrum) and a keenness for more devices to support LTE Band 28 before it was released. There was however, some demand from some stakeholders for the release of 700 MHz spectrum in 2020.

With this is mind, the PTD's preliminary position is that the 700 MHz band ought to be auctioned in 2021, subject to demand. This follows the likely regional release of this band in a number of ASEAN markets, namely Malaysia and Singapore (2019/2020), and Thailand and Vietnam (2020). The launch of APT700 services in these other ASEAN markets will accelerate the availability of affordable Band 28 smartphones and other devices in Myanmar.[7] It is likely that China and India will release/auction 700 MHz band spectrum in 2019 or 2020 – this will have the effect of turbo charging device availability and affordability, with support for VoLTE.

A short delay also means that MNOs can make an informed decision whether to utilise all or part of any 700 MHz acquired for 5G coverage as by late 2020 network equipment should be available for this band. While the MNOs are likely to deploy 4G initially, under Myanmar's technology neutral regime they have future options.

Also the PTD notes that the release the 700 MHz band will facilitate additional coverage in Myanmar as part of the Government's universal service obligation (USO) strategy[8] but importantly until affordable devices are available then there will be few customers for such extended coverage. The delay until 2021 will also be used PTD to assess whether any of the 700 MHz spectrum band should be reserved for PPDR broadband or other Government uses.

[7] This follows the launch of APT700 LTE services in the Philippines in June 2016. Furthermore, the release of 700 MHz in these larger ASEAN markets will also see the release of this band in smaller ASEAN markets in Lao PDR and Brunei Darussalam. The release of this band in Indonesia and Cambodia may be some way off. See GSMA, *Securing the digital divide across the entire ASEAN: A report on the status of the implementation of the APT700 band for ATRC*, August 2018

[8] The release of 700 MHz spectrum, would if deployed extend using existing sites the current mobile coverage by a couple of percentage points given the greater cell size of 700 MHz versus 900 MHz spectrum.

3.3 Other proposed spectrum releases in 2022 and beyond

As detailed in section 2.2 above the PTD envisages that:

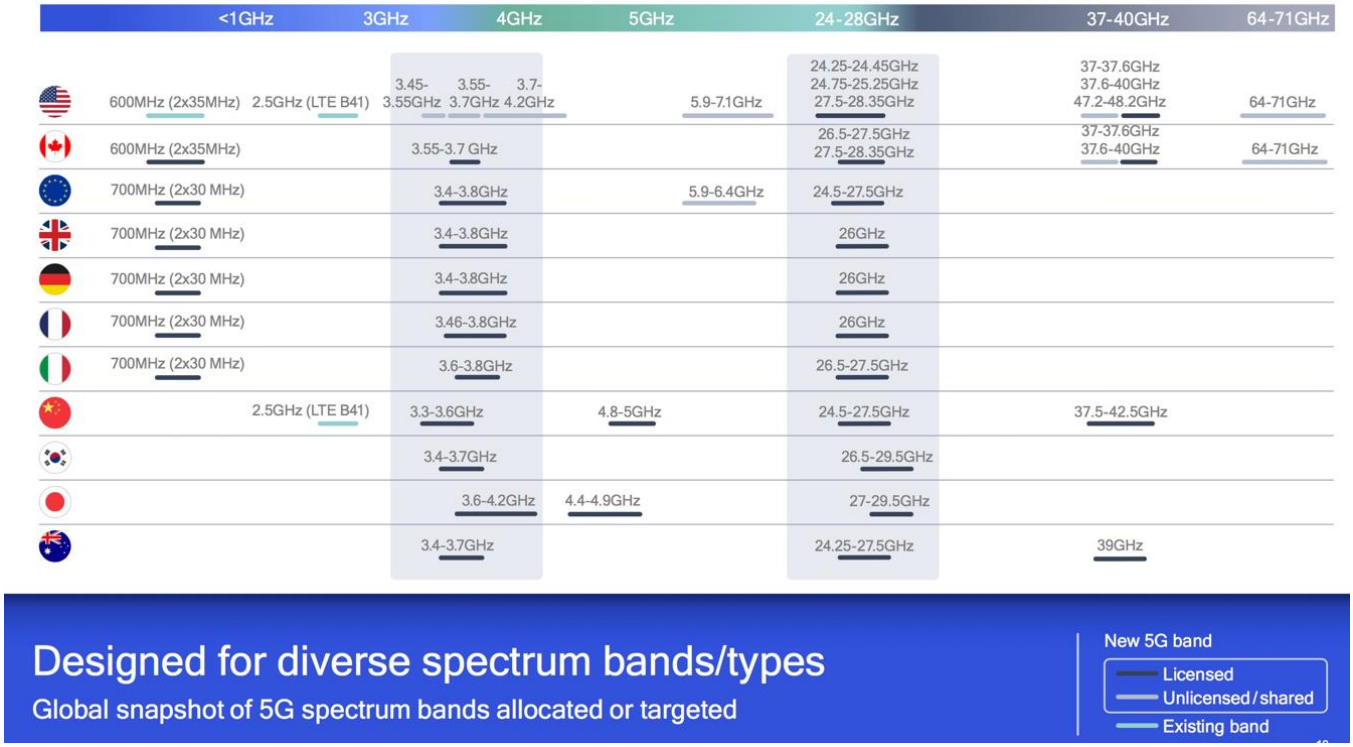
- If there is demand then further capacity band spectrum (namely the 1500 MHz, 4.8 GHz and further mmWave spectrum) could be offered to the market in 2022 and 2024 respectively. In addition, further 3.5 GHz spectrum could be released in 2023 (and will not be released any earlier in order to give earlier bidders greater confidence to make investments) following the likely determination of the optimal guard band in the C-Band given studies now being undertaken by the GSMA, GSA and ASEAN regulators such as the IMDA (in Singapore), NBTC (in Thailand) and the ARFM (In Vietnam);
- By 2023, the 850 and 900 MHz spectrum bands can be replanned prior to the expiry of the current E-GSM licences and the switch-off of legacy CDMA networks;
- If there is demand for other 5G spectrum including in the mmWave bands and the 4.8 GHz band this would be undertaken in 2024; and
- Lastly, decisions about the release of 600 MHz (n71) would be post 2025 post Myanmar undertaking its analogue to digital television switchover etc.

4. PROPOSED RELEASES OF 5G SPECTRUM

4.1 Global and regional 5G spectrum harmonisation

As highlighted in the first consultation paper the 2016 Spectrum Roadmap made no mention of 5G services. The key 5G bands are summarised in Exhibit 5 below. The key initial or pioneer 5G bands are in 3.4 to 3.7 GHz band and in mmWave bands from 24 to 28 GHz. It should be noted that in addition, the USA is supporting 600 MHz, and 2.6 GHz bands for 5G, the EU supports the lower APT700 duplex for 5G while China has endorsed 2.6 GHz with large allocation to China Mobile, and its new fourth 5G licensee China Broadcasting Networks will deploy 5G in the 700 MHz and 4.6 GHz bands.

Exhibit 5: Key 5G Bands



Source: Qualcomm, *The case for 5G NR Spectrum*, 5G ASEAN Conference, Hanoi, March 2019

4.2 Proposed release of IMT Spectrum in 3.5 GHz Band and mmWave in 2020 and beyond

Balancing the demand for C-Band/3.5 GHz spectrum between satellite and IMT services, the PTD's view is to release only 120 MHz of 3.5 GHz spectrum (namely 3400 to 3520 MHz) split into two lots with a guard band to satellite services at this time of 105 MHz (see Exhibit 6 below). This means that two successful MNOs can offer 5G services utilising the pioneer 5G mid-band spectrum from 2020 should they wish.

120 MHz to be allocated for 5G, and initial 105 MHz guard band

Exhibit 6: PTD's proposed release of IMT spectrum in the C-Band/3.5 GHz band in 2020

A further decision will be made by the PTD in 2022/23 as to whether additional 60 MHz in 3.5 GHz spectrum could be released in 2023 following the likely determination of the optimal guard band in the C-Band. The PTD will be informed by the studies now being undertaken by the GSMA, GSA and ASEAN regulators such as the NBTC (in Thailand) and the ARFM (In Vietnam) on the recommended guard plans to satellite services and the regional real experience of deployment/harmful interference of IMT services in this band. It is the view of the PTD that any additional 3.5 GHz spectrum would not be released any earlier than 2023 to ensure that successful bidders in 2020 are more confident to make investments in 5G infrastructure.

The PTD notes that while indoor mmWave deployments are doable, mmWave outdoor-to-indoor coverage for mobile is not technically feasible, outdoor mmWave coverage could free up 4G LTE or 5G NR coverage. In tropical markets there remain are serious doubts about the impact of rain attenuation even for small cell sizes given recent operator experience and Asian studies. In Myanmar parts of the country (the coastal strip) receives more than 5,500 mm of rain a year. In comparison the Irrawaddy delta receives between 2,000 to 3,000 mm of rainfall a year, while the north and eastern areas of country has 1,250 to 3,000 mm of rainfall. Central Myanmar receives the lowest amount at less than 700mm of annual rainfall. As at 2015, 62 percent of Myanmar's population lives in areas classified tropical climate.

With the above in mind the PTD considers that mmWave is unlikely to be in high demand in the Myanmar context and/or valued greatly, especially given the considerable costs of deployment. It should be emphasised that this spectrum has no value until an MNO is willing to substantially invest in it. Certainly, the submitters to the first Consultation Paper only saw demand for mmWave spectrum in Myanmar post 2022/23.

The PTD's position is therefore that successful bidders for the four spectrum lots offered in 2020 would also have the ability to be allocated say 200 to 400 MHz of

mmWave spectrum for a nominal or discounted price for the same licence period as 2.3 or 2.6 or 3.5 GHz spectrum allocations. Such an approach still leaves sufficient mmWave spectrum for enterprise and other future use should there be demand. Because of the current deployment in the USA and some other markets like South Korea is in the 28 GHz band (n257) then there is more equipment available sooner. Subject to industry views, n257 spectrum would be released first.

5. THE SPECIAL CASE OF THE CHANGE OF BAND PLAN FOR THE 2.6 GHz BAND

In the first IMT Spectrum Roadmap Consultation Paper, there was a lengthy examination of the special issues associated with the 2.6 GHz band. There was strong support from responders to the first Consultation Paper for Myanmar to move to TDD Band 41 with only one respondent being opposed. In particular there were seen to be significant long-term benefits of moving the band plan for this band so it was better able to support both 4G and 5G technology even if synchronisation (like for 3.5 GHz band) was required.

Recently, the PTD has been made aware that its neighbour Thailand is also supporting Band 41 which should make the process of co-ordination easier on that joint border. Likewise China, another of Myanmar's neighbouring countries, also uses TDD Band 41.

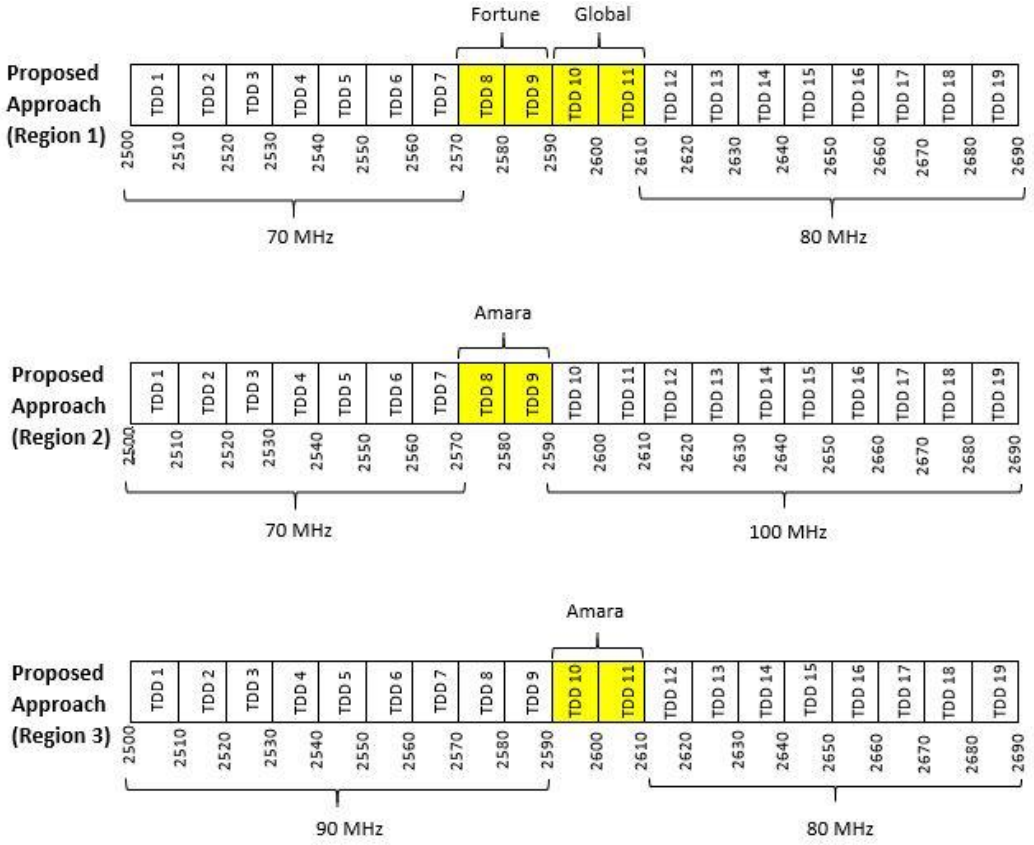
The PTD's view that is therefore that Myanmar will change its band plan for 2.6 GHz from the previous band plan articulated in the *Framework for 2600 MHz Spectrum Auction* to Band 41 (also known as n41). In markets like Myanmar where the pioneer 5G spectrum band (ie 3.5 GHz) – is not fully available in the near term - because it is currently allocated to satellite services, the 2.6 GHz band is an excellent alternative 5G band.

While the PTD will engage in specific consultation with the 2.6 GHz regional licensees, our current thinking is that:

(a) To be able to effectively usage of 2.6 spectrum band, the regional licensees would be encouraged to shift their current spectrum allocation according to the new band plan (Band 41).

(b) The synchronization of the 2.6 GHz regional licensee would also need to be broadened to include any new 2.6 GHz spectrum licensees. The proposed band plan would be set out in Exhibit 7 below.

Exhibit 7: Proposed band plan for the 2.6 GHz band (Band 41)



6. APPROACH TO THE LICENCE-EXEMPT BANDS IN THE 5 GHz BAND

Globally, the 5 GHz spectrum band is typically used for Wi-Fi connectivity (along with the 2.4 GHz band). As indicated in the first Consultation Paper, Myanmar's allocation for license-exempt usage in the 5 GHz band is only 5.725 to 5.875 GHz, amounting to 150 MHz in total. This is a significantly smaller allocation compared

to many other countries – including ASEAN markets - which have total bandwidth allocated in this band exceeding 500 MHz.

The PTD's preliminary view is that while it has some sympathy for expanding the licence-exempt band in this band, given there was no consensus of responders to the Consultation Paper, the PTD will wait until after the upcoming WRC-19 where this band is on the agenda to make a final decision on changes to this band. Other bands like 6 GHz may also be discussed concurrently at the WRC-19 given the current FCC proposed notice of rule-making.