MINISTRY OF TRANSPORT AND COMMUNICATIONS
POSTS AND TELECOMMUNICATIONS DEPARTMENT

CONSULTATION PAPER
Review of IMT Aspects of Myanmar's Spectrum Roadmap
8 March 2019

1. INTRODUCTION

1.1 Background

On 8 April 2016, following extensive public and industry consultation the then Ministry of Transport and Communications released a "***Spectrum Roadmap: Meet the Needs Over the Next 5 Years"*** *("2016 Spectrum Roadmap").* It is available at https://www.motc.gov.mm/my/search/node/Spectrum%20Roadmap.

As a little more half of this five year period the Spectrum Roadmap has passed, the Post and Telecommunications Department ('PTD') has decided that it is important to assess its appropriateness going forward and what changes (if any) are needed. Importantly there have been major technological changes affecting spectrum management including but not limited to the acceleration of widespread 4G deployment, commencement of 5G globally and the upcoming World Radio Conference (WRC-19). It is on these IMT spectrum management issues that this Consultation Paper is focused.

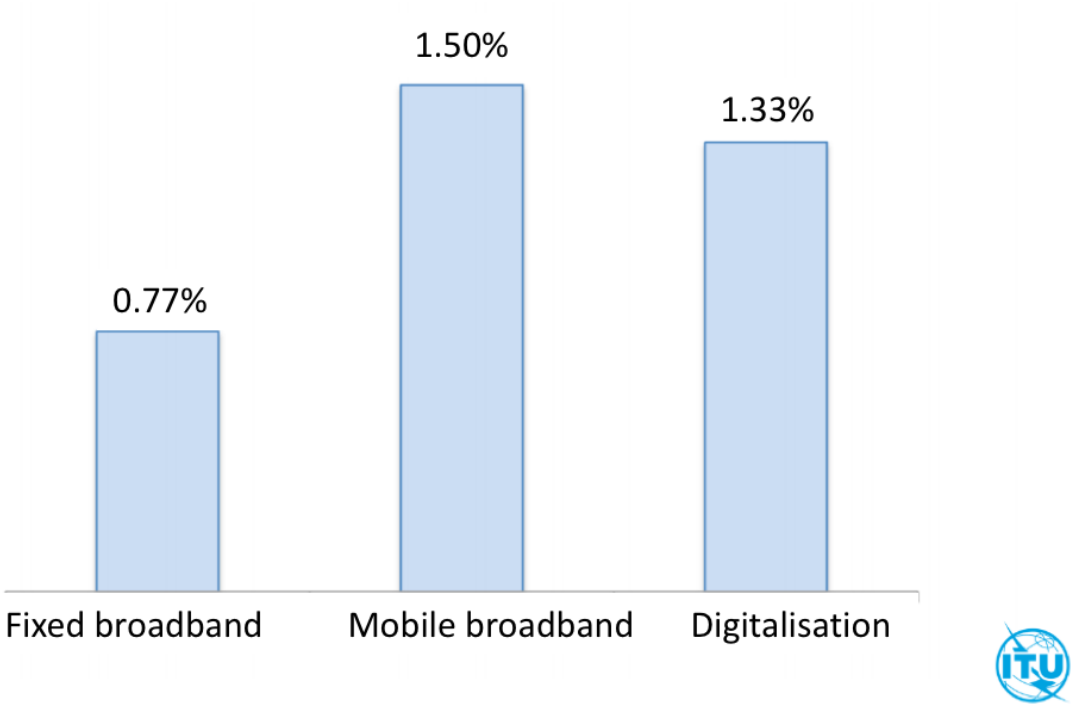
More generally Myanmar could advance in regional comparisons and support the development of the country's digital economy if it was to allocate additional spectrum to wireless broadband use.

An ITU study entitled *The economic contribution of broadband, digitization and ICT regulation*,[1] released in late 2018, provides additional evidence of the contribution of broadband and digital transformation to the economy and the impact of institutional and regulatory variables to the development of the digital ecosystem. The economic benefits accruing to emerging markets like Myanmar of increases in mobile broadband penetration and overall improvements in a range of sector measures (ie digitalisation[2]) are even greater (see Exhibit 1 over).

[1] See www.itu.int/en/ITU-D/Regulatory-Market/Documents/FINAL_1d_18-00513_Broadband-and-Digital-Transformation-E.pdf

[2] The digital ecosystem development index was based on 64 indicators, for 75 developed and developing countries and emerging economies and includes inter alia institutional and regulatory pillars, connectivity, infrastructure, competition, digital human capital and digital industries. See ITU study, page 19.

Exhibit 1: ITU Comparison of the economic impacts of broadband and digitalisation due to a 10 percent increase in penetration etc



Source: ITU, 2018

1.2 Scope of the Consultation Paper

From the PTD's perspective there are nine important issues which are being addressed in this Consultation Paper, namely:

(i) Timing of the release of further IMT Spectrum in Myanmar;

(ii) Ensuring spectrum for 5G services;

(iii) Reviewing the band plan for the 2.6 GHz spectrum band;

(iv) Changes to the 900 MHz allocations and the new E-GSM licences;

(v) Approach to the licence-exempt bands including IoT;

(vi) Review of 850 MHz spectrum band and reservation of spectrum for PPDR Broadband;

(vii) Making available spectrum for backhaul transmission;

(viii) Securing a second digital dividend for Myanmar; and

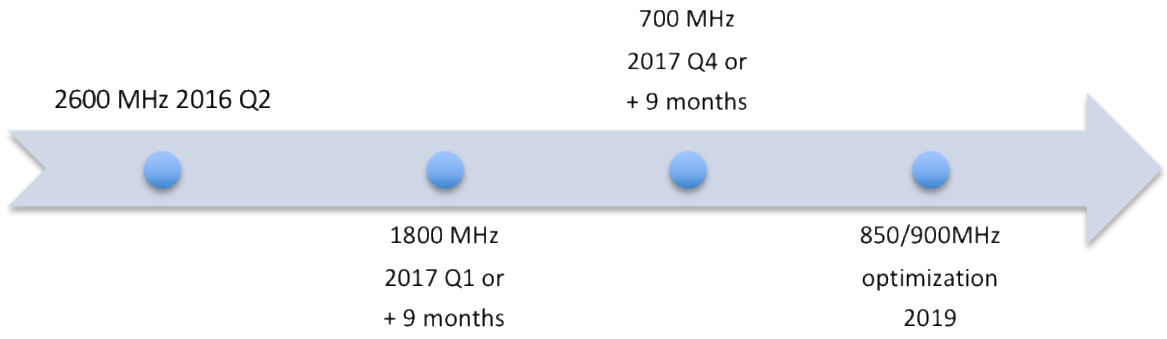
(ix) Addressing Cross-Border and WRC-19 issues in the Spectrum Roadmap.

2. INTRODUCTION

2.1 Timing of the release of further IMT Spectrum in Myanmar

The *Spectrum Roadmap 2016* 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 (see Exhibit 2 below).

Exhibit 2: Proposed Release Schedule of Available Spectrum in Myanmar



Source: PTD, *Spectrum Roadmap 2016*, page 61

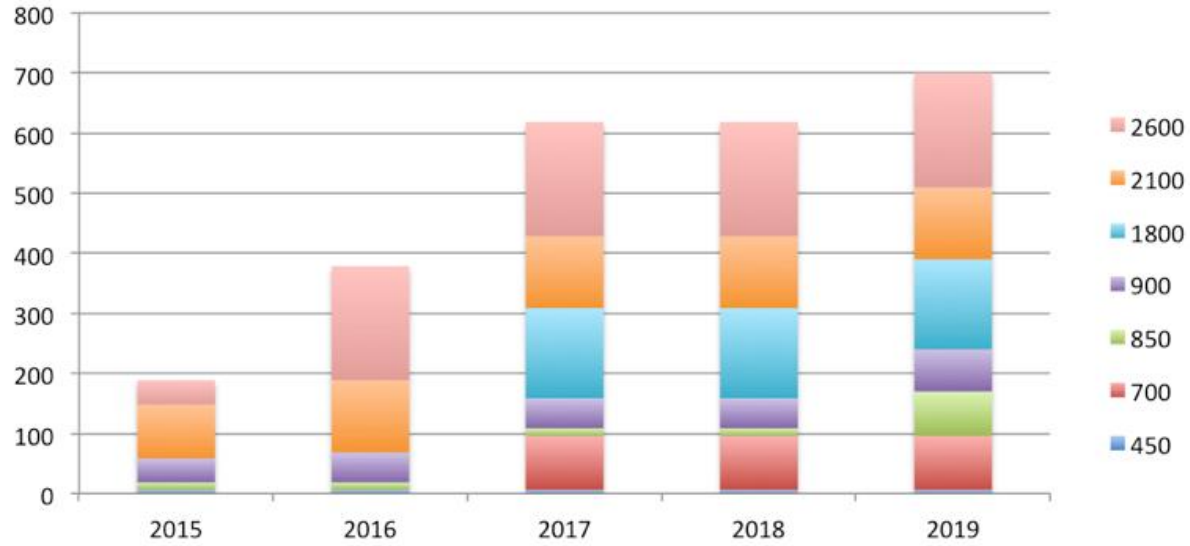
In the ITU Report ITU-R M.2290-0 prepared in advance of World Radiocommunications Conference (WRC-15), [3] defined the future spectrum requirements estimate for cellular mobile services below 6 GHz as 1340 MHz for lower user density settings and 1960 MHz for higher user density settings. In contrast, the ITU in its *Guidelines for the Preparation of National Wireless Broadband Masterplans for Asia Pacific Region,* October 2012, 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.[4]

Great strides have been made in the release of IMT spectrum in Myanmar with almost 390 MHz in total IMT spectrum allocated as at end of January 2019. Specifically, on 12 January 2017, a fourth mobile operator, MyTel was licensed and new regional licences for TDD 2600 MHz spectrum were also allocated by the Ministry in late 2016 via a spectrum auction. Furthermore, in May 2017, the 1800 MHz spectrum was independently valued and then offered to the major mobile operators who have acquired the entire 2 x 75 MHz of this spectrum band and the E-GSM spectrum was allocated in November 2018. Other spectrum noted in the 2016 Spectrum Roadmap has been returned to the PTD.[5]

However, the 2016 Spectrum Roadmap envisaged that 700 MHz in total IMT spectrum would be available by the end of 2019 (see Exhibit 3 below). The PTD is considering whether this is appropriate target (which could almost be reached by the release of either by coverage spectrum (eg 700 MHz) being released simultaneously with capacity spectrum (eg 2.6 GHz) or just capacity spectrum (eg 2.3 and 2.6 GHz spectrum). Alternatively, a lower overall IMT spectrum target could be set in Myanmar.

[3] ITU-R, M.2290-0 (01/2014), *Future spectrum requirements estimate for terrestrial IMT,* Geneva, January 2014.
[4] Available at www.itu.int/ITU-D/tech/broadband_networks/WirelessBDMasterPlans_ASP/Masterplan%20guidelines%20EV%20BAT1.pdf See page 45.
[5] For example, it should be noted that the 20 MHz of 2.3 GHz stated in the 2016 Spectrum Roadmap as being allocated to the Department of Civil Aviation has been returned to the PTD.

Exhibit 3: Current and Expected Spectrum Availability Plan in the 2016 Spectrum Roadmap over next 5 Years



Source: PTD, *Spectrum Roadmap 2016*, page 61

As indicated in detail in the GSMA's August 2018 report *Securing the digital dividend across the entire ASEAN: A report on the status of the implementation of the APT700 band for ATRC*,[6] there are a significant number of advantages for Myanmar including technical and economic advantages to issue/auction licences for APT700 spectrum given the strong ecosystem for devices in this spectrum band. Further benefits include improved national coverage and NB-IoT (which is actually a 4G rather than a 5G service) being optimally deployed in this band given the good experiences of Telstra in Australia and the Philippine operators.[7]

Q1.	Should the PTD set overall IMT spectrum allocation targets? If you support IMT spectrum allocation targets being set what should be the over IMT targets for 2020, 2022 and 2025?
Q2.	Do you support the overall IMT spectrum allocation at the end of 2019 being a total of 700 MHz? If you do what IMT spectrum bands should be released by the PTD and when? What are the current growth annual rates for wireless broadband data in Myanmar?
Q3.	Should Myanmar benchmark its total overall IMT spectrum allocation? If so, what regional exemplar markets should we benchmark itself against? How should such overall targets change with the move to 5G (ie with large allocations of mmWave and other spectrum)?
Q4.	When do you support the allocation of the 700 MHz band in Myanmar? How and when should this band optimally be allocated? Is this band likely to be used for 4G or 5G services?
Q5.	Should IMT spectrum be allocated on a regional or nationwide basis? Who should be eligible to apply/bid for such spectrum licences?

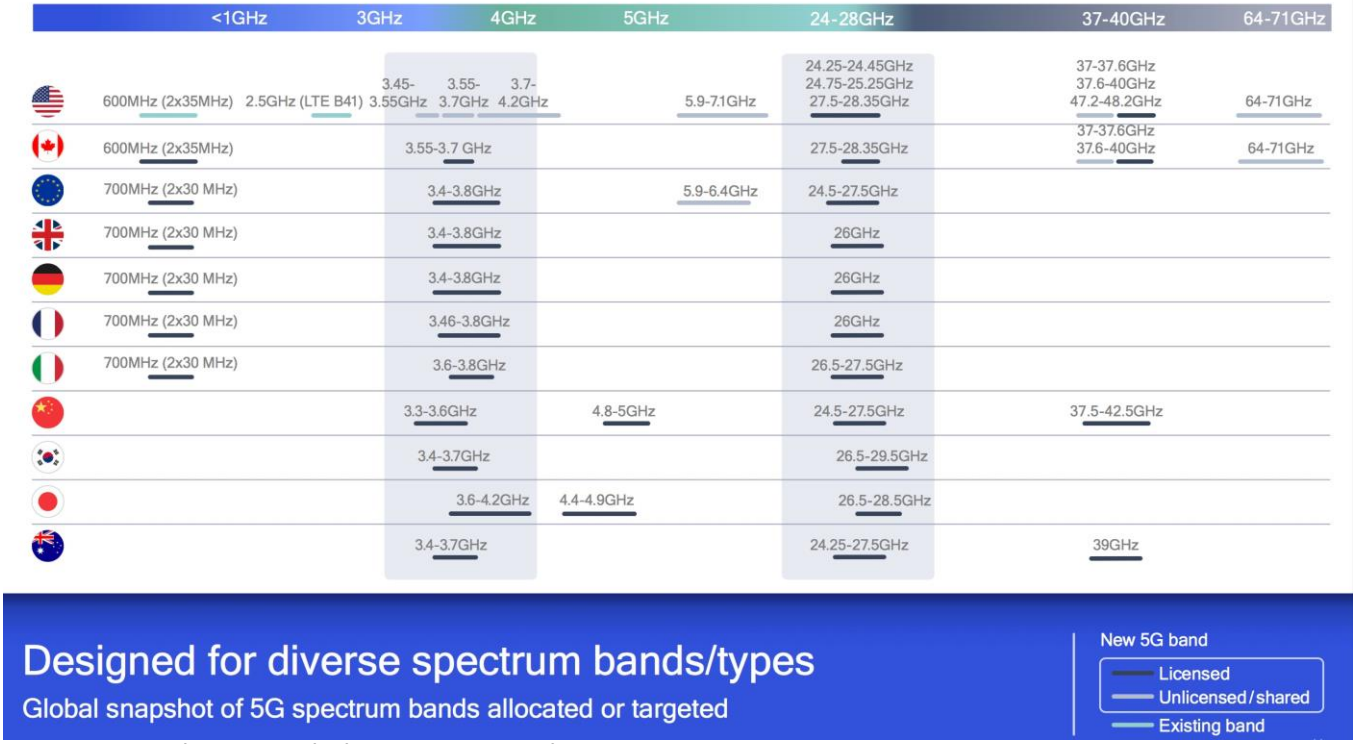
2.2 Ensuring spectrum for 5G services

2.2.1 Global and regional 5G spectrum harmonisation

[6] *Available at* www.gsma.com/spectrum/securing-the-digital-dividend-across-the-entire-asean/
[7] *Ibid*, page 20

The 2016 Spectrum Roadmap made no mention of 5G services. The key 5G bands are summarised in Exhibit 4 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.

Exhibit 4: Key 5G Bands



Source: Qualcomm, *Designing 5G NR*, September 2018

More broadly, the 3GPP has frozen the specification for 5G NR (New Radio) and TS 38.104 section 5.2 provides the list of bands in which NR can operate (see Exhibit 5 and Exhibit 6 below). As per 3GPP release 15, these frequency bands are designated for different frequency ranges (FR) and current specification (Release) defines them as FR1 (450 to 6000 MHz and FR2 (24,250 to 52,600 MHz). Apart from FR NR bands can be classified into three into categories: [8]

- Frequency Division Duplex Bands (FDD);
- Time Division Duplex Bands (TDD); and
- Supplementary Bands (SUL): Downlink Supplement Bands and Uplink Supplement Bands.

The 3GPP has also agreed upon a number of 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 3300-3800 MHz band.

[8] Furthermore, it should be noted that depending on the Subcarrier Spacing (SCS) in use, the supported channel bandwidths are up to a maximum of 20 MHz for FDD configurations in 5 MHz increments (except for the 1800 MHz band (n3) which has a maximum of 30 MHz) while TDD configurations are up to 100 MHz which is more usable for 5G services. For example, the maximum channel bandwidth for 2.6 GHz (n41) and 3.5 GHz (n78) is 100 MHz. For the 2.3 GHz (n40) and 1.5 GHz (n50) bands the maximum is 80 MHz.
https://portal.3gpp.org/ngppapp/CreateTdoc.aspx?mode=view&contributionUid=RP-172475

Exhibit 5: 5G NR Frequency Range #1 (bands in red are currently in use in Myanmar)

NR FR1 Band	Band Alias	Uplink (UL) Operating Band BS Receive / UE Transmit F_{UL_low} – F_{UL_high}	Downlink (DL) Operating Band BS Transmit / UE Receive F_{DL_low} – F_{DL_high}	Bandwidth	Duplex Mode
n1	2100	1920– 1980 MHz	2110– 2170 MHz	60 MHz	FDD
n2	1900 PCS	1850– 1910 MHz	1930– 1990 MHz	60 MHz	FDD
n3	1800	1710– 1785 MHz	1805– 1880 MHz	75 MHz	FDD
n5	850	824– 849 MHz	869– 894 MHz	25 MHz	FDD
n7	2600	2500– 2570 MHz	2620– 2690 MHz	70 MHz	FDD
n8	900	880– 915 MHz	925– 960 MHz	35 MHz	FDD
n12	700a	699 - 716 MHz	729 -746 MHz	17 MHz	FDD
n20	800	832– 862 MHz	791– 821 MHz	30 MHz	FDD
n25	1900+	1850 - 1915 MHz	1930 -1995 MHz	65 MHz	FDD
n28	700 APT	703– 748 MHz	758– 803 MHz	45 MHz	FDD
n34	TD 2000	N/A	2010 - 2025 MHz	15 MHz	TDD
n38	TD 2600	2570– 2620 MHz	2570– 2620 MHz	50 MHz	TDD
n39	TD 1900+	N/A	1880 – 1920 MHz	40 MHz	TDD
n40	TD 2300	2300 – 2400 MHz	2300 – 2400 MHz	100 MHz	TDD
n41	TD 2500	2496– 2690 MHz	2496– 2690 MHz	194 MHz	TDD
n50	TD 1500+	1432– 1517 MHz	1432– 1517 MHz	85 MHz	TDD
n51	TD 1500-	1427– 1432 MHz	1427– 1432 MHz	5 MHz	TDD
n65	2100+	2110-2200 MHz	1920-2010 MHz	90 MHz	FDD
n66	AWS-3	1710– 1780 MHz	2110– 2200 MHz	70/90 MHz	FDD
n70	AWS-4	1695– 1710 MHz	1995– 2020 MHz	15/25 MHz	FDD
n71	600	663– 698 MHz	617– 652 MHz	35 MHz	FDD
n74	L-Band	1427– 1470 MHz	1475– 1518 MHz	43 MHz	FDD
n75	DL 1500+	N/A	1432– 1517 MHz	85 MHz	SDL
n76	DL 1500-	N/A	1427– 1432 MHz	5 MHz	SDL
n77	TD 3700	3300– 4200 MHz	3300– 4200 MHz	900 MHz	TDD
n78	TD 3500	3300– 3800 MHz	3300– 3800 MHz	500 MHz	TDD
n79	TD 4500	4400– 5000 MHz	4400– 5000 MHz	600 MHz	TDD
n80	UL 1800	1710– 1785 MHz	N/A	75 MHz	SUL
n81	UL 900	880– 915 MHz	N/A	35 MHz	SUL
n82	UL 800	832– 862 MHz	N/A	30 MHz	SUL
n83	UL 700	703– 748 MHz	N/A	45 MHz	SUL
n84	UL 2100	1920– 1980 MHz	N/A	60 MHz	SUL
n86	UL 1800	1710 – 1780 MHz	N/A	70 MHz	SUL

Source: 3GPP and http://niviuk.free.fr/nr_band.php. Updated to 15 December 2018. It should also be noted NR has introduced a new notation for band which starts with "n" e.g. Band 20 is noted as n20 where in LTE it was termed as B20.

Exhibit 6: 5G NR Frequency Range #2

NR FR2 Band	Band Alias	Uplink (UL) Operating Band BS Receive / UE Transmit F_{UL_low} – F_{UL_high}	Downlink (DL) Operating Band BS Transmit / UE Receive F_{DL_low} – F_{DL_high}	Bandwidth	Duplex Mode
n257	28 GHz	26500– 29500 MHz	26500– 29500 MHz	3000 MHz	TDD
n258	26 GHz	24250– 27500 MHz	24250– 27500 MHz	3250 MHz	TDD
n260	39 GHz	37000– 40000 MHz	37000– 40000 MHz	3000 MHz	TDD
n261	28 GHz	27500 – 28350 MHz	27500 – 28350 MHz	850 MHz	TDD

Source: 3GPP. Updated to 12 September 2018

Q6. What are the likely 5G spectrum bands for Myanmar? What new 5G bands (eg mmWave bands and others) should the PTD offer in Myanmar and when? What size blocks should be allocated in for example mmWave and other bands?

2.2.2 Possible C-Band allocations for 5G In Myanmar

As indicated above one of the key global pioneer 5G bands are in the C Band – namely n78 TD3500 (3.3 to 3.8 GHz) and n77 TD3700 (3.3 to 4.2 GHz) bands. However, the C-Band is in extensive use in Myanmar and an agreement has been concluded with Intelsat for them to have exclusive use in the C-Band for 15 years (see Exhibit 7). This raises the question as to how much IMT spectrum which Myanmar can allocate in this band, how much a guard band is needed between IMT and satellite services if this band is to be shared. Furthermore, given the need in 5G for large contiguous blocks of spectrum (discussed below), how should this 125 MHz being allocated? For example, should it be auctioned in two lots of 60 and 65 MHz spectrum[9] or one lot of 125 MHz spectrum?

Exhibit 7: Current Myanmar IMT (5G) spectrum availability in C-Band

Source: PTD, 2019

Q7.	Do you agree that a guard band of 100 MHz is needed in the 3.X GHz band between IMT (5G) and satellite services? Is this guard band workable in relation to neighbouring countries with respect to cross-border frequency co-ordination?
Q8.	Should the 125 MHz from 3.4 GHz be made available in Myanmar? If so, when and by what method should it be allocated (eg auction, tender, beauty contest etc)? Should it be allocated in one or two lots?

2.2.3 Optimising 5G spectrum allocations

The ITU in its regulatory paper entitled *Global ICT Regulatory Outlook 2018* released in December 2018, emphasised "More spectrum bandwidth will be required to deploy 5G networks (compared to 4G) to the high capacity requirements, increasing the need for spectrum."[10] This is due to the technical requirements of the technology. For example, at the APT Spectrum Management Symposium in Manila in September 2018, a range of presentations from vendors, consultants and regulators highlighted this need.[11]

This technical fact is being reflected in the position adopted by global regulators including:

- In the ***United Kingdom***, the Department for Digital, Culture, Media and Sport has directed Ofcom that "*in future Ofcom, when issuing or amending licences to use spectrum for mobile networks, should have regard to the benefits of allowing the assembly of large contiguous blocks of spectrum*". It goes on to state that "*Both investment in 5G networks and effective competition between mobile network operators is likely to be harmed if the band is excessively fragmented; all things being equal, a few large contiguous blocks of spectrum are more likely to meet Ofcom's objectives to ensure optimal use of spectrum than many smaller ones*."[12]

[9] Such lot sizes would be similar to those set in Australia 3.6 GHz spectrum auction in the late 2018. www.accc.gov.au/system/files/ACCC%20advice%20to%20Minister%20Fifield%20on%203.6%20GHz%20allocation%20limits.pdf

[10] ITU, *Global ICT Regulatory Outlook 2018*, Page 67

[11] For example, see Lyu Boya, Huawei, *C-Band 100 MHz per operator for 5G business success, 3-5 September 2018* and Scott Minehane, *Spectrum Refarming and re-deployment*, 3-5 September 2018.

[12] UK Government, *Next Generation Mobile Technologies: An update to the 5G strategy for the UK,* December 2017, page 18

- In ***Germany*** the Bundesnetzagentur's intention is to provide *"….contiguous spectrum [which] would make it possible to provide larger frequency blocks for the effective use of both LTE carrier aggregation and 5G technologies."* It also stated that "*The assignment of contiguous spectrum enables spectrum to be used efficiently and is therefore appropriate from both the technical and the regulatory point of view*";[13] and
- In **China** as detailed in Exhibit 8 below, the Ministry has allocated large contiguous blocks of spectrum for 5G services. As has Vietnam in order to trial 5G services.[14]

Exhibit 8: China's 5G spectrum allocations

In December 2018, China's Ministry of Industry and Information Technology issued nationwide 5G trial licenses to the market's large three MNOs until June 2020. It is expected that these trial licences will be made permanent. Specifically, the 3 MNOs have been allocated large contiguous spectrum blocks:[15]

- China Mobile has been allocated spectrum from 2515 to 2675 MHz (160 MHz) and 4.8 to 4.9 GHz (100 MHz);
- China Telecom has been approved to use the 3.4-GHz to 3.5-GHz (100 MHz); and
- China Unicom has announced it has been approved to use the 3.5-GHz to 3.6-GHz (100 MHz).

Q9. What are the optimal spectrum allocations blocks for 5G in terms of MHz including in relation to mmWave spectrum, other NR bands etc?

Q10. Given the optimal approach of allocating larger contiguous spectrum blocks of IMT spectrum in a 5G NR environment, should Myanmar undertake a simultaneous multi-band (eg say 2.3, 2.6 and 3.4 GHz) spectrum allocation process to ensure that MNOs secured sufficient spectrum? If yes, what is the optimal method and when is the optimal timing for such an allocation process? Also, what is the optimal pricing of such spectrum?

2.3 Reviewing the band plan for the 2.6 GHz spectrum band

2.3.1 Background

In relation to the 2600 MHz band, the 2016 Spectrum Roadmap stated that:

"The Ministry/PTD proposes to release spectrum to meet the needs of wireless broadband services, wireless broadband is considered a priority and PTD is considering the release of 2600 MHz to meet this demand.
Action Planned by Ministry/PTD:
Develop a policy and a process for the release of 2600 MHz band with the intention of auctioning this spectrum."

This was actioned by the PTD in October 2016, with the release of the *Framework for 2600 MHz Spectrum Auction*. This framework offered by auction two lots of 20 MHz in three regional areas of Myanmar. The Framework for the 2600 MHz Spectrum Auction by offering 2 lots of 20 MHz of TDD spectrum as indicated in Exhibit 9 below implicitly endorsed a hybrid band plan for the 2.6 GHz band of Band 7 (2 x 70 MHz FDD) with Band 38 (50 MHz

[13] Refer to www.bundesnetzagentur.de/SharedDocs/Downloads/EN/Areas/Telecommunications/Companies/TelecomRegulation/FrequencyManagement/ElectronicCommunicationsServices/201070704_KeyElementsDemandIdentification.pdf?__blob=publicationFile&v=1
[14] Refer to https://vietnamnet.vn/vn/cong-nghe/vien-thong/viet-nam-bat-dau-trien-khai-thu-nghiem-mien-phi-dich-vu-5g-504465.html?fbclid=IwAR27wUVCbKMyJxGzd5zVbEQwSzGDK1Lv2I12_ZlD8wc0Bq61In3b1EPgYrw
[15] Refer to www.telecomasia.net/content/china-allocates-spectrum-nationwide-5g-trials

of TDD spectrum with two 5 MHz guard bands. A successful spectrum auction saw a number of regional spectrum licences being issued TDD Band 38 spectrum.

Exhibit 9: 2016's 2.6 GHz band plan

Source: PTD, *Framework for 2600 MHz Spectrum Auction*, October 2016, page 4

2.3.2 Proposed approach

Looking further at this issue, and seeing the adoption of TDD technologies in this band especially which support 5G (see the discussion above) and the lack of C-Band spectrum to allocate for IMT purposes in Myanmar the PTD is considering a change to the band plan.

Adopting TDD for the entire 2.6 GHz band (namely Band 41) would seem to have a range of significant benefits *inter alia*:

- The shift from FDD to TDD technologies will enable better matching of current upload and download use patterns in Myanmar which are likely to become more asymmetric over time with the increase in video streaming. Optimising IMT frequency spectrum for use has significant economic benefits for the country;
- TDD supports the use of new techniques such as massive MIMO technologies which offer around five times better spectrum utilisation than legacy technologies. Spectral efficiency is a key consideration of the PTD in relation to the allocation of IMT spectrum;
- Elimination of the need for 10 MHz of spectrum to be used as guard bands in the band. This is not insignificant (approximately 5 percent of the band) in the context of ongoing IMT spectrum scarcity especially in spectrum below 3 GHz;
- The Band 41 network deployment will result in lower per MB/GB costs for MNOs and hence makes compelling commercial sense for MNOs in the context of relatively low Myanmar monthly ARPUs. Such lower costs will allow more affordable retail tariffs for wireless broadband which is a Government policy objective;
- As Band 38 is a subset of Band 41, the adoption of this band plan would significantly improve the ecosystem for TDD supported devices and smartphones in Myanmar to the advantage of the current regional 2.6 GHz licensees, if a wider range of affordable user devices if is available;
- Subject to the preservation of the existing allocations, there are benefits for PTD in managing a homogenous block of 190 MHz spectrum rather than attempting to manage hybrid spectrum band plan. Importantly, larger block sizes of up to 100 MHz would improve integrated 4G+5G investment efficiency; and
- Given Myanmar's technology neutral spectrum licensing, the TDD configuration of the 2.6 GHz band enables transition by the MNOs to 5G at lower capital cost and therefore enables more Myanmar consumers to participate in the upcoming 5G revolution. They can also participate sooner. 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. This is therefore an attractive approach to the PTD.

Given the above, there is arguably a compelling case for the PTD to adopt and/or transition to 3GPP Band 41 in Myanmar in relation to the 2.6 GHz band in preference to the previous band plan articulated in the *Framework for 2600 MHz Spectrum Auction*.[16] The technical advantages of LTE Band 41 in the 2.6 GHz band as described, leads directly to a set of compelling economic benefits that are of particular value in Myanmar with its currently underdeveloped fixed telecommunications infrastructure.

To best effect this decision the spectrum allocations current 2.6 GHz regional licensees would need to move by 5 MHz up or down to better align with the band having, say 10 MHz TDD lots. Their allocations could also be increased to fit with the revised 2.6 GHz band plan. They could also, subject to the current regulation, partner with the MNO on wireless broadband services. If a decision is taken in this respect, the PTD will separately consult with the 2.6 GHz regional licensees.

Q11.	What band plan should Myanmar adopt for the 2.6 GHz band? Are there advantages of adopting a TDD Band 41 configuration? Are there any downsides of such an approach?
Q12.	Should the new 2.6 GHz spectrum blocks be allocated on a nationwide or regional basis? What is the preferred approach for the allocation of 2.6 GHz spectrum? When should this band be offered for allocation?

2.4 Changes to the 900 MHz allocations and the new E-GSM licences

The 900 MHz band is discussed in many parts of the 2016 Spectrum Roadmap (for example page 60). Subsequent to the 2012 licensing decision two additional nationwide telecommunication licences were awarded to Telenor and Ooredoo, which was followed by the licensing of the fourth nationwide 15 year Operating Licence and Spectrum Licence to Mytel in January 2017. Each of the nationwide licensees has been granted 2 x 5 MHz of 900 MHz, except MPT which retains an allocation of 2 x 10 MHz of 900 MHz.

As highlighted in the Spectrum Roadmap, following such allocations the E-GSM band namely 880-890/925-935 MHz) was left unassigned. However, following requests for additional temporary spectrum and creating a proper guard band with the 850 MHz band[17] the PTD decided, following discussions with industry to allocate part of the E-GSM band.

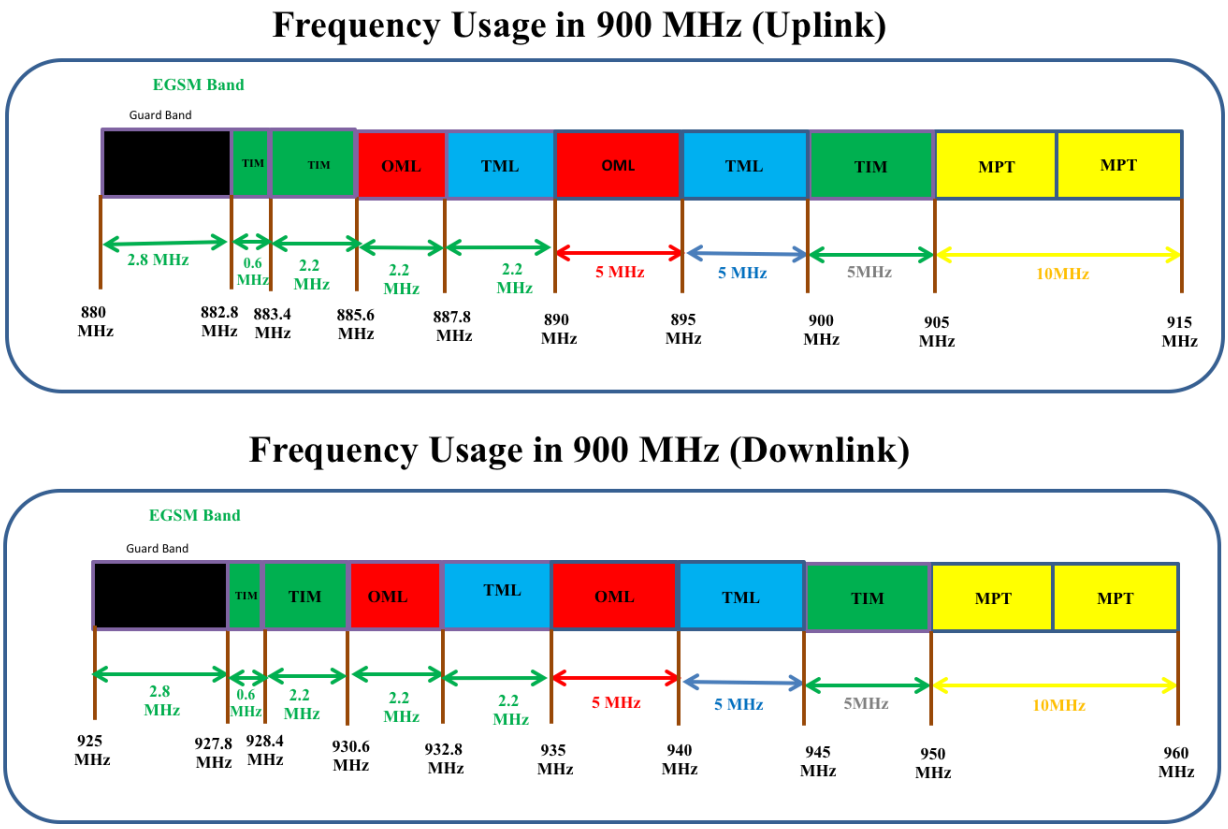
Consistent with the Ministry priorities detailed in the E-*GSM Consultation Paper 2017*, the PTD's approach to E-GSM spectrum was mindful to ensure that longer term arrangements and allocations of E-GSM spectrum (i) maximise the public benefit arising from the use of this harmonised sub-1 GHz spectrum, (ii) promote sector competition and (iii) facilitate Myanmar's early move to LTE/4G services (with a wider coverage) whilst ensuring that 2G only customers continue to be provided service while it remains commercially viable.

In November 2018, theallocations of E-GSM spectrum shown in Exhibit 10 were made with Telenor Myanmar, Ooredoo and Mytel each being allocated for 5 years, 2 x 2.2 MHz of spectrum with Mytel also being allocated at, a discount due to potential interference, 2 x 0.6 MHz of 900 MHz spectrum.

[16] See Consultant Reports on this, for example WPC, *Powered Evolution to 5G: The compelling case to adopt LTE Band 41 in the 2.6 GHz spectrum band in Asia and globally*. Available at www.gsacom.com

[17] See PTD, *Consultation Paper on the Spectrum Optimisation of the 850 MHz Band*, January 2019

Exhibit 10: Frequency Allocations in the 900 MHz band



Source: PTD, January 2019

Q13.	What is your preferred approach to the allocation of E-GSM spectrum post the end of the current 5 year licences? How is this optimally reflected in the Spectrum Roadmap? What method of allocation should be adopted?

2.5 Approach to the licence-exempt bands including IoT

2.5.1 Possible expansion of licence-exempt spectrum 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). Currently, 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 significantly smaller allocation compared to many other countries (see Exhibit 11 over) whereby many have total bandwidth allocated in this band exceeding 500 MHz.

Q14.	Should Myanmar expand the licence-exempt band in the 5 GHz band? If so, what are the implications for existing allocations/users? What particular blocks of spectrum in the 5 GHz band should be made available for licence-exempt use?

Exhibit 11: License-exempt 5 GHz spectrum bandwidth across selected countries

	Spectrum bands	Total bandwidth
Myanmar	5.725 - 5.875 GHz (150 MHz)	150 MHz
UK	5.150 - 5.350 GHz (200 MHz) 5.470 - 5.850 GHz (380 MHz)	580 MHz
US	5.150 - 5.350 GHz (200 MHz) 5.470 - 5.850 GHz (380 MHz)	580 MHz
Australia	5.150 - 5.350 GHz (200 MHz) 5.470 - 5.600 GHz (130 MHz) 5.650 - 5.850 GHz (200 MHz)	530 MHz
Canada	5.150 - 5.350 GHz (200 MHz) 5.470 - 5.600 GHz (130 MHz) 5.650 - 5.850 GHz (200 MHz)	530 MHz
Malaysia	5.150 - 5.350 GHz (200 MHz) 5.470 - 5.650 GHz (180 MHz) 5.725 - 5.875 GHz (150 MHz)	530 MHz
Singapore	5.150 - 5.350 GHz (200 MHz) 5.470 - 5.850 GHz (380 MHz)	580 MHz
Thailand	5.150 - 5.350 GHz (200 MHz) 5.470 - 5.850 GHz (380 MHz)	580 MHz

Source: Myanmar Wireless Broadband Association, *Empowering broadband connectivity in Myanmar: Policy recommendations for the proliferation of license-exempt wireless technology access*, July 2018, page 28

2.5.2 Spectrum allocations for Internet of Things (IoT)

In 2018, following industry consultation the PTD amended the Technical Specifications for Short Range Devices (SRD) as the Spectrum to be used for Radio Telemetry, Telecommand and RFID systems from 919 to 923 MHz to 919 to 924 MHz.

Given the rising global interest and focus on Internet of Things (IoT), the PTD is seeking views on whether further license-exempt frequencies should be made available for these services.

Q15.	Do you support additional licence-exempt spectrum being made available for SRD including IoT services? If so what frequencies – consistent with global frequency spectrum allocations – would you support?

2.6 Review of 850 MHz spectrum band and reservation of spectrum for PPDR Broadband

In February 2019, the PTD released a *Consultation Paper on the Spectrum Optimisation of the 850 MHz Band* focused on the way forward for this particular band. It can be found at https://www.ptd.gov.mm/NewsDetail.aspx?id=pkd%2f%2fq6cCQZJIcPQOR1Xew%3d%3d. Comments are due by 28 February 2019.

Q16.	Did you have any further comments on the 850 MHz band, PPDR broadband and related spectrum management issues in the context of the IMT Spectrum Roadmap review?

2.7 Making available spectrum for backhaul transmission

Given the current challenges, of deploying affordable optical fibre backhaul in cities like Yangon and Mandalay, given rising wireless data demand and a need to maintain quality of service to meet both customer expectations and regulatory requirements, the PTD is strongly supportive the deployment of fibre replacement technologies in Myanmar in order to facilitate affordable high speed wireless broadband deployment.

Compared with the microwave operating at traditional frequency bands, V-Band (60 GHz) and E-Band (70-80 GHz) equipment uses relatively high frequencies, links utilising this spectrum are excellent conduits for carrying high capacity (1 Gbps+) traffic at very short distance (typically 2-3 km). It should be noted that such microwave beams are narrow and as which (i) there is minimal interference between sites, (ii) dense site deployment is possible, and (iii) reuse of spectrum resources is facilitated.

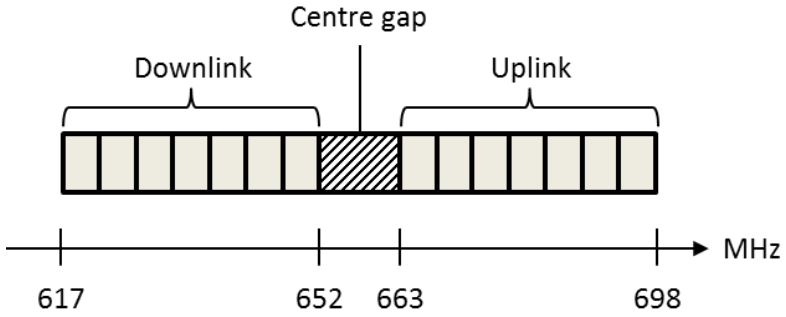
Q17.	The PTD seeks industry views on the optimal spectrum bands which should be allocated to such backhaul transmission uses, how these spectrum bands should be allocated and the pricing of such spectrum.

2.8 Securing a second digital dividend for Myanmar

Following the future allocation of the sub-1 GHz spectrum in Myanmar including the 900, 850 and 700 MHz spectrum bands in Myanmar, should there be a focus on securing a second digital dividend in the country in the 600 MHz? This would require the PTD along with the Authority (created in accordance with the *Broadcasting Law 2015*) to plan the digital switchover ("DSO") of television broadcasters in Myanmar so that 3GPP Band 71 (see Exhibit 12 below) could be released for 4G/5G and future services[18] in Myanmar.

This spectrum band could be planned for and optimally be timed for release in say, 2024 or 2025 period. This timing would likely accord with the growing global adoption of 5G services and improvement in the ecosystem for affordable 5G devices. It would seem to be possible in Myanmar given the current level of terrestrial television broadcasting in key urban markets of Yangon and Mandalay and Myanmar's neighbours.

Exhibit 12: 600 MHz Band (n71)



Source: APT

Securing the second digital dividend, would be consistent to the process in New Zealand[19] and Mexico[20] (announced in the past few months) and would align with the US 5G band in

[18] It should be noted that current 2018 iPhone XS and XS Max support 4G services in LTE Band 71 (600 MHz).

[19] See www.rsm.govt.nz/projects-auctions/current-projects/preparing-for-5g-in-new-zealand/technical-consultation/5g-spectrum-road-map-discussion-document.pdf

600 MHz band. Work has also commenced in the APT on such arrangements for the 600 MHz band.[21]

From an economic and social perspective, the release of the second digital dividend in the 600 MHz band (n71) is arguable compelling. Deploying 5G in lower bands is critical to its provisioning in lower ARPU markets like Myanmar, as it means lower capex and opex. It will also result in the utilisation of such 5G services by Myanmar's citizens beyond the major urban markets.

Q18.	The PTD seeks industry views on whether Myanmar should plan its DSO to secure a second digital dividend in the 600 MHz band (ie like n71)? What are the benefits and costs of such an approach? If supported what is the preferred timetable for the release of this spectrum band?
Q19.	What cross-broader co-ordination issues would be required to be addressed to release this spectrum band in ASEAN?

2.9 Addressing Cross-Border and WRC-19 Issues in the Spectrum Roadmap

The 2016 Spectrum Roadmap highlights in a number of places (eg page 50) the need for cross-border co-ordination arrangements. Since the 2016, cross-border co-ordination meetings have been held with Thailand (the second one will be held in the coming months) and contact has been made or attempted to be made with Lao PDR, Bangladesh and China. Given the growth in the Myanmar telecommunications market are further issues and bands needed to addressed more extensively in the Spectrum Roadmap? The PTD would like to provide an opportunity for interested stakeholders to submit on any WRC-19 issue.

Q20.	Are there any comments or suggestions on cross-border co-ordination arrangements including synchronisation issues which should be included or addressed in any future Myanmar Spectrum Roadmap?
Q21.	Do you have any input to the PTD's consideration of the WRC-19 agenda items and related issues?

3. REQUEST FOR COMMENTS

Consistent with the Law, and the *Spectrum Rules 2016*, the Ministry is pleased to provide key stakeholders with an opportunity to comment on any aspect of this *Review of the IMT Aspects of the Myanmar's Spectrum Roadmap Consultation Paper*. While the PTD would appreciate receiving detailed written responses to the 21 specific questions contained in this Consultation Paper responders are also welcome to make additional comments or suggestions on any aspect of this consultation paper or indeed any element of the 2016 Spectrum Roadmap.

Comments must be received in writing via email to resource@ptd.gov.mm by ***5pm on 8 April 2019.***

- END -

[20] See www.iicom.org/regions/americas/item/mexico-clears-600-mhz-band-in-claimed-world-first and
[21] See AWG-21/INP-43 (Rev.1)