9. Commercial Bands

Commercial bands encompass those bands that are used to provide cellular and broadband services to the people of Myanmar. There has been a rapid and steady growth of commercial mobile services since the introduction of competition and correspondingly, Myanmar has reaped significant economic and social benefits for its citizens. As a result of the introduction of competitive operators, new networks and services have been growing, leading to increasing demand in the amount of spectrum required to deliver these services. Demand forecasts from various sources – both for Myanmar and for markets with similar characteristics, indicate that there will be continued requirements for more spectrum as new services and products are introduced and as user demands placed on networks continue to evolve.

9.1. Demand Trends/Technology

As indicated in the introduction to this section, an understanding demand trends and technology evolution are important elements to the accurate definition of current and future spectrum needs.

9.1.1. Devices

Technological developments have resulted in an evolution in service definition. Network deployments and new innovative devices are driven by the consumer's appetite for information and functionality. This evolution has resulted in a convergence of functionality and services available to users. Increasingly, consumers' use of on-line program content - formerly limited to 'programmed broadcasting' services, has now evolved into a range of video content delivered over a variety of fixed and increasingly, mobile platforms. Most of this video content is comprised of un-programmed social media and movies available over the Internet and delivered by wireless fixed and mobile networks. Services that previously were limited to fixed wired networks - due to bandwidth requirements, are now available to wireless fixed and mobile users. This 'mobile first' delivery of content has resulted in a significant shift of traffic to mobile networks, new traffic characteristics and the evolution in devices and the network technologies necessary to support them.

A wide range of enhanced devices that incorporate cellular connectivity has entered the market during the past three years, including smartphones, USB dongles, tablets, e-book readers and gaming consoles. These devices offer larger screen sizes and higher resolution and hence, increased data consumption as well as encourage the use of traffic-intensive applications - such as video calling, gaming, social media applications, etc.

9.1.2. Changing traffic characteristics

New devices have been a key driver of increased mobile broadband traffic.[22] A wide range of new, connected devices, have a significant impact on mobile traffic volumes. Content is rich in applications: video entertainment, video sharing, YouTube, access to on-line education, multi-media and gaming. People now commonly use any Internet application ('app') on their mobile devices and in addition, mobile devices enable new applications such as location-based services.

[22] ITU-R M.2243, Assessment of Global Mobile deployments and forecasts for mobile IMT

Between 2008 and 2010 alone, over 300,000 mobile apps have been developed for smartphones. The most used mobile apps are games, news, maps, social networking, music and more recently medical apps. Many stakeholders are now offering mobile apps through commercial online stores and application stores.

In 2009, worldwide mobile app downloads amounted to approximately 2.52 billion and are expected to reach 268.69 billion in 2017.[23]

Figure 2: Changing Broadband Traffic Characteristics

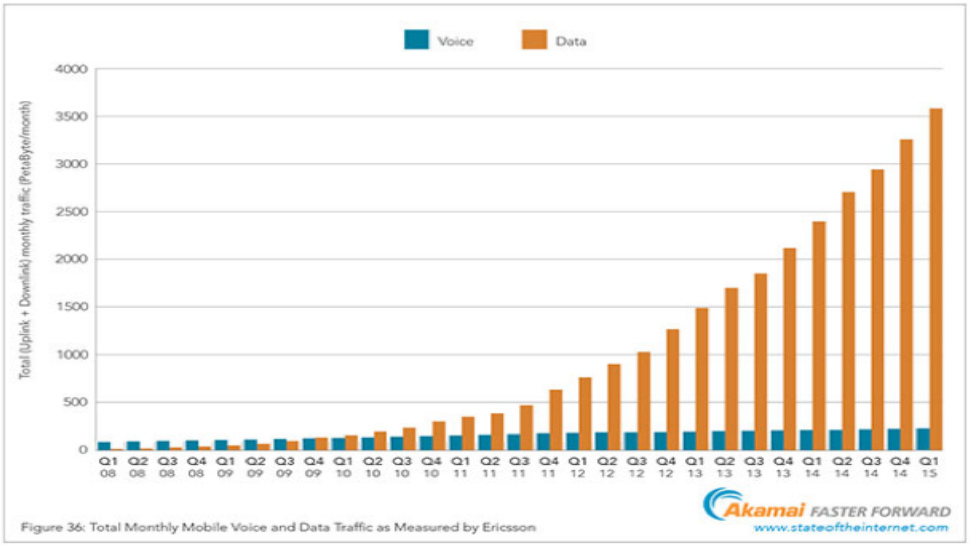
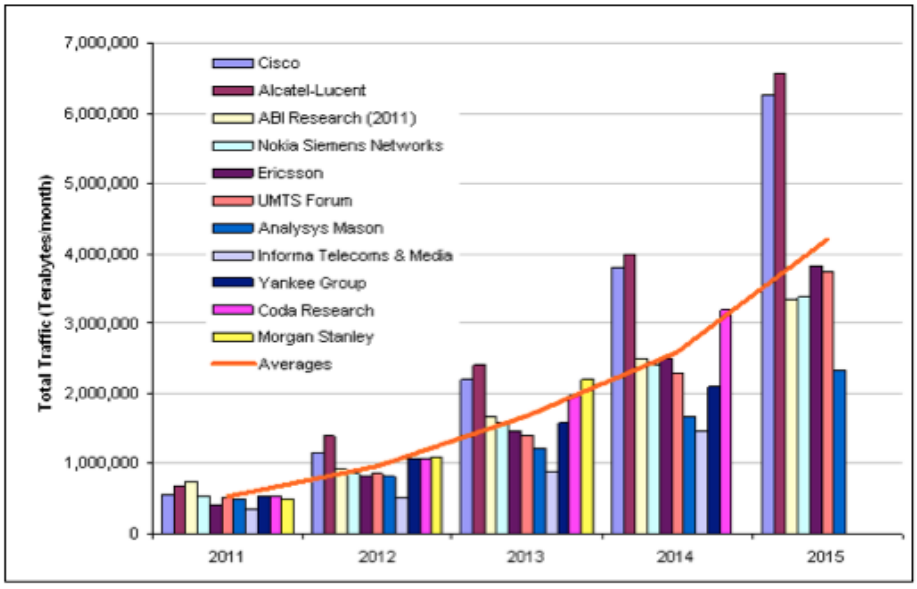
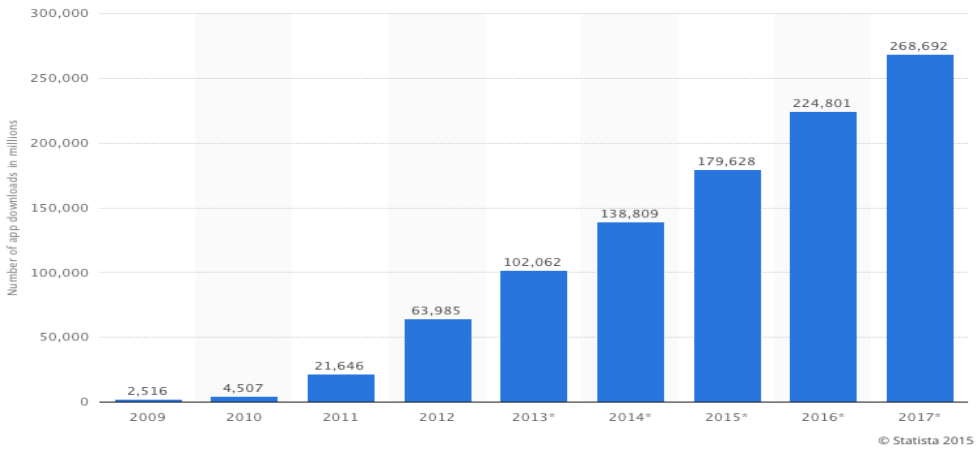


Figure 3: Mobile global data traffic estimates from 2011 - 2015 based on multiple sources



Source ITU R M. 2243

Figure 4: Number of App Downloads (Millions)



Source: Statista, available at: http://www.statista.com/statistics/266488/forecast-of-mobile-app-downloads/

In addition to terminals used by individuals, there has been an increase in applications related to machine-to-machine usage. Examples of industrial/commercial applications now include security monitoring, point-of sale terminals, health care, asset management along with many others yet to be developed.

In order to provide an idea of the progression of mobile services in emerging economies, the PTD considered the case of India. In that country, data growth in its four top cities expanded 120 per cent over the past year. Mobile Internet users are forecasted to jump from 254 million in 2013 to 436 million by 2017. Almost 70% of traffic is now data and is driving their push to 4 G[24].

Myanmar's objectives, as stated in the Master Plan, will increase network expansion, spur innovative service offering and drive demand by users. The Master Plan emphasizes mobile-first in the growth of connections as the most efficient means to enable its goals for the development and delivery of new services such as e-health, e-learning and e-Government.

The policy initiatives of MCIT will translate into more users, more terminals, increased use of data application. On the network side, the policy initiatives are expected to enable wide deployment of broadband infrastructure, wireless networks as well as a significant increase in spectrum access.

9.1.3. Global smartphone penetration

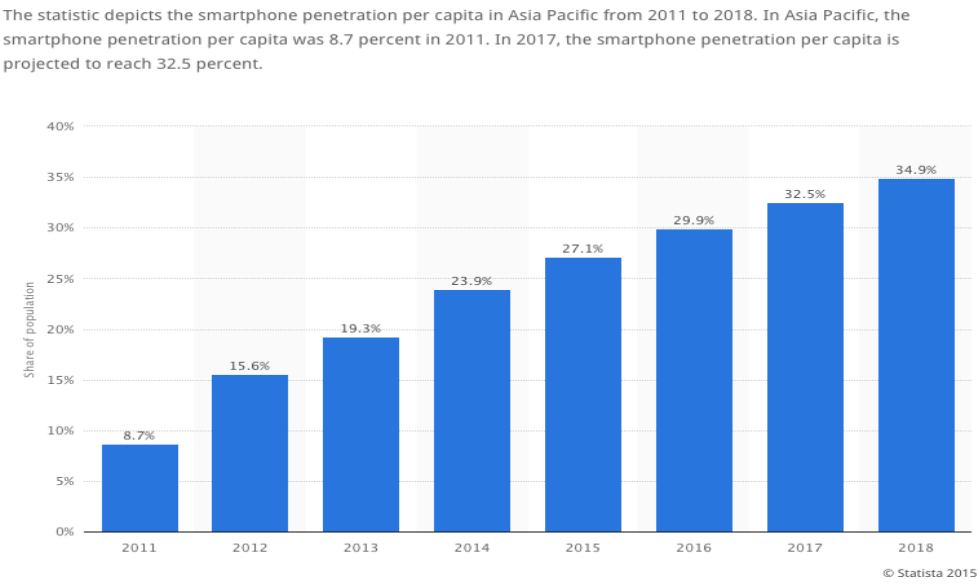
Over a third of the world's population is projected to own a smartphone by 2017, up from less than 10 percent in 2011. Western Europe is due to become the largest regional market as almost 65 percent of its total population is forecast to own a smartphone by 2017, over twice the figure in 2012. Within North America, around 64 percent of the population will own a smartphone in 2017, an increase of 13 percent on the figure from 2014. The smallest

[24] Source: Aircel, as reported in Mobile World Live, Oct 7, 2015.

regional market for smartphones is the Middle East and Africa, where smartphone penetration will stand at an estimated 13.6 percent by 2017.

In Asia, it has been estimated that smartphone penetration will be almost 35% in 2018. Almost one billion smartphones were sold to end users in 2013, an increase from less than 300 million units in 2010. The two most popular smartphone operating systems in 2014 were Android and iOS, which sold a combined 288 million units to end users worldwide in the third quarter of the year. The Google-backed Android held a global market share of 84.4 percent in the third quarter of 2014, whilst Apple's iOS held 11.7 percent of the market. The leading smartphone vendors in the global market were Samsung and Apple, who both held a share of around 20 percent by the end of 2014.[25]

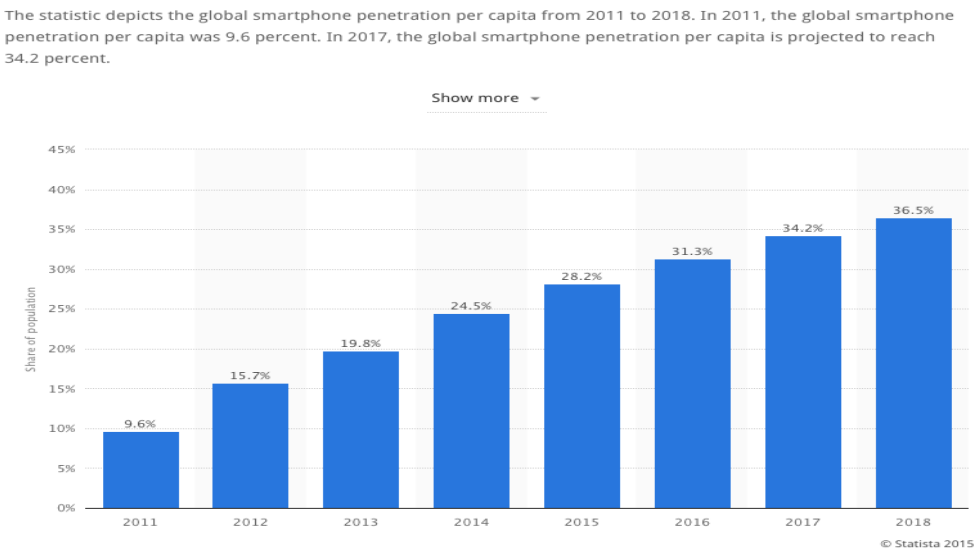
Figure 5: Smartphone Penetration per Capita in Asia pacific (%)



Source: Statista

[25] http://www.statista.com/statistics/203734/global-smartphone-penetration-per-capita-since-2005/

Figure 6 : Global Smartphone Penetration per Capita (%)



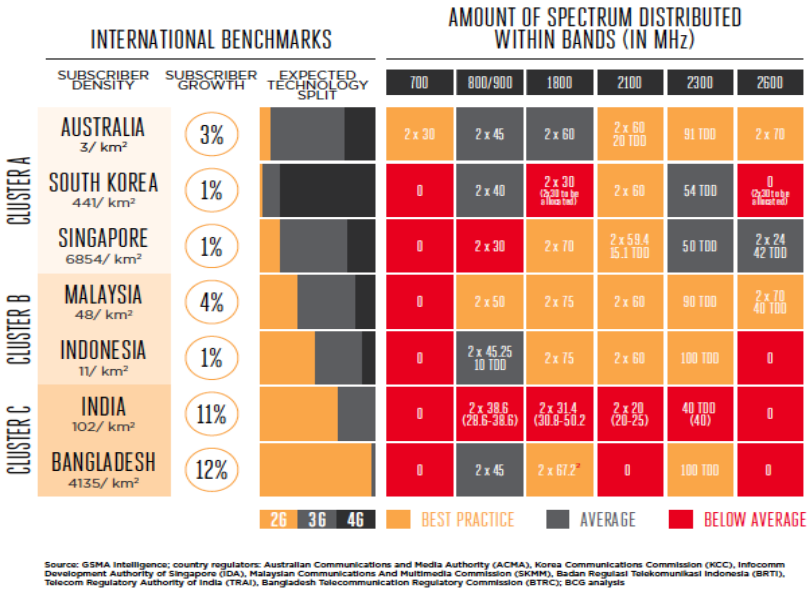
Source: Statista

Telenor forecasts 2020 mobile SIM penetration in Myanmar to reach 140% (70% real subscriber penetration @ 2 SIMs/subscriber).[26]

While almost all countries are experiencing the same consumer demand and technology drivers for spectrum, as shown in the following figure, spectrum availability to satisfy 'mobile first' varies greatly in the key commercial bands.

[26] Telenor white paper on Spectrum, October 14, 2015

Figure 7: Spectrum Available for Mobile Operators in Various Asia Pacific Countries



Source: GSMA Intelligence; country regulators: Australian Communications and Media Authority (ACMA), Korea Communications Commission (KCC), Infocomm Development Authority of Singapore (IDA), Malaysian Communications And Multimedia Commission (SKMM), Badan Regulasi Telekomunikasi Indonesia (BRTI), Telecom Regulatory Authority of India (TRAI), Bangladesh Telecommunication Regulatory Commission (BTRC); BCG analysis

9.2. Global and regional considerations for Myanmar in assigning spectrum

Spectrum assignments in nearby countries are critical to Myanmar in order to avoid interference, promote the efficient use of spectrum, co-ordinate the roll out of new technologies and in the longer term, as a basis for a common vision in the allocation of bands.

Below we provide a list of mobile frequency bands used by neighbouring and nearby countries[27]:

Bangladesh	
CDMA450	450 – 455 / 460 – 465
CDMA800	825 – 845 / 870 – 890
E-GSM	880 – 890 / 925 – 935
GSM900	890 – 915 / 935 – 960
GSM1800	1710 – 1785 / 1805 – 1880
CDMA2000	1890 – 1910 / 1970 – 1990

[27] INFORMATION OF MOBILE OPERATORS' FREQUENCIES, TECHNOLOGIES AND LICENSE DURATIONS IN ASIA PACIFIC COUNTRIES, No. APT/AWG/REP-15 (Rev. 1), Edition: March 2013

BWA systems (Mobile WiMAX)	2330 – 2400 TDD
BWA systems (Mobile WiMAX)	2585 – 2620 TDD

China (People's Republic of)	
CDMA800	825 – 835 / 870 – 880
GSM900	889 – 915 / 934 – 960
GSM1800	1710 – 1755 / 1805 – 1850
IMT	1755-1785 / 1850-1880
CDMA2000	1920 – 1935/2110 – 2125
IMT	1935-1940 / 2125-2130
UMTS(WCDMA)	1940 – 1955/2130 – 2145
IMT	1955 –1980 / 2145-2170
TD-SCDMA	1880 –1900 TDD
IMT	1900 – 1920 TDD
TD-SCDMA	2010 – 2025 TDD
TD-SCDMA	2300 – 2400 TDD
IMT	2500 – 2690 TDD

Malaysia	
E-GSM900	880 – 890 / 925 – 935
P-GSM900	890 – 915 / 935 – 960
GSM1800	1710 – 1785/ 1805 – 1880
UMTS(WCDMA)2100	1920 – 1980/ 2110 – 2170 1900 – 1920 (TDD) 2010 – 2025 (TDD)
BWA(WiMAX)	2300 – 2400 (TDD)

Thailand	
CDMA2000 1X	479 – 483.5 / 489 – 493.5
CDMA2000 1X EV-DO/HSPA	824 – 839 / 869 – 884
AMPS800/HSPA	839 – 849 / 884 – 894
GSM900/HSPA	897.5 – 915 / 942.5 – 960
GSM1800	1710 – 1785 / 1805 – 1880
IMT	1920 – 1980 / 2110 – 2170 2010 – 2025
BWA	2300 – 2400 2500 – 2690

Vietnam (Socialist Republic of)	
CDMA 450	453.08 – 457.37 / 463.08 – 467.37
CDMA800	824 – 835 / 869 – 880
eGSM900	880 – 890 / 925 – 935
GSM900	890 – 915 / 935 – 960
GSM1800	1710 – 1785 / 1805 –1880
IMT 2000	1920 – 1980 / 2110 – 2170

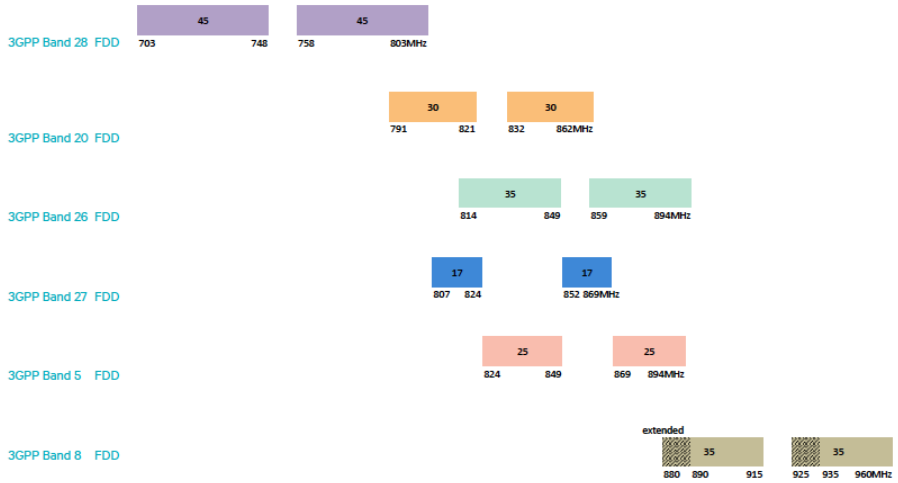
Laos	
CDMA 800	824-849/869-894
EGSM	880-890/925-935
PGSM	890-915/935-960
GSM1800	1710-1785/1805-1880
2300	2300-2330
2500	2500-2690
3500	3400-3600

Laos	
5800	575-5825

The band 450-470 MHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). See Resolution 224 (Rev. WRC 07) *. This identification does not preclude the use of this band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations (WRC 07). Regionally the 450 MHz band is used by a range of land mobile (LM) systems.

The above tables indicate that band edges vary widely among region 3 countries, depending on the band configuration, particularly relevant in Myanmar the 800MHz (806-880)[28] and 900 MHz (880-915/925-960). See figure below.[29]

Figure 8: Components for Sub 1Ghz spectrum Assignments in ASEAN



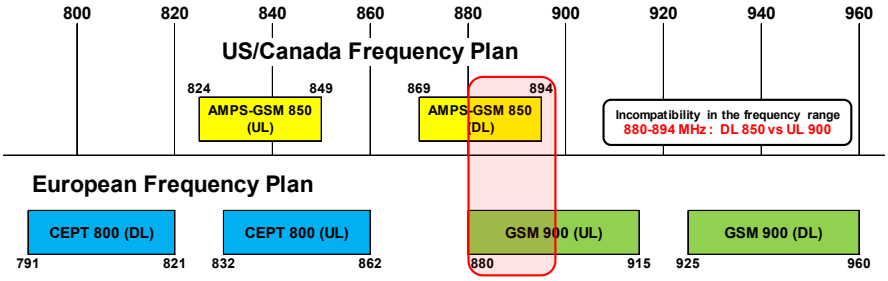
Source: Qualcomm (2015), Re-farming 2G bands – ASEAN situation

The complexity of the global / regional arrangements in the 850 MHz (824-849/869-894) and 900 band (880-915/925-960) – can result in orphan spectrum in domestic assignments as well as increased complexity to coordinate, potential interference, particularly in border areas.

- Unassigned spectrum in the 850 band includes the 835-849/880-894 MHz bands, due to overlap of 850 MHz DL (880-894) with 900 MHz band UL.

[28] The 800 MHz band in Myanmar follow part of the 850 (824-849/869-894)

[29] Extract from the article: 'Re-farming 2G Bands –ASEAN Situation', Alex Orange, Director, Government Affairs, Southeast Asia and Pacific



The impacts of this global/regional complexity in spectrum in Myanmar include a mix of 850 MHz (824-849/869-894) and 900 MHz band (880-915/925-960). The PTD is also investigating reports of interference MPT in the 850 MHz band and Ooredoo in the 900 MHz band. We note that APT AWG Report 35 provides guard band recommendations to minimize interference issues caused by the use of different technologies in adjacent bands.

Spectrum coordination issues with neighbouring countries

The complexity of the global / regional arrangements result in increased complexity for national regulatory authorities for the efficient coordination and use of spectrum as well as the ex post factor resolution of potential interference in border areas.

Myanmar operators have reported that mobile operators from Thailand use almost all available spectrums at the border of Myanmar – in particular in the 900MHz band but also, in the 2100MHz band. As a result of this interference in the border areas, MPT, TML and OML are not able to fully exploit their spectrum licences.

MCIT/PTD have initiated preliminary discussions with their counterparts in Thailand and cross border discussions were initiated with the Thai Regulator in 2015.

Similarly, there are several mobile operators from China that use spectrum on the Myanmar side of the border. There are also reports of operators from one country serving subscribers across the border. Only MPT operates currently in that area and is severely impeded in its operations. Ooredoo and Telenor have plans to expand in the north as well;

In light of the increase in 'mobile first' applications and consumer demand in the regional markets, the PTD recognizes that it is in the interests of Myanmar and its neighbours to negotiate – on a priority basis, bi-lateral arrangements for sharing issues in border areas in order to minimize economic disruption and to maximize spectrum use efficiency. The scope of these discussions will likely include technical standards and operational concerns regarding sharing, licensing, operating parameters.

9.3. Myanmar Commercial Assignable Spectrum Bands

Below we highlight commercial spectrum bands that have been identified by PTD for future assignments.

Table 2: Commercial Spectrum bands

Technology	Frequency MHz (UL/DL)	Band
CDMA800 / TDMA 800/ GSM 800	824 – 849 / 869 – 894	A
GSM900	890 – 915/ 935 - 960	B
EGSM 900	880 – 915/ 925 - 960	B2
GSM1800	1710 – 1785/ 1805 -1880	C
CDMA 1900 / GSM1900	1850-1910/ 1930-1990	D
UMTS (WCDMA)/ CDMA 2000	1920 – 1980/ 2110 -2170	E
CDMA450	450-460/ 460-470	F
PDC800	893 – 898 / 838 - 843 940 – 948 / 810 – 818 925 – 940 / 870 – 885	G
UMTS(WCDMA)1500/CDMA1500	1427.9-1452.9 / 1475.9 - 1500.9	H
UMTS (WCDMA) 800/ CDMA 800	815-845 / 860 - 890	I
CDMA800	887 – 889 / 832 - 834 898 - 901 / 843 - 846 915 – 925 / 860 – 870	J
UMTS (WCDMA)1500/CDMA1500	1427.9 - 1452.9 / 1475.9 - 1500.9	K
UMTS(WCDMA)1700/CDMA1700	1749.9 - 1784.9 / 1844.9 - 1879.9	L
PHS	1884.5 - 1919.6 (TDD)	M
TDD mobile communication systems	2 010 – 2 025 (TDD)	N
BWA systems (WiMAX, Next Generation PHS)	2 545 – 2 625 (TDD)	O

Source: MCIT/PTD spectrum plans.

9.4. Current commercial licensees

MCIT/PTD authorizes 4 types of telecommunication license categories:

1. Network Facilities Service (Individual) License – general licence for fixed or mobile telecoms operators.
2. Network Facilities Service (Class) License - limited to tower leasing and self-provision of telecoms services, - applies to tower companies and business users of voice-over-the-internet services.
3. Network Service License, for telecoms services resellers.

4. Application Service License, which permits the licensee to lease transmission capacity directly from telecoms providers and resellers.[30]

Up to the licensing of the 2 new mobile operators Telenor and Ooredoo in June 2013, MPT had the sole Network Facilities Service licence for the provision of public land mobile services in Myanmar.

In 2015, MCIT issued 21 Network Facilities Services (Individual) licences. These licences permit their holders to construct networks, lease access to service providers and to offer any type of public or private telecom service.[31] In addition, 25 Network Facilities (Class) licences were awarded. Network Facilities (Class) concessions permit licensees to deploy and maintain passive infrastructure and to lease access to service providers.

9.4.1. Current spectrum licence holders and overall spectrum holdings

In the following table, we provide a synopsis of the 3 mobile operator's spectrum licensees Spectrum licences:

Table 3: Summary on Spectrum Licences of Three (3) mobile Spectrum Operators in Myanmar

Frequency Band	Licensee	Technology	Uplink (MHz)	Down Link (MHz)	BW (MHz)
450 MHz	MPT	CDMA	453.35-457.1	463.35-467.1	2 X 3.75
850 MHz	MPT	CDMA	825-835	870-880	2 X 6.25
900 MHz	MPT	GSM	900-915	945-960	2 X 10[32]
	Ooredoo	GSM	890-895	935-940	2 X 5
	Telenor	GSM	895-900	940-945	2 X 5
2100 MHz	MPT	WCDMA	1935-1950	2125-2140	2 X 15
	Ooredoo	WCDMA	1950-1960 (1965)	2140-2150 (2155)	2 X 15
	Telenor	WCDMA	1965-1975 (1980)	2155-2165 (2170)	2 X 15

Note: Telenor/Ooredoo: Option to add 5 MHz pair @ 2100 MHz

Of the mobile operators, MPT has by far the largest holding of spectrum. Incumbent MPT has 70 MHz of spectrum, 30 MHz more than its competitors. Following discussions between PTD and MPT, an agreement was reached in December, 2015 whereby MPT would relinquishes 5 MHz @ 900 MHz, thus reducing its holding to 2x10 MHz.

As the spectrum authorizations for MPT were granted prior to the adoption of the new Telecommunications Law, a transition period will be required for formal licensing of their commercial spectrum.

Ooredoo and Telenor were provided 10MHz (5 up, 5 down) licenses in the 900MHz band and 30 MHz (15 up, 15 down) in 2100 MHz band.[33] In Appendix A, we provide a website link

[30] 'Myanmar Telecommunications Law 2013. Industry articles: Recent Developments in Myanmar's New Telecommunications Law. 'Jones Day. Published in Lexology See http://www.lexology.com/library/detail.aspx?g=c6839a83-34d6-49f6-94ef-835fd1b07f53

[31] 'MCIT Issues New Licences'. TeleGeography, March 2015

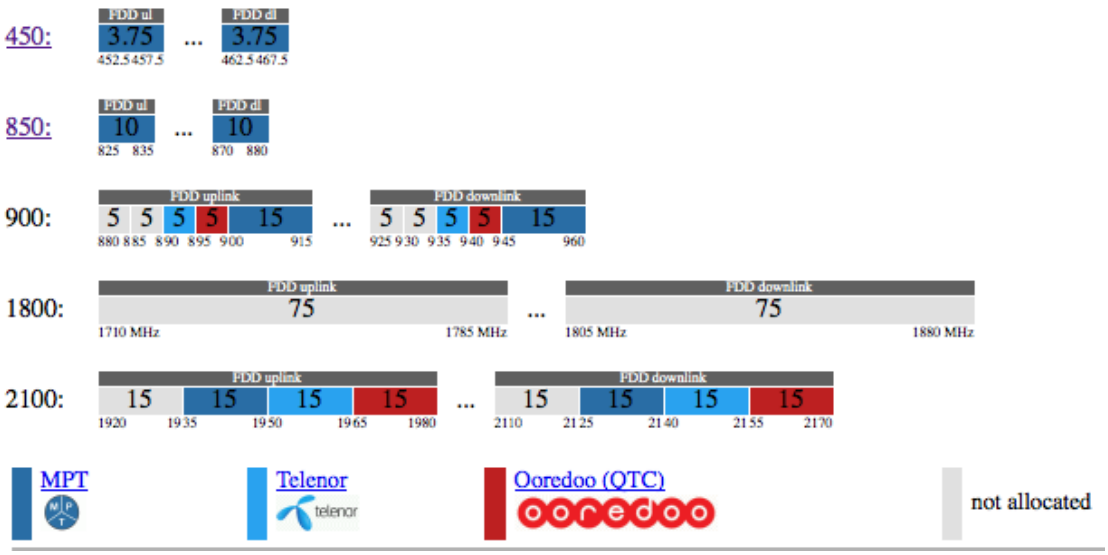
[32] 5 MHz to be returned to PTD and to be made available to a 4th operator 2016

from the MCIT, that includes a list of current commercial operators in Myanmar. New entrants - Ooredoo and Telenor, each have 40 MHz of spectrum in the same bands.

Not all entities holding licences have associated spectrum licences. MecTel operates as an MVNO - using spectrum provided by MPT.[34]

Below is a pictorial representation of Myanmar's mobile telephone frequency assignment blocks[35].

Figure 9: Myanmar Phone Frequency Assignments



Source : http://www.spectrummonitoring.com/frequencies/frequencies3.html#Myanmar

In addition, since 2013 MPT has been given a temporary non-commercial authorization in the 1800 MHz band. This spectrum was provided to MPT to support its role as a host organization for the Asian Games as well as for LTE development /experimentation for LTE technology and services. We note that global best practices generally limit the duration of developmental / experimental non-commercial authorizations to 6 months or less and would normally have attached specific objectives and reporting requirements. While extensions are frequently granted, in the overall perspective, if such extensions are to become prevalent, they will effectively block the longer term objective for national regulators of making spectrum available to the most efficient, higher economic usage.

9.4.2. Aggregate Mobile spectrum holdings above and below 1GHz

In the mobility world, it is generally recognized that spectrum holdings below 1GHz confer significant advantages to licences in terms of capital requirements for towers as well as

[33] Includes 5MHz of additional spectrum held by PTD/MCIT in reserve for Telenor and Ooredoo – under their current Licencing option would effectively preclude assignment to any other operator.

[34] MecTel does not have either a Network or Application Service licence.

[35] Prior to the relinquishing of spectrum 5+5 MHz at 900 MHz

operating cost efficiencies. Spectrum below 1 GHz is generally preferred, particularly in early deployment phases, due to the requirement of fewer base stations to achieve coverage and in-building penetration.

Incumbent MPT has 40 MHz of spectrum below 1 GHz, compared to its competitors with 10 MHz each. However, at the time competitors Telenor and Ooredoo entering the market MPT legacy assignments were known.

In the following table, we provide a synopsis of the current spectrum holdings of the mobile operators in the bands above and below 1GHz:

Table 4: Current Spectrum Holdings of Mobile Operators in the Bands above and Below 1 GHz

Licensee	450 MHz	850 MHz	900 MHz	1800MHz	2100 MHz	2300 MHz	2600 MHz	Aggregate <1 GHz	Aggregate >1 GHz
MPT	7.5	12.5[36]	20	Temporary authority (>1year)[37]	30			40	30
Ooredoo			10		30			10	30
Telenor			10		30			10	30

9.4.3. Global and Regional considerations in use of sub 1 GHz bands

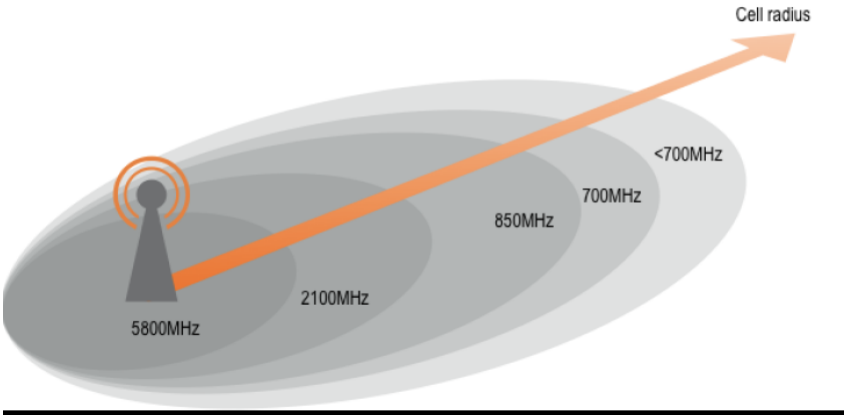
Overall, given the legacy spectrum authorizations to MPT, this has resulted in a vast majority of holdings being in the hands of the incumbent.

Lower frequency bands are generally preferable for mobile communications. For a given height and power, lower frequencies propagate further providing for favourable coverage characteristics, lower frequencies also better penetrate buildings providing better in-building coverage. Licensing and deployment of systems in lower frequency bands can result in faster deployment since a single cell has a greater coverage radius than a similar (Height and power) cell at a higher frequency, this translates to fewer cells to cover a geographic area. In rural and less densely-populated areas, lower frequencies frequently have critical advantages in coverage, service reliability and costs. To cite just one study, GSMA[38] estimated that the price of providing mobile broadband is 70% lower than providing similar services at 2100 MHz.

[36] Assigned BW.

[37] Temporary authorities could be used to serve a number of purposes such as special events and technology development. With clearly defined objectives, reporting and timeframes Temporary authority is a useful tool to spur innovation. Developmental/experimental authorizations would normally not exceed 6 months and not provide for early access or be seen to provide tenure on the assignment.

[38] Mobile broadband Roadmap Cambello Sebastian, Director Public Policy, GSMA quoted from SCP Associates Study.



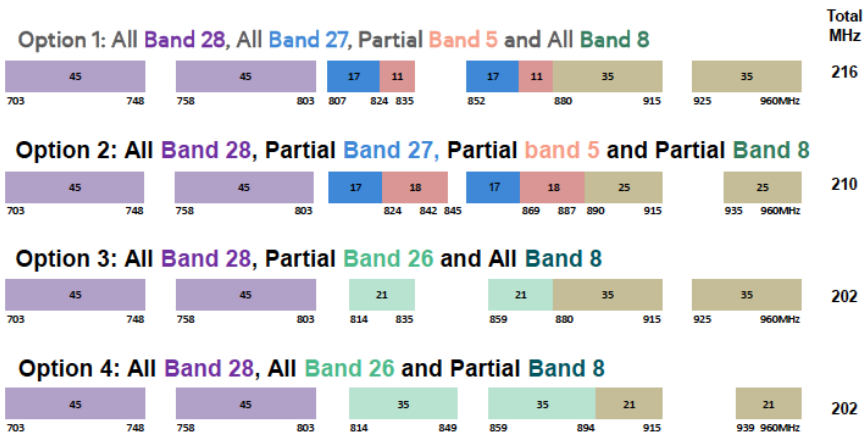
Source: GSMA Spectrum Policy Digital dividend paper

Since radio frequencies are a limited resource, while frequencies below 1 GHz provide superior coverage and in-building penetration, frequencies above 1 GHz allow for the provision of higher capacity systems.

Below is a list of bands assigned that PTD considered for future assignment:

1. 700 MHz has been assigned in a number of countries in Region 3[39].
2. 850 MHz reconfiguration could result in improved utilization, possible options below[40].

Figure 10: Options for Sub 1 GHz Spectrum Arrangements in ASEAN



Source: Qualcomm (2015), Re-farming 2G bands – ASEAN situation

[39] Australia, New Zealand, Taiwan and Japan.

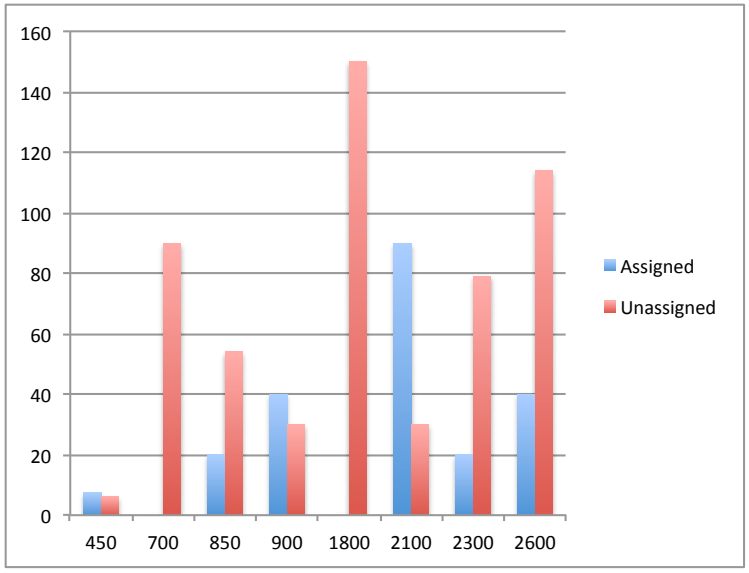
[40] Extract from the article 'Re-farming 2G Bands –ASEAN Situation', Alex Orange, Director, Government Affairs, Southeast Asia and Pacific. Source: http://readi.asean.org/readi.asean.org/media/files/3_Alex-Orange_READI_ASPF-5_180315.pdf

Question 13 (850/900 MHz realignment): While the release of 850 and 900 MHz and any associate band arrangements would be part of a separate consultation, we invite your preliminary views on options presented in figure 11.

3. 900 MHz allows for the use of three[41] 5 MHz pairs.
4. 1800 MHz band is unassigned in Myanmar (except for a temporary assignment to MPT for special event) and common throughout R3.
5. 2100 MHz has a 3 pairs of 5 MHz pair unassigned.
6. Unassigned spectrum in Myanmar in the 2300[42] and 2600[43] bands.
7. 3500 MHz[44] band is currently unassigned in Myanmar.

In the following figure, the PTD highlights the assigned and unassigned spectrum in Myanmar in various bands [45]:

Figure 11: Assigned/Unassigned Commercial Spectrum (MHz)



[41] The extended GSM band, plus the pair to be returned by MPT.

[42] Assigned in China, Hong Kong, India

[43] Assigned in Australia, China, Hong Kong, Malaysia, New Zealand,

[44] The band is identified for IMT by some countries of Asia-Pacific Region, utilization is recorded in APT/AWG/REP-37

[45] For most bands assigned and unassigned spectrum reflects allotments as per the spectrum rules, adjusted to reflect current users. In a few cases the bandwidth reflects actual assigned bandwidth. PTD is will re-examine allotments in these bands in order to ensure spectral efficiency and minimize interference.

Device availability is, and will remain an important consideration in the assignment of bands in order to ensure that a number of competing operators have cost efficient options for deployment. As an example, according to GSA "1800 MHz (3GPP band 3) continues to be the most prominent band for LTE network deployments globally and enjoys the largest devices ecosystem with 1,141 user devices. Over 43% of all LTE devices can operate in this band. 532 LTE1800 devices were announced during the past year."[46]

9.4.4. IMT bands – Recommended priority areas for MCIT/PTD in working with global spectrum planning bodies

IMT bands along with associated footnotes (FN's) are listed in the following tables.

Table 5: IMPT Bands and Associated Footnotes

Band (MHz)	Footnotes identifying the band for IMT for all Regions	Region 3 Some countries (Note1)	
450-470	5.286AA	20 MHz	–
470-694	5.idR2a,5.idR2b,5.idr3		88 MHz (610-698 MHz)
694-960	5.313A, 5.317A	170 MHz	92 MHz (694-790 MHz)
1427-1518	5.R1a,5.R2a,5.R3g,5.R3h	91 MHz	
1 710-2 025	5.384A, 5.388	315 MHz	–
2 110-2 200	5.388	90 MHz	–
2 300-2 400	5.384A	100 MHz	–
2 500-2 690	5.384A	190 MHz	–
3300-3400	5.R1b,5.C11,5.R3d,5.R3e		100 MHz
3 400-3 600	5.430A, 5.IMT,5.IMT2,5.432A, 5.432B, 5.433A	–	200 MHz
4800-4990	**5.R3f,5.A11**		**Up to 190**
	Total	**976 MHz**	**670 MHz**

Note1:

In the band 470-698 MHz, Bangladesh, New Zealand and some Pacific island states have identified all or part of the band 88 MHz for IMT.

[46] Global Suppliers Association http://www.gsacom.com/news/gsa_422.php

Band 698-790 MHz: This band is identified in 25 countries including Myanmar for IMT through FN 5.313.AThis band is part of the APT band plan for the 700 MHz. Since Myanmar is planning to license the 700 MHz

Band 790-960 MHz is identified for IMT in R3 and provides remaining part of the 700 MHz APT band plan i.e. 790-806 MHz

Band 3300-3400 MHz is identified for IMT at WRC-15, FN 5.R3e for Cambodia, India, Lao P.D.R., Pakistan, Philippines and Viet Nam

The band 3.4-3.6 GHz has become an almost global band for IMT (R1+R2 and 12 R3 countries).

Band 4800-4990 MHz or parts thereof are identified through FN 5.R3f at WRC-15 in Cambodia, Lao P.D.R and Vietnam for IMT

The identification of spectrum for a specific service requires satisfying certain requirements:

- Assessment of compliance or impacts of international allocations;
- Assessment of compliance or impacts of regional allocations;
- Updating the National Table of Frequency Allocations and,
- Harmonization of standards.

Finally, MCIT needs to have in place appropriate supporting utilization and licensing policies and technical requirements.

9.4.5. Additional Spectrum Going forward – A 5-year perspective for spectrum planning

In this section, we provide a view on the release of spectrum, anticipated timing and the planned generic licensing consultation process proposed over the next five years. In cases where a competitive licensing process is expected, MCIT would first initiate a public consultation specific to that process.

The idea of a spectrum release plan is to notify to stakeholders including industry and licensees as well as other interested parties of new frequency resources that may be opened for licensing in the near future. The spectrum release plan is beneficial to stakeholders to assess evolving market dynamics and for spectrum users to plan future deployment strategies.

MCIT considers that spectrum releases would further the vision of the Master Plan (and its objectives):

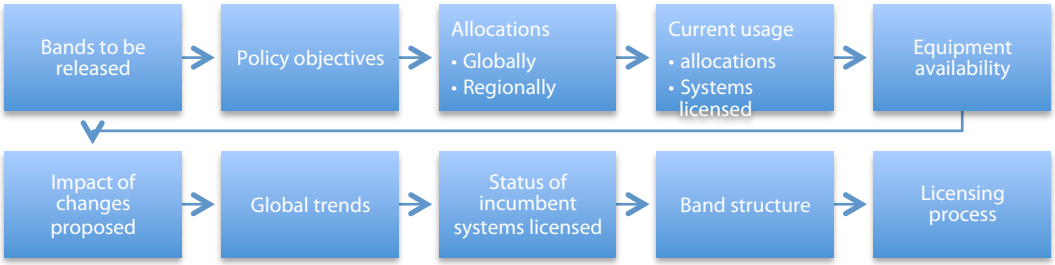
- 'Spectrum broadening': ensuring adequate spectrum for new 3 G and 4 G advanced mobile services,
- 'Spectrum extending': ensuring adequate spectrum for existing broadband wireless access services, [satellite orbital positions and associated spectrum].

Recognizing that current deployments are based on using 2 G and 3 G technologies, it is anticipated that operators will want to deploy 4 G LTE to support increasing data traffic profiles and evolving broadband applications and to compete with improved service offerings. User terminals operating at 2Gand 3G will not be upward compatible with 4 G, therefore, 2G and 3 G networks will need to be operational for some time in order to support current 2G and 3G subscribers.

Proposed generic Consultation Process

The following figure provides an overview of the steps that would typically be included in a consultation process leading to the release and licensing of a band:

Figure 12: Consultation Process



1. <u>2600 MHz</u>

The MCIT/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.

<u>Action Planned by MCIT/PTD:</u>

Develop a policy and a process for the release of 2600 MHz spectrum.

2. <u>1800 MHz</u>

The 1800 MHz (1710-1785/1805-1880 MHz) band is widely used for LTE deployments around the world. MCIT proposes to release this band following the release of 2600 MHz. Currently MPT authorized to temporarily use 1730 – 1750 / 1825 – 1845 MHz for special events and testing.

If it is necessary to assign around MPT's temporary assignment of 1710-1730 MHz and 1750-1785 MHz for Uplink, then bands 1805-1825 MHz and 1845-1880 MHz could be assigned for Downlink. This will provide 55+55 MHz of spectrum for FDD.

<u>Action Planned by PTD / MCIT:</u>

Develop Policy and process for the release of 1800 MHz band with the intention of auctioning this spectrum in the 4th Quarter of 2016.

3. <u>850/900 MHz</u>

800 MHz (806-880) - 825-835/870-880 are assigned as CDMA 800 mobile and CDMA WLL.

806-825 +835-870 are unassigned. According to MCIT/PTD Spectrum Rules, 54 MHz of spectrum is available.

900 MHz: (PGSM 890-925/935-960) +(EGSM (880-890/925-935)

EGSM (880-890/925-935) is unassigned, allowing for two 5 MHz pairs

Two 5 MHz pairs in the EGSM 900 MHz band provides for 2x5 MHz of assignable spectrum.

There is a history of reported interference in extended GSM band. PTD will consider granting short-term authorizations to interested parties to conduct technical trials. There will be strict terms and conditions associated with these authorizations.

Actions Planned by MCIT/PTD:

1) PTD will provision for the temporary licensing of short-term experimental systems in these bands. Licensees granted authorization will be required as a condition of authorization to provide information supporting their proposed trial, including details of tests to be conducted and commit to file a findings report to PTD at the end of the trial. PTD may also observe or participate in specific tests to be conducted.

2) Develop a policy and consultation to optimize 850 and 900 MHz bands

4. 700 MHz

The 700 MHz: Bands 703-748/758-803 MHz are unassigned, thus, allowing for 45 + 45 MHz (90 MHz) of unassigned spectrum

Action Planned by MCIT/PTD:

Develop a policy and consultation to release 700 MHz spectrum.

The timing of release of spectrum - as proposed the figure below, takes into account various factors including the internal capacity of MCIT/PTD/MCRC to manage the spectrum planning licensing processes and the anticipated needs of Commercial users. Over the course of the next 5 years, MCIT may decide to release additional spectrum if warranted and subject to availability of professional resources.

Figure 13: Proposed Release schedule

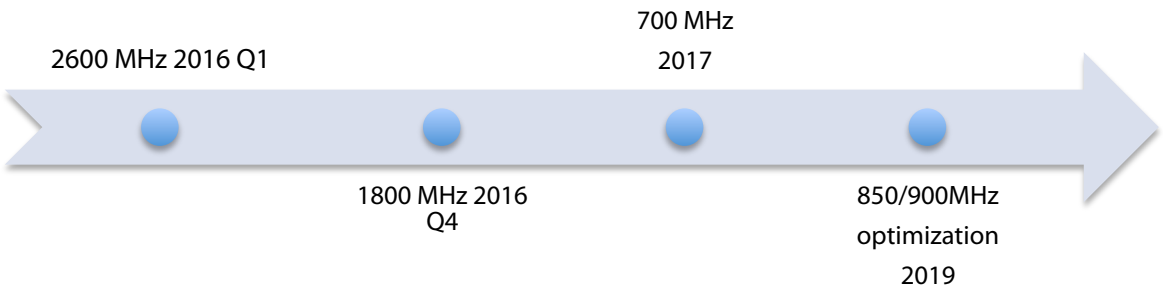
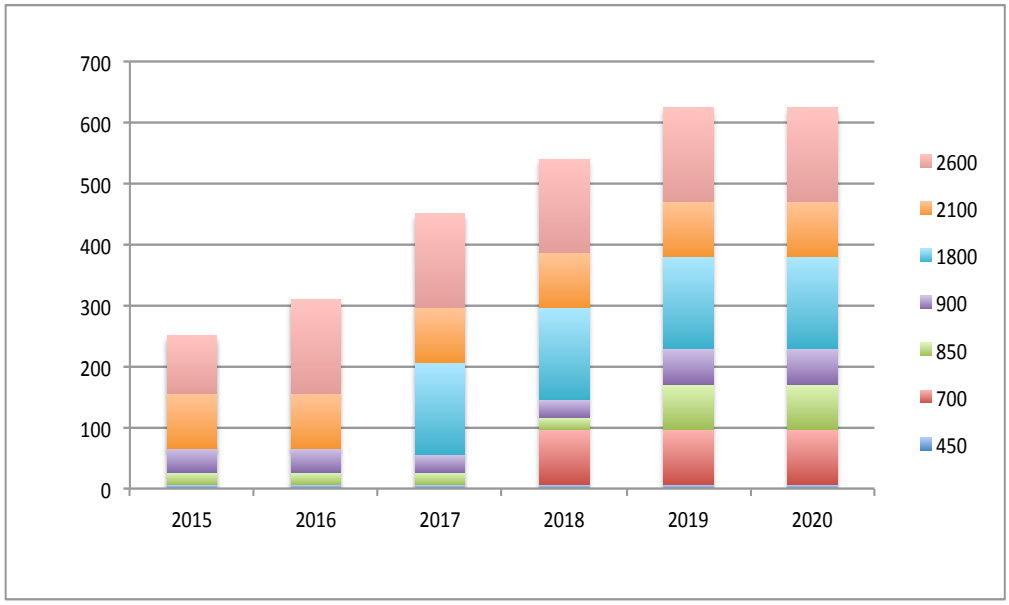


Figure 14: Current and Expected Spectrum Release Plans



It should be understood that the plan reflects current forecasts and the plan continues to provide MCIT/PTD sufficient flexibility to adjust the timing of release and the designation of specific frequency bands to be licensed in order to take into account evolving technological advancements, changes in market conditions resulting in new business opportunities and to ensure orderly development of communications in Myanmar.

Question 14 (Commercial spectrum Release): Note: Figures 14 and 15 above show the bands selected for release and as well as the sequence of such release.

Q14 (a): Please comment whether the targeted bands are the priority bands for release.

Q14 (b): Please comment on the sequence of the release of the selected bands.

Q14 (c): Please comment on the overall timing of release.

9.4.6. Future Spectrum Demand for Commercial Mobile Services in Myanmar

There are a number of sources forecasting the amount of spectrum required to meet commercial mobile requirements. Many administrations have also made forecasts to guide their spectrum planning decisions. ITU-R Report M.2290-0[1] present forecasts for growth in the total amount of mobile traffic in the world to 2020 and then models spectrum demand based on traffic density in across a variety of service environments that include urban, suburban and rural areas. It concludes that the demand for spectrum in 2020 is between 1340 MHz and 1960 MHz (in low and high demand situations respectively). However, a

number of industry experts have challenged the results, claiming the forecasts are too high[47].

> "Future spectrum forecast assessment makes necessary assumptions about future technologies and market developments on some tangible basis, however, the use of any particular assumption should not be taken to imply that an alternative development is not equally likely."[48]

Growth: Since the introduction of competitive services in Myanmar there has been a growth in mobile subscribers from an estimated 4.4 M in March 2013, to about 9 M in March 2014 and subsequently to 18.1 M in March 2015. As only 14% of the population in Myanmar are using mobile phones solid growth is expected to be seen for at least a couple of years.

Forecasted Subscribership Growth: According to the latest figures[49] mobile subscriptions will grow at a 21% CAGR, to reach 38.5 million subscriptions at end-2019, as operators expand their networks to new cities and rural areas.

Smart phones: Both Telenor and Ooredoo report a high 80% smartphone usage rate.

Traffic: Telenor reports that its voice traffic grew 90% in the first half of 2015, but data usage grew a stunning 200%. 55% of Telenor subscribers are data users on a monthly basis and web browsing consumes 43% of all data costs, followed by Facebook at 24%, and 14% for streaming video. Games account for 8% while other uses at 11% round out total data consumption on Telenor's network.[50]

As noted previously, there is an aggressive growth in the mobile market that correspondingly signals that commensurate spectrum will be required to support this growth. However, in order for PTD to accurately forecast spectrum requirements specific to Myanmar, substantial additional information is required. Spectrum forecasts require country-specific detailed information including:

- Network configuration,
- Number of base stations,
- Subscriber traffic densities, and,
- Technology migration plans.

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[47] LS Telcom, TMF, The European Broadcasting Union (EBU)

[48] ITU – MCMC International Training Program 2015, 26 - 28 August 2015, Kuala Lumpur, Malaysia

[49] http://www.ovum.com/press_releases/myanmars-mobile-market-sees-phenomenal-growth-after-liberalization/

[50] http://www.ictworks.org/2015/09/30/wow-myanmar-is-going-straight-to-smartphones/

In order for PTD to assess longer-term spectrum requirements for Myanmar, it would need to work in concert with operators in order to:

- Develop the appropriate methodologies to be used;
- Gather the required information;
- Make assumptions – supported by data, about technology and services evolution;
- Analyze the data sets according to the methodological framework;
- Make allowances for uncertainties and alternative outcomes; and,
- Monitor the evolving market needs closely on and on-going basis and make appropriate adjustments to the long term spectrum plans.

We note that each assumption supporting each input introduces potential inaccuracies in determining spectrum requirements, thus results should be viewed and used cautiously.

In this Spectrum Roadmap for Myanmar, a provision is made for a total of 625 MHz of licensed Terrestrial IMT over the five-year period, ending in 2020.

Question 15 (Spectrum Demand): Is the amount of spectrum proposed for release over the next 5 years adequate? If not, please provide detailed rationale supporting the need for more commercial spectrum in Myanmar.