



Spectrum Roadmap: Meet the Needs Over Next 5 Years

February 1st, 2016



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Summary

The Roadmap will play a critical role in the development of the Myanmar telecommunications industry by providing assurance to stakeholders that future spectrum resources will be available to meet the growing demands of users. This Roadmap thus informs stakeholders about the current status of the MCIT spectrum management program, planned activities to enhance program delivery, current spectrum usage and MCIT overall plans in order to ensure that appropriate spectrum resources are available to meet the demand of users over the next five years. The Roadmap can assist operators to plan the development of current and new systems, and for operators, service providers and other stakeholders, to plan future investment in telecommunications in Myanmar.

In the past few years, significant policy and regulatory changes in the spectrum management framework have occurred, opening opportunities for the leveraging of spectrum as a national asset that enables the introduction and development of new services. The Ministry of Communications and Information Technology (MCIT), the oversight Ministry for the telecommunications sector, has set out a vision based on Myanmar becoming **mobile-first, digitally connected nation** based on three connected themes:

1. **Connect the people of Myanmar** through a series of initiatives and policy measures to be implemented over the next five to seven years to create a broadband infrastructure asset for Myanmar.
2. This infrastructure will connect most Myanmar citizens to high-speed Internet services, assisting economic advancement through **Innovation and digital transformation** in many industries.
3. Digital technology and high speed connectivity to support **eGovernment** services, in order to make public services and information more easily accessible to everyone and increase the efficiency with which the Union Government and State Governments work together

In 2014, the PTD licensed 2 new mobile operators: Telenor and Ooredoo and these operators have quickly built out their networks to cover most of the nation, offered new services and increased the number of mobile subscribers.

Due to liberalization of telecommunications and the introduction of private enterprise, the telecommunications market in Myanmar has evolved from the least developed to one of the fastest growing markets in the world. Increased liberalization of spectrum policy and the entry of new competitive telecommunications providers is bringing immense social and economic benefits to the people of Myanmar as well as opening new avenues for business investment. In the brief (two year) period since the implementation of this new framework, Myanmar has witnessed the arrival of new service providers, the introduction of new services and handsets. With new competition, there have been improvements in the quality of service, delivery of new services quicker deployment of new technologies and networks, improvement in system performance, availability of the latest end-user devices and a reduction in prices for consumers.

This draft Roadmap has been developed in the context of current legal and policy frameworks guiding spectrum management and available licensing information. The Roadmap takes into consideration the comments and recommendations by stakeholders to identify key issues to



be addressed and provide a way forward to further improve spectrum management in Myanmar.

There are significant challenges in transition from the historical approach of spectrum management and state-deployed services to a liberalized market approach that encourages foreign investment and greater access to radio spectrum for a variety of operators and the deployment of private competitive telecommunication services. PTD recognizes that change will require a meaningful shift in government thinking to focus on governing and management of the spectrum resource and on assisting a plethora of users, operators and service providers – public and private, in the development of spectrum use and the development of new technologies services.

While this rapid liberalization of telecommunications market has brought both immense benefits to the people of Myanmar, it also poses significant regulatory and policy challenges. The Government of Myanmar has agreed that Post and Telecommunications Department (PTD) - the telecommunications regulatory body – currently embedded in the Ministry of Communications and Internet Technology (MCIT), will become an independent regulatory body – the Myanmar Communications Regulatory Commission (MCRC). As the regulator, the challenges faced during this transition period are described below:

- MCIT/PTD/MCRC operational readiness,
- Effective institutional arrangements with stakeholders to assist in spectrum management and development and,
- The need for the negotiation of fair international coordination arrangements for spectrum use in border areas.

Spectrum Landscape: Spectrum Demand, Availability and Future Releases

The Myanmar Post and Telecommunication (MPT)'s monopoly in telecommunications services ended in August 2014 with the competitive entry of Telenor and Ooredoo. Over this very short period of competition in the wireless market as of end of March, 2015, the mobile telecommunications market has grown to a total of 18.1 million subscribers (pre- and post-paid combined), more than double the figure reported a year before and up from an estimated 4.4 million subscribers in March 2013.¹

The mobile market growth hasn't slowed down based on the November 2015 data. The competitive landscape of the three operators at the end of November 2015 was as follows: Telenor: 13 million, Ooredoo 5.5 million, and MPT 17.3 million subscribers².

¹ TeleGeography CommsUpdate, 12 May, 2015, available at: www.telegeography.com/products/commsupdate/articles/2015/05/12/myanmar-mobile-growth-beats-expectations-with-18-1m-active-users/

² PTD (November, 2015)



PTD's estimates place the current mobile population coverage at approximately 50% of the population. Limited wireline infrastructure and the insatiable appetite for telecom services in Myanmar means wireless demands are increasing and more spectrum needs to be made available. PTD will, over time, consider licensing a full range of spectrum availability options to meet the needs of competitive Fixed and Mobile services, in order to make efficient use of spectrum and to provide consumers with choice of services and service providers at a reasonable cost. Thus, in addition to operators – the PTD may consider further MVNOs, resellers and sub-licensees as the market grows and becomes more diverse.

The following bands could potentially be made available by PTD for assignment in the next 5 years:

- Unassigned portions of the 850/900 MHz and 2100 MHz bands;
- 700 MHz;
- 1800 MHz;
- 2300 MHz; and,
- 2600 MHz.

These bands were identified for consideration in light of the allocations of the updated NTFA (National Table of Frequency Allocation), spectrum already assigned and spectrum release activities internationally with a particular emphasis of Asia-Pacific Telecommunity (APT) countries.

Consistent with PTD's priorities and the comments provided by stakeholders, this Roadmap proposes consultations for the release of 2.6 GHz, a portion of 900 MHz, followed by 1.8 GHz, 700 MHz and the balance of unassigned 800 and 900 MHz over a 5-year period. Following the release of the additional spectrum in the individual bands, PTD can monitor deployments over the period and reassess its release plan to include additional allocated spectrum - as appropriate.

Technological Options for Operators to Improve Spectral Efficiencies

Globally, many mobile service operators are deploying heterogeneous network architectures, which are a mix of large and small cells, this mix helps meet the explosive growth in traffic and address traffic requirements in specific areas. These small cells, called femtocells and picocells, are low-power base stations operating within licensed spectrum, allow operators to increase their network capacity by reusing spectrum, offloading traffic from their macro networks, resulting in more capacity and improved service to subscribers.

In addition to using their licensed spectrum, operators are increasingly turning to licence-exempt spectrum to meet the bandwidth requirements for mobile data. In the United States, for example, AT&T supports approximately 45,000 licence exempt hotspots, providing Wi-Fi access for the company's wireless customers.

A recent study found that the number of Wi-Fi hotspots is expected to increase by three-hundred-fifty percent over four years (2011-2015) as more and more operators around the

world deploy hotspots to offload traffic from their mobile networks.³

With the growth in wireless services to subscribers, spectrum necessary to support backhaul for mobile network deployments has become a critical component for the operation of mobile networks and consequently, a very important consideration in calculating spectrum needs of the operators.

In this Roadmap, we include a discussion of the current situation and make recommendations to improve effective and efficient utilization of this equally essential spectrum for backhaul microwave links. Mobile broadband networks and supporting backhaul will continue to evolve to meet increasing capacity needs. Microwave carrier aggregation, along with a host of other technical advances, will facilitate the efficient use of spectrum in short haul, high frequency bands. These efficiency gains are critical in meeting the capacity needs of operators not only in densely-populated areas, but also in rural areas where lower frequency bands are typically used.

Further details regarding technological changes are presented in section 2.2.

This Roadmap should be seen as an evolving document, that necessarily will evolve with the advancement of domestic spectrum policies, introduction of new technologies and international activities including spectrum allocations, treaties with neighbouring countries, and the recommendations from ITU, WRC and the APT.

The Roadmap will deal with the following issues:

- Current Landscape, spectrum supply and demand; inventory of spectrum licensed and available;
- The challenges of transitioning from legacy MCIT/PTD to the new modern Spectrum Management regime including supporting spectrum policies, procedures as well as development of internal processes;
- Global/Regional considerations (ITU, WRC, neighbouring countries, treaties, APT, etc.);
- Possible allocations that could be made available;
- Consultative approach for the release of specific identified bands and bandwidths (BW);
- Identify key stakeholders;
- Provide stakeholders with and overview of approach and planned Spectrum management activities;
- Provides MCIT/PTD planned initiatives for the provisioning of domestic satellite services in Myanmar.

³ See the Wireless Broadband Alliance's 2011 report entitled *Global developments in Public Wi-Fi* (http://www.wballiance.com/wba/wp-content/uploads/downloads/2012/07/16_WBA-Industry-Report-2011-Global-Developments-in-Public-Wi-Fi-1.00.pdf).



1. Introduction

The radio frequency spectrum is a natural, finite, non-depleting and valuable national resource. Radiofrequency spectrum is used for a broad range of applications serving private- and public sector activities and provides many important social and economic benefits to the citizens of Myanmar. Over the last two years Myanmar has seen steady growth in demand for spectrum used to support a variety of commercial mobile broadband voice, data' and video services. Along with the deployment of commercial systems, Myanmar has experienced significant growth in microwave backhaul systems used to support the new commercial wireless services.

The radiofrequency is currently managed through the MCIT and its PTD – the de facto regulatory body. MCIT has announced that PTD will evolve into a new independent regulator the Myanmar Communications Regulatory Commission (MCRC) within the next one to two-year period⁴. The management of the radiofrequency spectrum is guided through the provisions of the Telecommunications Law and Spectrum rules.⁵ It is expected that the Ministry will continue to have responsibility for high level spectrum policy and strategy – including spectrum allocations and the MCRC will be responsible for the management of the spectrum.

The rapid growth of telecommunications has placed increasing demand on the spectrum currently available and licensed. At the same time, increased liberalization of spectrum access results in spectrum management challenges to ensure proper processes and procedures are in place to manage transition in regulatory regime.

MCIT recognizes that transparency and predictable policy making are key to promote investment in networks and new services. In this context, PTD is committed to support growth of new services with an emphasis on commercial mobile services over the next five years and beyond. With the completion of the Roadmap, PTD will provide stakeholders with an outline of its planned activities that will enable orderly development and release of spectrum and correspondingly, spectrum resources necessary to help meet demand of users are available. This Roadmap provides stakeholders and interested parties with information concerning MCIT/PTD views on, and correspondingly, plans to address current spectrum utilization issues. This Roadmap also identifies plans for spectrum release - in the next 5 years, designed to ensure that adequate spectrum is available for growth of communications systems as well as the introduction of new competitive service. The plan provides for orderly development and makes recommendations - based on internationally established best practices, on steps to minimize incompatible assignments resulting in radiofrequency interference.

It should be noted that effective spectrum management program requires a number of integrated activities including appropriate legal frameworks, effective policy, spectrum

⁴ The actual name of and the time to implement the new independent regulator is influenced by a variety of factors, including regulatory reform and therefore is still to be confirmed.

⁵ The Telecommunications Law (The Pyidaungsu Hluttaw Law No. 31, 2013)

The 4th Waxing Day of Thadingyut, 1375 M.E. (8th October, 2013)



planning (International and domestic), licensing frameworks for efficient assignment, interference management, compliance programs, institutional relationships with key stakeholders and efficient administrative business processes. Implementation requires a Regulatory agency with committed and trained staff, with the tools and the capacity to manage the program. Since spectrum management is a program that requires numerous integrated activities the Roadmap occasionally makes reference to various activities and issues identified. However, the focus of the Roadmap is on spectrum needs and how best to satisfy those needs for spectrum through effective and efficient planning and allocation. As a separate related activity, MCIT/PTD will assess recommendations made by a consultancy firm concerning approaches to streamline radiofrequency spectrum assignment and licensing within allocated bands in order to ensure efficient utilization.

1.1. Approach

While developing the Roadmap, the PTD gave due consideration to all existing material that provided insight into spectrum and telecommunications development in Myanmar. Inputs were sought early on from MCIT/PTD and a broad range of stakeholders. This provided a baseline of the current frameworks (policy, regulatory and precedents) now guiding spectrum development, where MCIT/PTD stands in development of the spectrum management program and development of the spectrum resource. Also identified are the needs and challenges both from a regulatory point of view and from a client perspective in order to assess gaps and develop priorities to address gaps laying out the Roadmap. The scope of our review included a review of the following:

- Legal Frameworks
 - Legislation
 - Policy
 - Licensing frameworks
- Technical Standards
- Treaties
- Approaches to Assign Spectrum (Tools)
 - Procedures and processes
 - Licence Records
- Stakeholder Consultation
- Spectrum assigned in Myanmar and nearby countries
- International frameworks to minimize interference
- Spectrum needs
- MCIT Priorities
- Proposals going forward
- Institutional arrangements



1.2. Purpose

The purpose of this consultation is to seek input on the government's spectrum Roadmap to respond to growing the telecommunications industry and services provided to the people of Myanmar.

The telecommunications industry relies heavily on the use of the radiofrequency spectrum and in the last two years there has been an increasing demand for spectrum access. As other markets and industries grow we will also see increasing demand for spectrum access by business and government to support increased efficiencies in their operations. The radiofrequency spectrum is a limited natural resource and ensuring it is allocated and assigned effectively and efficiently allows the Government to maximize its use so that it provides the maximum return to the Union of Myanmar. MCIT is the lead Ministry for the telecommunications sector and the radiofrequency spectrum is currently managed by the PTD. Through this consultation we invite all stakeholders to put forward, with supporting rationale, alternative proposals to those presented in this paper.

1.3. Invitation to provide comments

Comments are sought on PTD's proposed Roadmap and the specific question areas. Respondents are asked to specify question numbers for ease of referencing and provide supporting rationale for their comments,

Interested parties are invited to provide written submissions via email or mail no later than February 29th, 2016 to:

- If by email send to; spectrumresource.ptd@gmail.com
- If by mail, then send to : Ministry of Communications and Information Technology (MCIT) Office, Building #2, YaZaHtarNi Street, Special Economic Development Zone, Nay Pyi taw, Myanmar Att: Moe Kyaw Soe, Director, Human Resources and PTD Project Manager for the Spectrum Management Project

In either email or mail, please mention the term 'Comments on Roadmap' in the title.

Stakeholders will be also invited to a question and answer (Q&A) session with PTD staff on February 16th, 2016 between the hours of 10:00 – 12:00 at the MCIT. PTD will provide a PowerPoint presentation:

- Overview of the Roadmap Process
- Key Objectives
- Key Proposals
- Key Questions

Following receipt of comments, MCIT/PTD may, at its discretion, request additional information or request clarification of comments or any alternative proposals made. In these cases, additional time to response period will be provided.



Depending on the nature of comments received and considerations of commercial confidentiality, MCIT/PTD will subsequently make a decision regarding the publication of comments received.



1.4. Structure of Report

The Roadmap is presented in three main parts:

1. Part 1 – Drivers of the Spectrum Roadmap

There have been significant developments since liberalizing the spectrum management in Myanmar. These changes have resulted in an explosion of new products and services resulting in a growth in demand for spectrum access. The significant increase in demand for spectrum has had a significant impact on availability of clear interference free spectrum. This and the need to maximize the return possible from this limited and valuable resource are now primary drivers of the Roadmap and the plan for specific initiatives that are proposed to take place over the next 5 years. The initiatives will form the focus of spectrum management activities over the next 5 years.

2. Part 2 - Regulatory Initiatives

There are significant challenges in transition from the historical approach of spectrum management and state-deployed services to a liberalized market approach that encourages foreign investment and greater access to radio spectrum for a variety of operators and the deployment of private competitive telecommunication services. The PTD recognizes that this change will require a meaningful shift in government thinking to focus on governing and management of the spectrum resource and on assisting a plethora of users, operators and service providers – public, government and private, in the development of spectrum use and the development of new technologies services.

3. Part 3 – Rapid Growth of Infrastructure and Service

Demand within specific frequency bands and services offered are growing at enormous rates placing significant pressures on these licensees and bands in which they operate. The Roadmap outlines plans to release more spectrum to meet current and anticipated demand going forward.

2. Part 1: Drivers of the Spectrum Roadmap

In this section, we look at drivers and review changes taking place that should be factored into the spectrum management plan for the release of future spectrum.

2.1. Changes at home

Political, social and economic reforms as well as specific initiatives to modernize have created demand for telecommunications services in Myanmar.

Myanmar's economy is poised for growth as part of South East Asia - the world's fastest growing economic region and its strategic position between larger, diversified economies: India, the People's Republic of China, and Thailand. Recent reforms have also motivated interest in leveraging this momentum and maximizing its domestic growth potential. Asian markets offer huge potential for harmonization of trade rules, attraction of new investment in telecommunications infrastructure, leveraging technology advances and economies of scale for radio equipment.

The total population of Myanmar is roughly 51.4 million⁶ and while still predominantly rural, there are several metropolitan areas with significant populations: Yangon (7.4M), Ayeyawady (6.2M), Mandalay (6.1), Sagaing (5.3M), Bago (4.9M), Mon (2M) and Naypyidaw (1.2M).

Myanmar's economy has traditionally been dependent on resource industries such as mining and forestry that in most countries are typically users of the radio spectrum supporting land mobile communications, data, and fixed systems and various industrial applications. Infrastructure related to electrical distribution and supporting utilities are also growing and are also dependent on access to radio frequencies for mobile and fixed applications. As the economy develops we expect increase spectrum requirements across all industries, similar to all other developed countries.

Myanmar was - until the licensing of new operators in 2014, one of the least connected countries in the world. The context of this radical change was set out in the Myanmar Master plan:

- **Among the lowest fixed and mobile teledensity rates in the world**, long waiting times for a fixed line, prohibitive prices for acquiring a mobile connection, and internet connections available to very few had been characteristics of the market until 2014. Myanmar ranks close to the bottom in the World Economic Forum's networked readiness index.
- **Thinly spread telecommunications infrastructure**, that is concentrated in the main towns and cities, with few fibre links, a limited mobile towers infrastructure across the country and restricted capacity for handling incoming and outgoing international traffic.
- **Only basic services available in most of the country**, comprising voice services, limited data connectivity and very few locally developed value added services or applications.

⁶ Population and housing census, 2014

- **Weak telecommunications policy and regulatory framework**, with an incomplete institutional framework to address challenges and capture the opportunities mass telecommunications offers Myanmar's citizens, businesses and Government.

Since 2014 with the launch of new mobile operators, Myanmar has witnessed a transformation in the pace of mobile telecom industry evolution. Almost overnight, Myanmar's 130-year old telecommunications sector has rapidly moved ahead from the past through measures to connect more of the Myanmar people and expose them to a new world of possibilities. The latest digital network technologies and handset equipment are facilitating this, with mobile as the clear connection choice for the people. This transformation can be summarized in the following metrics:

- **Explosive connections growth:** connections amongst Myanmar population rising from around 10% in 2013 to over 40% today (measuring all connections⁷ as a % of population)
- **Smartphone-led:** between 60-70% of customers are using smartphones, a uniquely high uptake at this early stage of development compared to anywhere else in the world
- **Internet in the people's hands:** Myanmar is witnessing data usage of around 500 Mb per month with promising uptake where mobile internet is available in rural areas
- **A foreign investment success story:** with an estimated 250,000 new jobs to be created over the coming 15 years through investment of over USD 2.8 billion in just two years from China, Japan, Norway, Qatar and other countries, placing telecommunications as one of the lead sectors for FDI into Myanmar

As of end of March, 2015, the mobile telecommunications market has grown to a total of 18.1 million subscribers (pre- and post-paid combined), more than double the figure reported a year ago and up from an estimated 4.4 million subscribers in March 2013.⁸ The mobile market growth has not slowed based on the latest mobile subscribership data in Myanmar. The competitive landscape of the three operators at the end of November 2015 was as follows: Telenor: 13 million, Ooredoo 5.5 million, and MPT 17.3 million subscribers⁹. The prime connectivity in Myanmar is via wireless networks, to meet demands of subscribers and to remain competitive. Licensees will want to deploy higher capacity 4 G LTE in the near future.

As the economy improves and the Industry grows we anticipate spectrum demands from numerous industries. While actual growth targets vary¹⁰, the Asia Development Outlook 2015 -

⁷ The difference between the number of mobile connections (the metric frequently used by the industry to measure market size and penetration) and what we term unique mobile subscribers. 'Subscriber' refers to a single individual that has subscribed to a mobile service and that person can hold multiple mobile connections (i.e. SIM cards). A single subscriber may use two SIM connections, and is counted by the as two mobile connections.

⁸ TeleGeography CommsUpdate, 12 May, 2015, available at: www.telegeography.com/products/commsupdate/articles/2015/05/12/myanmar-mobile-growth-beats-expectations-with-18-1m-active-users/

⁹ PTD (November, 2015)

¹⁰ World Bank recently cut regional growth forecasts to 6.5pc

After moderating in FY2014, growth is forecast to accelerate to 8.3% in FY2015 and remain close to this pace in FY2016 as it is propelled by investment stimulated by structural reform, an improved business environment, and Myanmar's gradual integration into the sub-region.

Historically, decisions concerning spectrum access and use were made at a time when spectrum resources were plentiful and the primary user was the category: Government users. Assignments were made without benefit of spectrum utilization planning and without the discipline of band plans and standards or appropriate records. As a result, as spectrum demand increased, new competitive entities entered the market and certain high demand bands became congested and interference became common. In addition, consumers are increasingly leveraging the benefits of new technology. Consequently, consumers have imported and installed radio systems comprised of equipment from various countries that incorporate a range of technical standards. The utilization of such equipment is a frequent source of interference in Myanmar.

2.2. Technology

New services and ecosystems as well as rapid advancements in radio access technologies such as those enabling simultaneously sharing of a given band of spectrum, have significantly changed the way spectrum is being used. Growth in network coverage, penetration rates and uptake of services are educating consumers and this in turn is expected to further increase consumer demand for newer and more advanced products and services.

Fast evolving technologies present new opportunities for as well as existential threats to traditional ways of doing business. New technologies drive new applications, increased demand, falling prices, a growing knowledge base and expertise provide opportunities for improved efficiencies and radically change on how we work. The concept of the "Internet of Things" (IoT) connecting millions of devices presents a whole new paradigm in technology and connectivity. Breakthroughs in new products connectivity through Wi-Fi and commercial networks offer opportunities for technology use and sources of revenue.

The role of technology is an important a driver of competitive advantage and innovation in the business framework¹¹:

- Innovation is a primary source of competitive advantage for companies in essentially all industries and environments and drives efficiency, productivity, and differentiation to fill a higher variety of needs;

¹¹ Source: Boundless. "Technology as a Driver and Enabler of Innovation." *Boundless Management*. Boundless, 21 Jul. 2015. Retrieved 15 Dec. 2015 from <https://www.boundless.com/management/textbooks/boundless-management-textbook/organizational-culture-and-innovation-4/technology-and-innovation-37/technology-as-a-driver-and-enabler-of-innovation-201-3574/>



- Innovation builds upon itself, enabling new approaches within the evolution of technology;
- Innovation works best in hubs such as California's Silicon Valley which provide powerful resources that entrepreneurs and businesses can leverage in pursuing innovation;
- In pursuing innovation, Singapore and South Korea are all strong representations of how embracing technology leads to innovation, which in turn leads to economic growth.

According to a recent Goldman Sachs Investment Research report¹², the Internet of Things (IoT) will be the next driver of spectrum demand. IoT has an enormous scope that touches every facet of consumer and business on a daily basis. The report organizes into five key verticals of adoption:

1. Connected Wearable Devices,
2. Connected Cars,
3. Connected Homes,
4. Connected Cities, and,
5. The Industrial Internet.

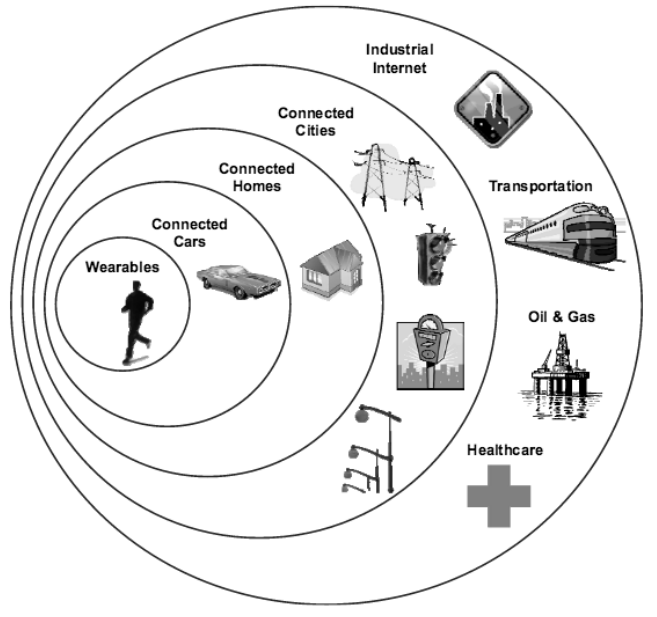
Enablers of the IoT include:

1. Cheap sensors,
2. Cheap bandwidth,
3. Cheap processing,
4. Smartphones,
5. Ubiquitous wireless coverage,
6. Big data, and,
7. IPv6 - the newest version of Internet Protocol

¹² Goldman Sachs Global Investment Research, September 3, 2014

The verticals are summarized in the following schematic diagram:

Figure 1: The IoT Landscape



Source: Goldman Sachs Global Investment Research.

As Mobile broadband networks and supporting backhaul continue to evolve spectrum and new technological enhancements will be required to meet increasing capacity needs. Microwave carrier aggregation, along with a host of other technical advances, will facilitate the efficient use of spectrum in short haul, high frequency bands. These efficiency gains are critical in meeting the capacity needs of operators not only in densely-populated areas, but also in rural areas where lower frequency bands are typically used.

A developing trend is the use of fronthaul¹³. In this scenario, operators that are looking to increase capacity, have proposed C-RAN¹⁴ architectures that co-locate BBUs in order to allow sharing of resources. Fronthaul is a fundamentally different architecture from the mobile backhaul approach that has been widely implemented around the world. Both architectures offer their own benefits and drawbacks when it comes to deploying and operating the connectivity network for supporting mobile broadband expansion. Operators today require the flexibility to combine multiple different technologies and concepts including fronthaul and backhaul, microwave and optical fibre, small cells and macro cells resulting in heterogeneous networks that employ different mobile technologies within the same zone to meet the range of needs they today face.

¹³ Front-haul is the link that connects the Baseband Unit (BBU) to the associated Remote Radio Head (RRH)

¹⁴ C-RAN – “Cloud Radio Access Network”

2.3. International Activities

With intensification in the use of spectrum and rapid changes in the wireless ecosystems, harmonization of spectrum has become ever more essential and conversely, non-harmonization results in ever more severe impacts. At a broader level, harmonization involves:

- Alignment of Spectrum allocations,
- Utilization policies and Equipment standards with neighbouring countries,
- Effective and efficient sharing of spectrum in border area through negotiated coordination arrangements, reduce incompatible spectrum use, and
- Access to other markets for import and export of services and equipment.

Myanmar's participation in ITU, WRC and the APT (the APT representing about 60% of the world population) is important to ensure understanding, participation and alignment with major decisions concerning spectrum allocations, use and international standards. Harmonization of spectrum use and standards translates into more choice of products for consumers, reduced costs due to economies of scale, improved roaming capabilities and simpler frameworks to minimize interference with neighbouring countries. Development of capacity to assume leadership roles in these forums is also essential to build consensus with other countries that reflect Myanmar's and South East Asian interests and preferences and to identify opportunities for working with gear suppliers in the application new technologies.

2.4. Improved spectrum services

MCIT/PTD the regulatory body responsible for spectrum management in Myanmar wishes to facilitate spectrum access to those that need it. This requires the development of appropriate regulatory frameworks to ensure this valuable national resource is developed in an efficient manner, while at the same time avoiding imposing an unnecessary regulatory burden on users. Various regulatory initiatives have been identified that will be implemented over the next 5 years, each with a view to improve spectrum access, promote efficiencies and streamline the licensing process. Initiatives include implementation of standards, transparent processes and partnership arrangements with industry.

Question1 (Drivers of the Spectrum Roadmap):

Q1 (a): Do you agree that these are the primary drivers for the roadmap?

Q1 (b): Are there other drivers that should be considered?

3. Part 2: Regulatory Initiatives

There are specific needs and challenges from a regulatory point of view that impact the delivery of spectrum management services to both to operators providing wireless services and to users requiring access to spectrum for their private use, often supporting commercial businesses. This, in turn, impacts the subscribers of wireless services and the productivity and efficiency of commercial businesses.

3.1. The Creation of Myanmar Communications Regulatory Commission

The radio frequency spectrum is currently managed by the (PTD) – the de facto telecommunications Industry regulator. This regulatory body is currently embedded within the Ministry of Communications and Information Technology (MCIT). The Myanmar government has agreed to create the Myanmar Communications Regulatory Commission (MCRC) – an independent spectrum regulator incorporating the functions and staff of the current PTD.

It is expected that the essential components for the new Myanmar Communications Regulatory Commission - including enabling legislation, organizational structure, processes and procedures, staffing, etc. will be implemented over the next two years.¹⁵ Following this period, it will take time to build the organizational capacities needed; however, we expect to see immediate improvements in the efficiency and effectiveness of regulatory services by just having an organization with resources dedicated to managing the spectrum.

Among other responsibilities, the MCRC will have the prime responsibility to manage spectrum access and client services delivery including licensing, interference mitigation/enforcement, interfacing with neighbour countries regulatory agencies concerning spectrum sharing in border areas. Radiofrequency spectrum is an enabler of economic development. Working with other domestic regulatory authorities, MCRC will enable spectrum access facilitating the effective and efficient development and use of the radio frequency spectrum resource that benefits both Industry and consumers.

Action Planned by MCIT/PTD:

MCIT has engaged the service of an external consulting company to provide the framework of the Myanmar Communications Regulatory Commission to in line with the international practice.

Question 2: What stakeholder benefits would you hope to see materialize from the creation of the new independent regulator?

¹⁵ Incyte Consulting - an Australian consultancy has been retained to assist MCIT in the creation of the new regulator.

4. Myanmar Telecommunications Framework

MCIT maintains a number of official policy documents that provide guidance on the administration and implementation of Telecommunications in Myanmar. Frameworks are important for the orderly development of the radiofrequency spectrum and provide the necessary legal basis, policy direction and tools providing access to radiofrequencies. The key frameworks are outlined below, noting that - with the exception of the Telecommunications Law, they have yet to be promulgated by the government.

4.1. Telecommunications Law

The legal framework for the management of the radio frequency spectrum can be found in Telecommunications Law (TL)¹⁶. The TL incorporates a comprehensive approach to spectrum management including the applicability, objectives of the law as well as licensing requirements for operation for telecommunications services, possession of radio apparatus, responsibilities of licensees, management of the radiofrequency spectrum and orbital slots, technical standards, installation, inspection and enforcement.

4.2. Spectrum Rules

The Spectrum Rules provide a framework for the management and utilization of radio frequencies and Radio Apparatus. These Rules also contain the rights and obligations of organizations and individuals involved in the management and use of radio frequencies in the Republic of the Union of Myanmar. Finally, these Rules govern the process to authorize the use of Frequency Spectrum by eligible licensees.

The Telecommunications Act sets out the spectrum rules for the major bands as follows:

1. Final Spectrum Rules
2. Final Spectrum Rules - Annex A – National Table of Frequency Allocations (NTFA) – 23 Dec
3. Spectrum Rules - Annex B - Distress and Safety Communications Frequencies 7Dec. 13
4. Spectrum Rules - Annex C - Spectrum Fees 7Dec13
5. Spectrum Rules - Annex D - Public Land Mobile 7Dec13
6. Spectrum Rules - Annex E - Frequencies and Channelling Arrangements 7Dec13
7. Spectrum Rules - Annex F - Aeronautical Mobile Frequencies 7Dec13
8. Spectrum Rules - Annex G - Broadcasting Frequencies 7Dec13
9. Spectrum Rules - Annex H - Specification of Emissions 7Dec13

¹⁶ The Telecommunications Law (The Pyidaungsu Hluttaw Law No. 31, 2013). Available at: http://www.mcit.gov.mm/sites/default/files/Telecom%20Law%20English%20Version_0.pdf

4.2.1. Register of Frequencies Assigned

A Register of frequency assignments contains technical information about Frequency assignments made by PTD, or any other authorized agencies in Myanmar. Maintaining an up-to-date list of all frequencies assigned, including pertinent technical information about the assignment is essential information to carry out the following functions:

- a) Identify potential frequencies for assignment
- b) Carryout compatibility studies to assess the impact of interference
- c) Conduct cross border as well as inter-user frequency coordination
- d) Evaluate the degree of frequency reuse
- e) Investigation of radiofrequency interference
- f) Assess frequency congestion within a specified band or frequency range
- g) Identify unlicensed operation

Action Planned by MCIT/PTD:

Consistent with section 9 of the Spectrum Rules, complete a frequency register of all authorized assignments and relevant data elements.

Question 3: Do you agree that completing a frequency register is a high priority and beneficial to spectrum users?

4.3. Licensing Rules for The Republic of the Union of Myanmar December 23, 2013

In Myanmar, there are specifically defined licences, each with associated privileges and proscribed activities. Licensees eligible to hold spectrum must also apply for spectrum use authorizations. In addition, according to the Telecommunications Law, Chapter IV, any entity wishing to possess or use telecommunications equipment shall apply to the Department for a telecommunications equipment licence.

The objectives of Licensing Rules are to promote competition and liberalization of the telecommunications market; ensure transparency in licensing application, award and administration process; establish a technology and service-neutral approach; and to ensure non-discriminatory treatment of similarly situated licenses in the Republic of the Union of Myanmar.

Licensing Rules set forth the following scope:

- a) The framework for the licensing of Telecommunications Networks and Telecommunications Services;
- b) The authorized activities, rights, and obligations associated with Telecommunications Service Licenses and Telecommunications Equipment Licenses;
- c) Overview of authorizations to scarce resources for Licensees of Telecommunications Networks

and Telecommunications Services;

- d) Monitoring and enforcement mechanisms for Licensees of Telecommunications Networks and Telecommunications Services; and
- e) Transitional provisions from the current licensing regime to the framework specified under these Licensing Rules.

4.4. Policy

In this section of the Roadmap, we review various policies, frameworks and reports that govern the management of spectrum in Myanmar with a particular focus on the deployment of commercial spectrum and services.

4.4.1. Myanmar Telecommunications Master Plan

As part of its policy priorities, the (MCIT) enunciated in a Master Plan its vision for Myanmar to become a **mobile-first, digitally connected nation**. This vision is centred on three connected themes:

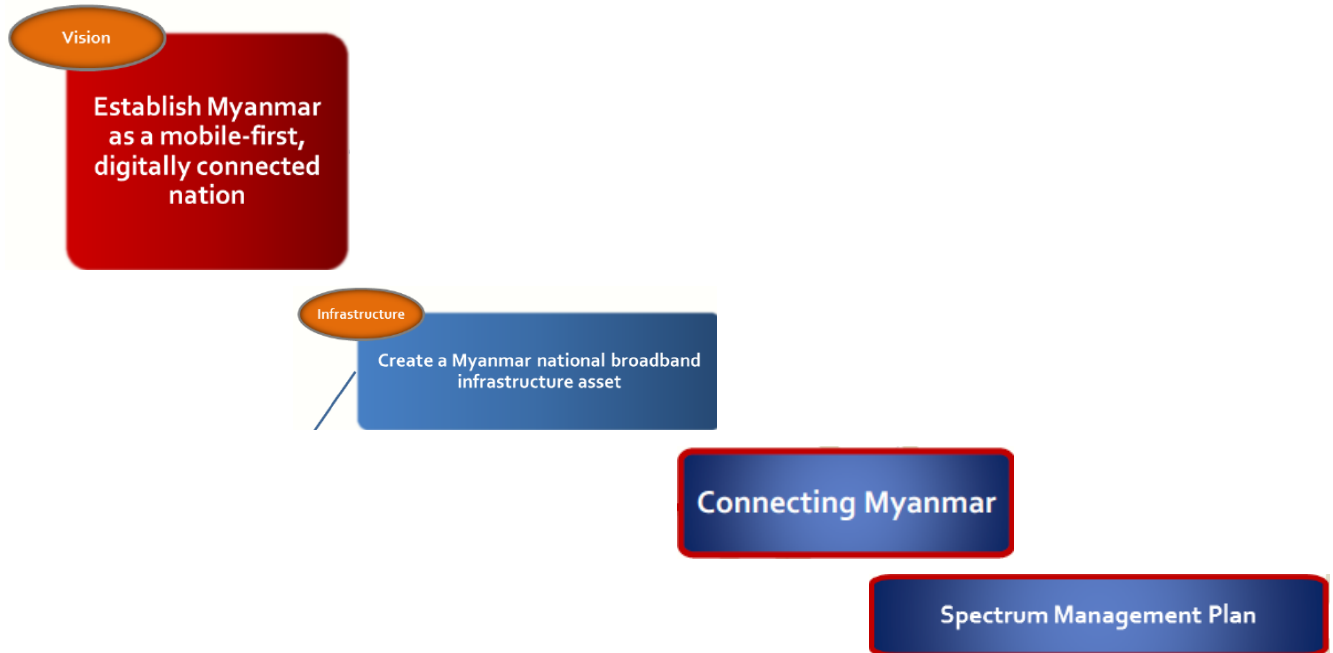
1. **Connect the people of Myanmar** through a series of initiatives and policy measures to be implemented over the next five to seven years to create a broadband infrastructure asset for Myanmar.
2. Use this broadband infrastructure to connect most Myanmar citizens to high-speed Internet services, in order to assist economic advancement through **Innovation and digital transformation** in many industries.
3. Apply digital technology and high speed connectivity in order to support the emergence of **eGovernment** services, in order to make public services and information more easily accessible to everyone and increase the efficiency with which the Union Government and State Governments work together

The Telecommunications Masterplan also develops these themes into three enabling objectives:

1. Create a Myanmar national broadband infrastructure asset – through initiatives to Connect Myanmar to broadband services, to encourage Affordability and Quality, and to safeguard security
2. Deliver communications content and services for the Myanmar people – to foster a mobile-first orientation in the delivery of many goods and services in the economy, to encourage truly local innovation, to understand and protect consumer rights and drive customer value
3. Create an enabling institutional framework – envisioning a dynamic Ministry setting policy, an empowered and independent Regulator, accountable and autonomous service providers, and most important of all, enriched and satisfied customers who benefit from a wide choice of high quality, competitive and affordable services.

There are policy programs to support each of the objectives. The Policy program “Connecting Myanmar” will be one of the most substantial elements of MCIT’s policy strategy. This program will focus directly on supporting the market in deploying, leasing and wholesaling networks as Myanmar builds its national broadband telecommunications infrastructure. A critical

component of creating a “national broadband infrastructure asset” is wireless infrastructure and the preparation of a Spectrum Management Plan.



Source: Myanmar Telecommunications Master Plan (2015)

The existing Telecommunications Plan provides a vision reflecting best practices and has been approved by the Minister. The plan provides a guiding instrument to form future policy.

4.4.2. The Wireless Broadband Master Plan (WBB) for the Union of Myanmar

The WBB Master Plan, developed by the ITU, provides an important input into the development of a Radiofrequency Spectrum Roadmap. Drafted in 2012, the report describes the broadband market in Myanmar, provides international context and in particular, highlights the need for radiofrequency spectrum. The report provides specific objectives¹⁷ for the Management of the radiofrequency spectrum – some elements of which are incorporated as recommendations and objectives in this Radio Spectrum Roadmap.

¹⁷ WBB Masterplan, section 5

4.4.3. Roadmap for transition from Analog to Digital Terrestrial and Mobile television in Myanmar

The Roadmap for the transition from analogue to digital terrestrial television broadcasting has been jointly developed by an ITU expert and the National Roadmap Team (NRT) of Myanmar. The report provides a good background of the existing broadcast systems and service, as well as the evolving regulatory reforms (some of which have since come to fruition).

The Plan is comprehensive and describes the deployment strategy for a phased approach to the Digital Switchover, including: standards, station deployments, set-top-boxes and antennas, etc. and the roles and responsibilities of the Regulator and operators through the deployment phases.

RF Roadmap includes specific items such as Analog to Digital transition, assignment and licensing conditions (as well as later licensing deliverables), issues surrounding site approvals, site sharing, RF safety and protecting the public, and recommendations regarding the 'digital dividend'.¹⁸ There was no associate frequency plan showing the frequencies allocated for migration.

Action Planned by MCIT/PTD:

1. Develop a Policy that:
 - a. Sets out the objectives of the Spectrum Management program;
 - b. Guides the development and implementation of Broadcast Spectrum including assignment policies, technical standards and licensing requirements; and
 - c. Distinguishes spectrum regulatory objectives for Broadcast allocated spectrum.

Question 4 (Policy): Noting that specific consultations would take place as part of any new policy.

Q4 (a): Do you agree that it would be beneficial for MCIT/PTD to articulate a Spectrum policy that establishes a framework providing objectives, procedures and standards and guidelines to manage the radio frequency spectrum?

Q4 (b): Do you agree that there needs to be clarification of spectrum policy concerning the roles of authorizing ministries when it comes to spectrum for broadcasting?

¹⁸ Section 4.7 states: Analogue TV in Myanmar is now using channels in Band III. It has been envisaged that DTTB/MTV operations will be in UHF band to take advantage of the 8 MHz bandwidth. The VHF Band III frequencies as freed on implementation of ASO or a part of it could be auctioned to generate necessary funds for the DSO and ASO strategy.

5. Technical standards

This section presents the technical standards set forth by the MCIT as well as those planned for development.

5.1. National Table for Frequency Allocation (NTFA)

Incorporated as part of the Spectrum Rules, Annex A has been reviewed and updated. NFAT governs the use of the national spectrum resource for specific radio services.

Question 5 (NTFA): Do you support the changes made by PTD in the recently published and updated NTFA?

5.2. Equipment Standards

Technical standards ensure compatibility in frequency allocation, assignment of systems and deployment of equipment. Telecommunications Law, provides specific requirements with respect to standards for equipment as outlined in Sections:

24. The Department shall determine and publish the relevant technical standards according to service in respect of the licenses with the approval of the Ministry.

25. The Department shall supervise the licensees to comply with the technical standards.

26. The Department shall determine the standards of types of Network Facilities and Telecommunications Equipment for import and export.

27. A person desirous of manufacturing, selling or distributing any Network Facilities or Telecommunications Equipment shall apply to the Department in order to get the technical standard approval of the Network Facility or Telecommunications Equipment to be manufactured, sold or distributed by him in accord with the stipulations.

28. The Department may issue or refuse to issue a technical standard approval after scrutinizing the application.

As part of MCIT/PTD move to liberalise the telecommunications sector, it is important to establish a proper Equipment Standardization and Certification Framework in order to facilitate both the orderly transition to, and maintenance of equipment deployed in the market.

Equipment standards and certification schemes in many jurisdictions typically include the power to prescribe, or otherwise identify, technical standards or specifications for particular types of telecommunications equipment as follows:



1. To establish, or otherwise identify, authorized testing laboratories and certification bodies;
2. Identified procedures for testing equipment for certification or for demonstrating conformity to standards and requirements;
3. To establish domestic certification programs, or alternatively, the entry into agreements concerning equipment certification by other countries or authorities; and
4. The maintenance of registries identifying certified equipment and applicable certification criteria and standards.

The purpose of standards and certification schemes is to ensure compatibility of telecommunications equipment with the telecommunications networks to which they are connected, and to protect the public from improperly functioning or unsafe telecommunications equipment. The use of radiocommunications equipment raises additional concerns about safety, the possibility of harmful interference and for equipment to function in accordance with frequency and output specifications.

Within Myanmar, there are currently no published equipment standards or a framework for equipment certification.

Action Planned by MCIT/PTD:

Develop a framework for establishing standards and the approval of equipment permissible for use or licensing in Myanmar.

Question 6: (Equipment Standards) PTD invites comments concerning the establishment of a framework for equipment certification and approval for permitted equipment in Myanmar.

(Note: Respondents should factor the limited capacity within PTD as well as the time necessary to operationalize the independent regulator. Ideas may include a transitory approach to a full certification and approval process.)

5.3. Spectrum Planning

Spectrum planning anticipates and responds to the major trends and developments in technology and the needs of both current and future users. Spectrum Planning identifies the bands and technical considerations for the assignment and licensing of spectrum and allowing its efficient use in an orderly manner. The degree of detail that may be included in a spectrum plan can be quite detailed, particularly when specific policies are developed for the many uses accommodated; we suggest as a starting point a national spectrum plan be developed for services now being licensed and deployed.

Publishing a PTD plan in the form of a national spectrum plan serves as an umbrella document describing how spectrum is to be used and would be comprised of various individual Spectrum plans. This plan would serve to guide interested parties in the planning of radio systems for specific services such as:

- Land mobile radio systems
- Point-to-point and point to multipoint systems
- Commercial radio systems
- Broadband fixed networks

Harmonization is an important element in spectrum planning. Projections based on historical growth domestically, as well as in other markets, provide some insight into spectrum needs over time. PTD understands the importance of spectrum planning and has started a process to develop a comprehensive spectrum planning process.

Action Planned by MCIT/PTD:

Develop a Spectrum Plan that provides information on spectrum available for use and assignment in order to meet the needs of interested parties requiring access to the radio Spectrum.

Question 7 (Spectrum Plans): Spectrum Plans, developed in consultation with industry, are an important part for the development of the resource and ensure that all users' needs are considered and the resource is used efficiently.

Q7 (a): Fixed microwave bands are under intensive pressure, given their use by cellular service operators backhaul.

Should detailed plans be created first in these bands?

- Yes

- No

Q7(b): If the response to Q7(a) is a 'No', what bands should be considered first?

5.4. Band Plans

Band plans typically should provide the minimum technical requirements as well as equipment characteristics necessary for the efficient use of specific frequency bands. Sub-allocations should add further precision by specifying channeling for simplex operations, as well as, go and return channels for duplex split arrangements. Provisions should also be specified for the operation of frequencies in border areas, such as sharing arrangements, coordination requirements, technical requirements and often include roles and responsibilities of licensed operators.

Within Myanmar, PTD is in the process of developing formalized channeling plans. The Spectrum Rules, section 13 provide General terms and Condition to issuing a spectrum authorization stating:

“Consistent with National Table of Frequency Allocations. All authorizations to use frequencies or a frequency band shall be consistent with the National Table of Frequency Allocations.”

However, this is far too broad to guide efficient spectrum assignment decisions. The result of not having proper Spectrum Plans and Band Plans has resulted in inefficient spectrum assignment and use, and created artificial congestion impacting the ability to make further assignments in some bands.

However, limited information and guidance has been developed by MCIT/PTD for certain bands as follows:

- Spectrum Rules Annex B incorporates the Distress and Safety frequencies for non- Global Maritime Distress and Safety (GMDSS) and GMDSS. The frequencies follow ITU RR.
- Spectrum Rules Annex D – Public Land Mobile Spectrum Assignment Plan contains the specific arrangements that have been established for the public land mobile Telecommunications Services sector in Myanmar.
- Spectrum Rules Annex E – Frequencies and Channelling Arrangements for Maritime Mobile as extracted from the ITU RR.
- Spectrum Rules Annex F – Frequencies related to Aeronautical Mobile are provided based on ITU RR.
- Spectrum Rules Annex G – Frequencies identified for Broadcasting in Myanmar are provided including shortwave, AM, FM and TV.

Action Planned by MCIT/PTD:

Develop Standard Radio Plans that detail channeling plans and specific minimum requirements for operation of systems in designated bands.

Question 8 (Band plans): Detailed channel plans constitute a fundamental requirement for the development of the spectrum. The lack of these band plans has resulted in ad-hoc assignments and the need to realign deployed systems. While the PTD is in the process of developing formalized band plans, no formalized band plans are currently available. These band plans would have to be developed in consultation with stakeholders. Microwave users have provisionally adopted ITU band plans.

What bands do you consider to be a priority for band planning?

5.5. Compliance program

Interference is occurring in a number of bands. Without proper procedures in place to investigate and make determinations of relevant cases of reported interference, cases cannot be systematically addressed with some assurance that PTD findings can be reasonably enforced. A proper systematic approach to interference or any compliance investigation also



lends confidence to stakeholders of PTD regulatory proficiency. Compliance programs are needed to ensure spectrum quality.

Action Planned by MCIT/PTD:

Develop a compliance framework for reporting, investigations, enforcement and maintaining compliance in order to minimize interference issues. Elements of the compliance program would include: Regulatory capacity building, implementation of compliance sampling programs, on-site Inspections, off-air Monitoring and an appropriate and implementable enforcement program.

Question 9 (Compliance): We invite comments from stakeholders concerning compliance issues that are impacting spectrum use today.

6. Treaties

6.1. Bi-lateral/Multi-lateral Spectrum Sharing Agreements in Myanmar

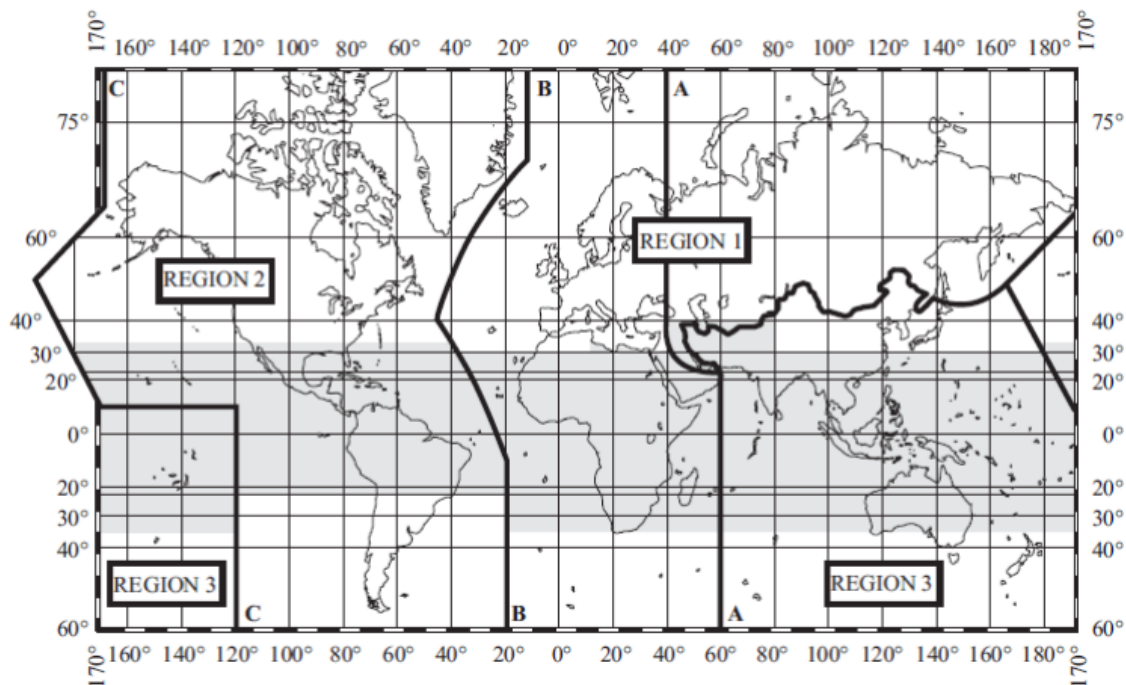
Radio waves propagate through space and transcend national borders. Spectrum is a valuable national resource and countries should protect its sovereign right to interference free access. Frequencies in border areas should be carefully planned and coordinated to minimize the risk of interference in either country. Treaties ensure a compatibility of spectrum use and standards with a view to Regional and global harmonization and for fair access to interference free spectrum.

Myanmar currently has no bilateral or multilateral spectrum sharing agreements with neighbouring countries; however, Myanmar has initiated discussion with Thailand to pursue a bilateral framework in order to minimize the risk of interference in the border area. Similarly, Myanmar has plans for negotiations with other neighbouring countries – starting with Laos in the near future. Myanmar also participates in international wireless industry groups and spectrum regulatory planning forums and monitors the developments of ITU, APT and various other organizations.¹⁹

¹⁹ Various regional, international and UN organizations include: 1) International Civil Aviation Organization (ICAO), 2) International Telecommunication Union (ITU), 3) United Nations (UN), 4) United Nations Development Programme (UNDP), 5) United Nations Economic and Social Commission for Asia and the Pacific (UN-ESCAP), 6) Asia-Pacific Broadcasting Union (ABU), 7) Asian Development Bank (ADB), 8) Asia-Pacific Economic Cooperation (APEC), 9) Asia-Pacific Satellite Communications Council (APSCC), 10) African Telecommunications Union (ATU), 11) European Conference of Postal and Telecommunications Administrations (CEPT), 12) Inter-American Telecommunication Commission (CITEL), 13) Commonwealth Telecommunications Organisation (CTO), 14) European Communications Office (ECO), 15) Information for Development Program (InfoDev), 16) Pacific Economic Cooperation Council (PECC), 17) Pacific Islands Forum Secretariat (PIFS), 18) Pacific Islands Telecommunications

6.2. ITU

The Radiocommunication Sector of the ITU (ITU-R) serves to facilitate the equitable, efficient and economic use of spectrum among all radiocommunication services. The ITU-R maintains the international Radio Regulations, which define the allocation of spectrum bands to various types of services on the basis of the International Table of Frequency Allocations. Additionally, the ITU-R specifies technical standards to be observed by radio stations, as well as procedures for international coordination, in order to ensure technical compatibility of radio systems between countries. The Radio Regulations are reviewed and amended at the ITU's World Radiocommunication Conferences (WRCs), which are typically held every three to four years. The last WRC was held in November 2015 this year.



Asia Pacific is in Region 3. The Asia Pacific Telecommunity (APT) organises Preparatory Group meetings (APG) to formulate common positions among members for consideration at the WRC.

Association (PITA), 19) Pacific Telecommunications Council (PTC), 20) UMTS Forum, 21) World Bank, 22) WiMAX Forum, 23) World Trade Organization (WTO).

6.3. APT

The Asia Pacific Telecommunity (APT) was founded on the joint initiatives of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) and the International Telecommunication Union (ITU). The APT is an intergovernmental organization and operates in conjunction with telecom service providers, manufacturers of communications equipment, and research and development organizations active in the field of communication, information and innovation technologies. APT serves as the focal organization for ICT in the region.

The Asia Pacific Telecommunity includes 38 member countries, 4 associate members, and 131 affiliate members of which Myanmar is a member.

The 13th Session of the General Assembly of the Asia-Pacific Telecommunity was held from 25 to 26 November 2014 in Yangon, Myanmar. The Ministry of Communications and Information Technology of the Republic of the Union of Myanmar hosted the meeting.

In the short-term, the PTD will look closely at neighbouring countries spectrum agencies or agencies of countries where they see alignment in philosophical approach to spectrum management, and work in collaboration with those countries in order to leverage spectrum management tools (policies, procedures and standards) where possible. This is practical for tools such as spectrum band plans, utilization policies, licensing procedures and equipment standards, even if some modifications are considered appropriate. As spectrum management include many functional areas where detailed technical analysis capability is required, appropriate tools to undertake this analysis needs to be available with staff trained to use them.

Action Planned by PTD / MCIT:

Continue to participate in International forums such as WRC, APT, etc. in order to ensure Myanmar's spectrum interests are well represented.

Question 10 (International Activities): In many countries, stakeholders play an important part in preparing for, and participating in international spectrum planning conferences.

We are interested in your views on how Industry might contribute internationally to further the interests of spectrum planning and development in Myanmar.

7. Approaches to Spectrum Assignment

Frequency allocation and assignment is a central key activity of spectrum management. Once allocated, the specific spectrum assignments significantly impact how efficiently the band is used. Spectrum assignment approaches are often made by factoring various broader policies and objectives. There are generally three accepted approaches used for spectrum assignment:

- Traditional or 'command and control',
- Competitive and
- Commons/licence exempt.

Each approach has associated advantages and disadvantages and all three have a place in spectrum management and are commonly used by regulatory agencies as tools to allocate and assign spectrum.

(Note: This section included in the Roadmap because it is a part of PTD's strategic considerations for the Department for good governance. However, detailed discussion on *approaches to assign spectrum* will be included in a separate licensing report that PTD has commissioned).

7.1. Traditional Approach

The traditional approach, often referred to as *Command and Control*, relies on the administrative decision approach to assign spectrum based on the type of use (how spectrum may be used - e.g. fixed, mobile, or possibly further to dispatch, paging, etc.) or type of user (spectrum earmarked or sub-allocated to a type of user such as public safety, military, commercial, government). The process is accomplished using an integrated spectrum management system that is comprised of existing spectrum allocation as per the National table of Frequency Allocations (NTFA) and spectrum use policies, licensing policies, regulations, administratively established fees and technical and radio system standards. It is this integrated spectrum management system that makes the effective and efficient management of spectrum users and their systems and frequency assignments possible. The end result is that a large number of users can be accommodated with an efficient use of limited spectrum. The FCFS approach is used in instances where there is sufficient spectrum to meet the demand in a given frequency band. Assignments are generally made on a First-come, First serve (FCFS) basis. Almost all agencies use the traditional approach to spectrum management as a tool in spectrum management. Spectrum access and licensing decisions are generally administratively decided following defined procedures. Authorizations do not normally confer any tenure or rights (exclusivity) and frequently have associated operating conditions. Where the demand for spectrum in any given band is expected to exceed, supply regulators may change from a FCFS licensing process to a competitive process.

7.2. Competitive Approach

Competitive approaches to spectrum access and licensing decisions range from comparative reviews to varying degrees of mechanisms that are market-based. A comparative review approach involves a comparative assessment of defined attributes of a

given application relative to other competing applications. Market-based mechanisms may involve satisfying some administrative qualifying criteria and submission of bids in some form of an auction. Licences frequently (but not always) include exclusive rights and may include privileges to participate in secondary market activities such as to sell, trade or lease spectrum to a third party, sometimes requiring additional regulatory approvals. Market mechanisms constitute a more liberalized approach to spectrum management. These are generally preferred because they are more economically efficient. In effect, the market determines who gets access to spectrum and bidders determine the spectrum fees based on the value entrants place on the spectrum and the associated rights/privileges. Generally, depending on the particular auction approach used, bidders that value the spectrum the most would win the rights/privileges associated with the assignable resource. Auctions are now the globally preferred method of spectrum assignment.

7.3. Commons/Licence Exempt Approach

In designated bands equipment (usually approved or certified), meeting specified technical criteria is preapproved for operation without the need to apply for an authorization or licence. The designated licence exempt frequencies are available to all users on an equal and shared basis. Interference management relies on the technical protocols and characteristics of the equipment. Licence exempt equipment is commonly found in consumer goods like garage door openers, remote control models, cordless phones, alarm systems, wireless speakers and wireless Internet, etc. As bands become heavily used, radiofrequency (RF) noise levels increase and interference occurs resulting in deteriorated system performance.

7.4. Triggers to initiate Competitive Process

It is important to demarcate spectrum resources and situations that would continue to use a first-come, first-served (FCFS) licensing process and those that would use a competitive licensing process (comparative selection or auction).

As noted above, a competitive process would be considered in situations where there is, or is likely to be, more spectrum demand than resources available.

FCFS processes would normally be used where spectrum supply is adequate to meet demand or spectrum access requests can be managed and reasonably be accommodated. Bands and services captured under FCFS processes would frequently apply where a modest amount of spectrum is requested such as to point-to-point microwave systems and conventional land mobile systems; point-to-multipoint applications; and satellite earth stations. Change from FCFS based on factors such as spectrum policies and spectrum demand.

FCFS processes will also continue to be used to meet the requirement of national security and defence as well as services related to the safety of the general public, such as emergency response e.g. Police, Fire and Ambulance.

MCIT/PTD as a matter of good spectrum governance will closely monitor resource demand to identify, to the extent possible, the frequency bands or situations where there is, or could be, excess spectrum demand relative to supply or where there is a Government

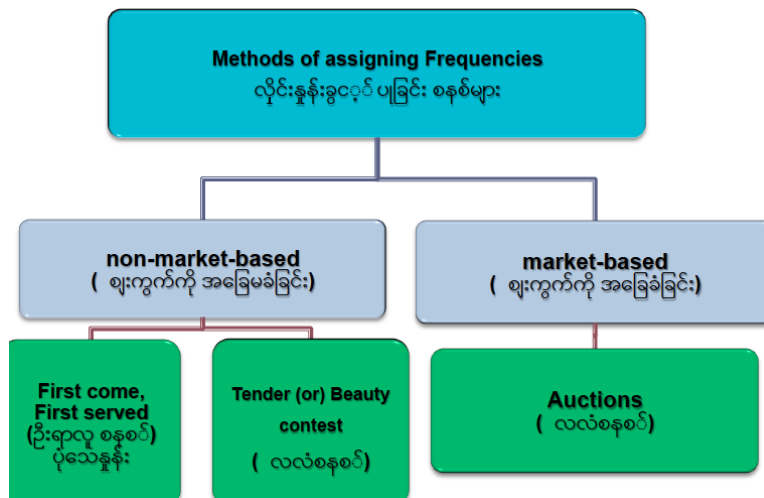
identified need to pursue certain telecommunications policy objectives. In these cases, a competitive licensing process may be initiated.

Where it is determined that sufficient spectrum is available to reasonably meet the needs of all applicants, it would be logical to proceed on a FCFS basis.

MCIT will also monitor FCFS licensing activities in order to determine where licensing activities may appropriately trigger excess demand for a particular band. In cases where excess demand is noted, MCIT would notify the industry that the traditional FCFS licensing process needs to be altered or will no longer be used for certain situations. MCIT would normally consult to establish the framework for a change to a competitive radio licensing process.

When developing frameworks for a specific competitive spectrum licensing process, the MCIT will be guided by the vision and specific objectives of the Master plan and applicable licensing policies furthering competition in the provision of national broadband telecommunications infrastructure asset, advancing broadband services to all areas of Myanmar.

In Myanmar, the method of assigning spectrum frequencies is depicted below:



Question 11 (Assignment approaches): Note: Approaches to licensing would be a key element of the spectrum policy framework mentioned in Question 3.

Q11 (a): Does Myanmar have the right balance between the three spectrum assignment approaches viz. the traditional approach, the market-based approach and the commons approach?

Q11 (b): When demand exceeds supply, do you agree that the default process be market-based, with comparative spectrum assignment processes only being used in exceptional cases?

7.5. Redeployment of encumbered spectrum

“Spectrum redeployment (spectrum re-farming)” is a combination of administrative, financial and technical measures aimed at removing users or equipment of the existing frequency assignments either completely or partially from a particular frequency band. Redeployment is a normal and necessary part of spectrum management. Redeployment may be required to changes in frequency allocation, national utilization policies, where equipment becomes obsolete and inefficient or where congestion in a given band warrants steps be taken to optimize utilization efficiencies of the spectrum resource. The frequency band may then be allocated to the same or different service(s). These measures may be implemented in short, medium or long time-scales.”²⁰

Effective spectrum management requires planning the development of radio services in advance of their requirement. In some cases, strategies may involve the introduction of new services or possibly extending the coverage of existing services. Sometimes making spectrum available for new services or expanding existing services requires the displacement or relocations existing and previously authorized assignments.

Redeployment of Government systems is generally more complex than public or private, often as a result of long planning and budget approval cycles.

Prerequisites for the deployment of both commercial and government systems include adequate notification and planning timelines as well as the identification of options to assist migration.

Spectrum refarming/redeployment is an important and integral part of spectrum management and includes strategies for implementation. These implementation strategies include:

- Advanced notification
- Timelines to redeploy
- Options of alternative spectrum
- Licence expiry
- Voluntary/regulated
- Assessment of operational or cost impacts
- Compensation mechanisms, particularly when involving expedited timelines
- Improved spectral efficiencies/benefits

In cases where spectrum has been previously assigned and licensees have on-going operations, MCIT/PTD endeavours to provide licensees adequate time to transition operations to an alternative band.

When it becomes necessary to displace an existing system MCIT/PTD will normally apply a minimum notification period of two years to any system where system changes are required (modification, replacement or removal). Where possible, MCIT/PTD will endeavour to identify alternative spectrum if a change of frequency assignment is required. If it is economically feasible to make changes sooner, the two-year period may be

²⁰ Rec. ITU-R SM.1603



accelerated. Sooner displacement may occur where incumbent operators and licensees eligible for licensing in the spectrum reach a negotiated arrangement.

In cases of interference, where a system is not operating in accordance with authorized parameters or applicable radio standards a shorter time frame may be specified including immediate termination of operations.

Action Planned by MCIT/PTD:

The process for redeploying spectrum is proposed to be detailed in a policy concerning recovery of spectrum for redeployment (re-farming) so that licensees fully understand the process.

Question 12 (Redeployment/Refarming): Do you agree that there is a need for a refarming policy that would provide guiding principles concerning spectrum recovery and redeployment?

8. Spectrum Inventory

8.1. Scope

Spectrum roadmaps generally provide a medium term (5-year) perspective on those radiofrequency bands that have the greatest commercial potential and correspondingly, technology pathways. In this Spectrum Roadmap, The PTD has primarily focused on bands below 5 GHz. MCIT has a primary focus on Commercial broadband and its priorities for deployment of public broadband services and the creation of a broadband national asset.

The PTD intends to review and renew the spectrum roadmap on a regular basis as regulatory priorities change, technologies, user needs and competitive landscapes evolve. Typically, spectrum practices are updated every 5 years in best practice jurisdictions.

This Roadmap includes the following elements:

- A review of current services and allotted bands being assigned;
- Users assigned;
- Identification of forecasted needs and planned initiatives;
- A description of users impacted;
- A review of MCIT spectrum management records - along with interviews, to assess current allocation, licensing policies, spectrum assigned and spectrum that could be assigned.

When evaluating the spectrum needs, the following services (table 1) were considered and preliminary information was requested from stakeholders commercial mobile, fixed systems (backhaul and other permitted services including fixed wireless access), land mobile, public safety, broadcasting, satellite services, aeronautical services and applications, marine mobile, radio-determination and licence-exempt devices.

Table 1: Review of Telecommunications Services in Myanmar

Service	Users	Needs	Planned initiatives
Mobile	Commercial Broadband	While not all bands have been assigned, the ability accommodate evolving traffic profiles, to deploy new 4G services and to facilitate new entrants will require more spectrum	<ul style="list-style-type: none"> Identify new bands to be released and initiate consultation on a licensing policy and process. X-border framework
	Private LM: These systems are Point-to-Area systems and may be point-to-multipoint systems where end points are not known. Systems coverage range from in-building to wide area of many kilometres and consist of a single LP site to multiple sites. PTD licensing information includes about 3,000 records.	Businesses of all sorts rely on radiocommunications to support efficient operations. Myanmar with (60 million, growing GDP) can expect many licensing requests. Countries much smaller have 100's to 1000's of such licensees.	<ul style="list-style-type: none"> Identify bands and release plans Develop band plans Licensing processes Client circular for application submission Focus will start with planning VHF X-border framework
	Government (excluding Public Safety)	Under Study	PTD studying future requirements, including radiolocation
	Trunked systems	It is anticipated that trunked radio systems will be required over the next 5 years.	<ul style="list-style-type: none"> Spectrum will be allocated to accommodate trunked systems within band plans to be created
	Public safety	Under Study	PTD studying future requirements. PTD will in its review consider REV.WRC RESOLUTION 646-15) Public protection and disaster relief
Fixed	Systems typically operate in the microwave region of the spectrum of usually 1 to 60 GHz. Backhaul users including Cellcos, Utilities and other industries. These systems are <i>point-to-point</i> and at times <i>point-to-multipoint</i> systems, where end points are known.	Critical for infrastructure to support network deployments including: Commercial Mobile, Government, utilities, broadcasters, Fixed facilities,	<ul style="list-style-type: none"> Spectrum Utilization Plan defining how spectrum is to be used Band plans and standards Licensing Processes Client circular to assist in application submission



Service	Users	Needs	Planned initiatives
		anywhere point-to-point (or point-to-multipoint) communications links may be required	<ul style="list-style-type: none"> • Refarming of existing bands, work has started in this area • Release plans • X-border framework
	Broadband Fixed systems		Identify spectrum and develop a spectrum policy and licensing process. This is important to address some of the interference issues in Licence exempt bands.
Broadcast	HF		No change
	MF (AM)		No change
	FM		No change
	TV		Refer to NFAT use of 698-806 band allocated for mobile in Myanmar.
Aeronautical			No change
Maritime			No change
Satellite		Myanmar market includes services provided exclusively by foreign /international space station providers. Myanmar needs a satellite policy concerning satellite services. Consultation is required on a policy that includes domestic satellite services.	Develop an appropriate Satellite policy for Myanmar and undertake a consultation.
Licence Exempt		Valuable asset to support low power /SRD devices in ISM and other bands	<ul style="list-style-type: none"> • Establish equipment standards, appropriately harmonized with neighbour countries • Harmonized bands • Certification process • List of equipment • Labelling program • User education pamphlet



Service	Users	Needs	Planned initiatives
			<ul style="list-style-type: none">• Design a compliance program

This 5-year Roadmap evaluated spectrum availability, current options to satisfy needs and included consultations within MCIT and sought preliminary input from stakeholders', from this, priorities were established. It was clear that to ensure continued growth and development of telecommunications in Myanmar, all services needed to have a way forward and that spectrum would need to be available to meet growing user demands. The spectrum review also highlighted key areas where there was rapid growth and new spectrum would be particularly beneficial and a detailed release plan is needed.

Part 3: Rapid Growth of Infrastructure and Service

In order to establish priorities for the 5-year Roadmap, the PTD project team undertook multiple lines of research including analysis of global trends and best practices, as well as consultations with industry and within MCIT. Through a process of comparing and integrating the lines of evidence produced from the research, we then were able to develop an evaluation of spectrum currently authorized and deployed, spectrum needs, spectrum availability, current options to satisfy needs.

It was clear that a fundamental requirement for continued growth and development of telecommunications in Myanmar, would be for all services to have a pathway forward and that spectrum would need to be available to meet growing user demands. The spectrum review also highlighted key areas where there was rapid growth and new spectrum would be particularly beneficial and a detailed release plan is needed on a priority basis.

For each of the bands and services captured in our review, we examine the following:

1. Trends/Technology
2. Assignments in nearby or similar countries
3. Current commercial assignments
4. Going Forward, including spectrum release plans, where appropriate

In this document, the timings of specific spectrum releases are identified to the extent they are known today. Spectrum development is evolving, therefore, PTD plans to follow a consultative approach to release plans factoring domestic, global, regional activities and the comments by interested parties as part of a consultation for the release of new bands.

We start with a focus on the priority bands - as defined by the lines of evidence: commercial bands and bands to support deployment. Once these are set out, we describe options for other services to grow. A number of bands are not yet assigned and are proposed for release, however, as spectrum is a limited resource, licensees must use existing spectrum allocations efficiently in order to provide improved service without requiring additional spectrum resources. Greater spectrum use efficiency can be achieved by optimizing infrastructure deployment (for example, increasing network density in order to increase frequency re-use) or by adopting innovative technologies (such as 4G wireless mobile broadband technologies). Operators are encouraged to augment deployment by implementing innovative network designs and technologies in order to improve coverage and capacity in restricted areas. These include Wi-Fi offloading, Femtocell deployment, smart repeaters and distributed antenna systems.²¹

²¹ Femtocells and Pico cells, which are low-power base stations, they use licensed spectrum to provide for enhanced coverage and capacity in areas of high data usage and weak signal levels such as in-building and high traffic density areas, such as, airports.