

REGIONAL INITIATIVES – ASIA-PACIFIC

Wireless broadband masterplan FOR THE UNION OF M Y A N M A R



O C T O B E R 2 0 1 2
Telecommunication Development Sector



Wireless broadband masterplan for the Union of Myanmar

October 2012



This report for the Union of Myanmar has been prepared as part of the ITU wireless broadband masterplan project for countries in the Asia-Pacific region in conjunction with the Korean Communications Commission (KCC). ITU would like to thank the Korean Communications Commission for supporting the IUT wireless broadband master plan project for countries in the Asia-Pacific region and in particular for Myanmar. The project objectives are to:

- carry out an assessment of existing policy and regulatory frameworks with a view to facilitate deployment of wireless broadband technologies taking into account convergence trends and provide recommendations for future requirement in selected pilot countries;
- demand side assessment and take up of applications, content and services that are envisaged by the users with wireless broadband in Asia-Pacific region in general and the four pilot countries in particular; and
- examine key policy and regulatory issues including but not limited to licensing, spectrum access/interconnection, deployment of new technologies, rollout obligations, incentive based regulation, infrastructure sharing, universal service obligations etc. in each selected pilot countries and provide concrete recommendations to promote broadband wireless services vis-à-vis identified national priorities and international best practices.

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Executive Summary

This report provides an analysis of the current state of Myanmar's broadband capability and recommendations for the implementation of an effective wireless broadband technology. It also considers key regulatory aspects for the provision of wireless broadband services throughout the country.

The Government of Myanmar is committed to ensuring that all citizens have access to effective wireless broadband services, and to encouraging a content-rich environment that will facilitate a growing online community. Myanmar presents its own unique set of challenges in developing wireless broadband. Myanmar is the largest nation in South East Asia and yet from those countries selected to participate in the ITU wireless broadband masterplans for the Asia Pacific region, Myanmar has the least developed telecommunications market (the other selected countries being, Nepal, Samoa, and Viet Nam). With a population of some 60 million people and extremely varied topography, the country's policy requirements are therefore based on these factors.

The recommendations in this report are focused on achieving the maximum gains in terms of coverage, and on ensuring that the provision of fast and effective broadband services can be achieved in a short period of time.

Key considerations in the Myanmar wireless broadband masterplan include:

- the economic and social importance of broadband and its role in improving productivity and providing information and services;
- the structure of the Myanmar telecommunication market and the current regulatory framework;
- broadband access targets and Myanmar future spectrum requirements;
- the case for legal/regulatory reform; and
- key technologies, including GSM, W-CDMA/HSPA, WiMAX, satellite, and LTE.

With these considerations in mind the masterplan reaches the following conclusions:

1. There is a need to commit early to legal/regulatory reform in the telecommunications sector. The new legislation should clarify, inter alia, the following areas: licensing, frequency management, legal position of the ministry and regulator etc.
2. There is a need to facilitate the entry of additional operators in order to secure the necessary investment of at least USD 1.5 billion to meet the government's ambitious 30 million line rollout target as part of the ICT Masterplan. Deployment of the most efficient technologies available should be encouraged in order to provide affordable services. Early LTE deployment is possible to support high speed wireless broadband services.
3. It is suggested that the government should aim to provide at least total of 418 MHz for mobile services by 2015 in the 450, 700, 900, 1800 and 2100 MHz bands.
4. Greater high speed international connectivity needs to be secured by obtaining long term capacity on cable systems such as SEA-ME-WE 4.
5. The Government of Myanmar could greatly encourage the development of new and existing content by using a range of tools, including education programmes, subsidies and government leadership.

1. Introduction

1.1 Project background

Based on an objective assessment of needs and priority, the Republic of the Union of Myanmar was one of the four countries the others being, Nepal, Samoa and Viet Nam selected by the International Telecommunication Union (ITU) in which ITU developed national pilot wireless broadband masterplans. The ITU Guidelines for the preparation of national wireless broadband masterplans for the Asia Pacific region provides the reference framework for the development of a national wireless broadband development. It was used extensively in the development of this report.

As a populous nation of some 60 million people whose government is undergoing a transformative shift in its desire to integrate with the global economy, Myanmar presents a unique opportunity for ITU to collaborate with key stakeholders in establishing a framework which will drive the deployment and uptake of wireless broadband services and hasten the nation's evolution into one of Southeast Asia's most promising emerging markets.

Myanmar has an opportunity to promulgate high quality policies and regulation which are informed by past two decades of telecommunications reform and regional and global and regional. In doing so it can permit its licensed operators to select the optimal technology for deployment in Myanmar, provide efficient and affordable services to Myanmar consumers, and 'leap frog' to higher speed LTE and 4G wireless broadband offerings.

This report forms an important input into the country's broader telecommunications sector policies and strategies which have as their aim to propel the nation into a more advanced ICT economy. The implementation plans to improve Myanmar teledensity and to address its digital divide are being developed within the Ministry of Communications, Posts and Telegraphs (Ministry) especially by the Posts and Telecommunications Department (PTD).

1.2 Structure of the masterplan

This masterplan comprises six main topics of analysis and recommendations:

- (i) broadband: global and regional context (section 2);
- (ii) Myanmar and the wireless broadband market (section 3);
- (iii) medium to long term goals to optimise wireless broadband for Myanmar (section 4);
- (iv) key considerations of the wireless broadband masterplan (section 5);
- (v) facilitating applications and content (section 6);
- (vi) conclusions and recommendations (section 7).

2. Broadband: Global and regional context

There is now almost a global consensus on the importance of broadband to a market's economic growth and the social interaction of citizens. The ability to access and provide data rich applications and content has become a pre-requisite for global trade and is fast becoming a necessary component of interaction between members of the public as well as government. While broadband connectivity is simply a means

of accessing and providing data in as fast a manner as possible, its role has been identified as of high enough importance for it to warrant the characterisation of a 'human right'.¹

Aside from the practical benefits of broadband, such as greatly enhanced ease of accessing and providing data-rich content, numerous studies have documented the positive relationship between broadband access and national prosperity. A World Bank study emphasised the importance of broadband penetration for developing economies having concluded that every 10 per cent increase in broadband penetration provides a 1.38 per cent increase in GDP.²

Likewise other studies project a boost to Malaysian GDP by 2020 as part of the modelling the impact of Malaysia's High Speed Broadband (HSBB) project³ and that 10 per cent higher broadband penetration in a specific year is correlated with 1.5 per cent greater labour productivity growth over the following five years.⁴

Broadband networks are able to deliver a host of applications and services that other mediums are simply not capable, and these services include:

- e-commerce;
- e-banking;
- e-government;
- e-education;
- paper-less work;
- improved education/training; and
- telemedicine/e-health.

Given these factors, broadband and improving broadband is now an international focus of development work including by the United Nations (UN), ITU and UNESCO.⁵ This has resulted in broadband targets being incorporated with the UN Millennium Development Goals and the prompting the creation of the Broadband Commission as a joint undertaking of ITU and UNESCO.

¹ www.broadbandcommission.org/Documents/Broadband_Challenge.pdf

² Christine Zhen-Wei Qiang and Carlo M. Rossotto with Kaoru Kimura, Chapter 3 Economic Impacts of Broadband, in World Bank, Information and Communication for Development 2009: Extending Reach and Increasing Impact (IC4D2009).

³ Windsor Place Consulting, A high level cost benefit analysis of Malaysia's broadband deployment, Melbourne, 17 December 2007.

⁴ Booz & Company *Digital Highways: The Role of Governments in 21st Century Infrastructure (2009)*.

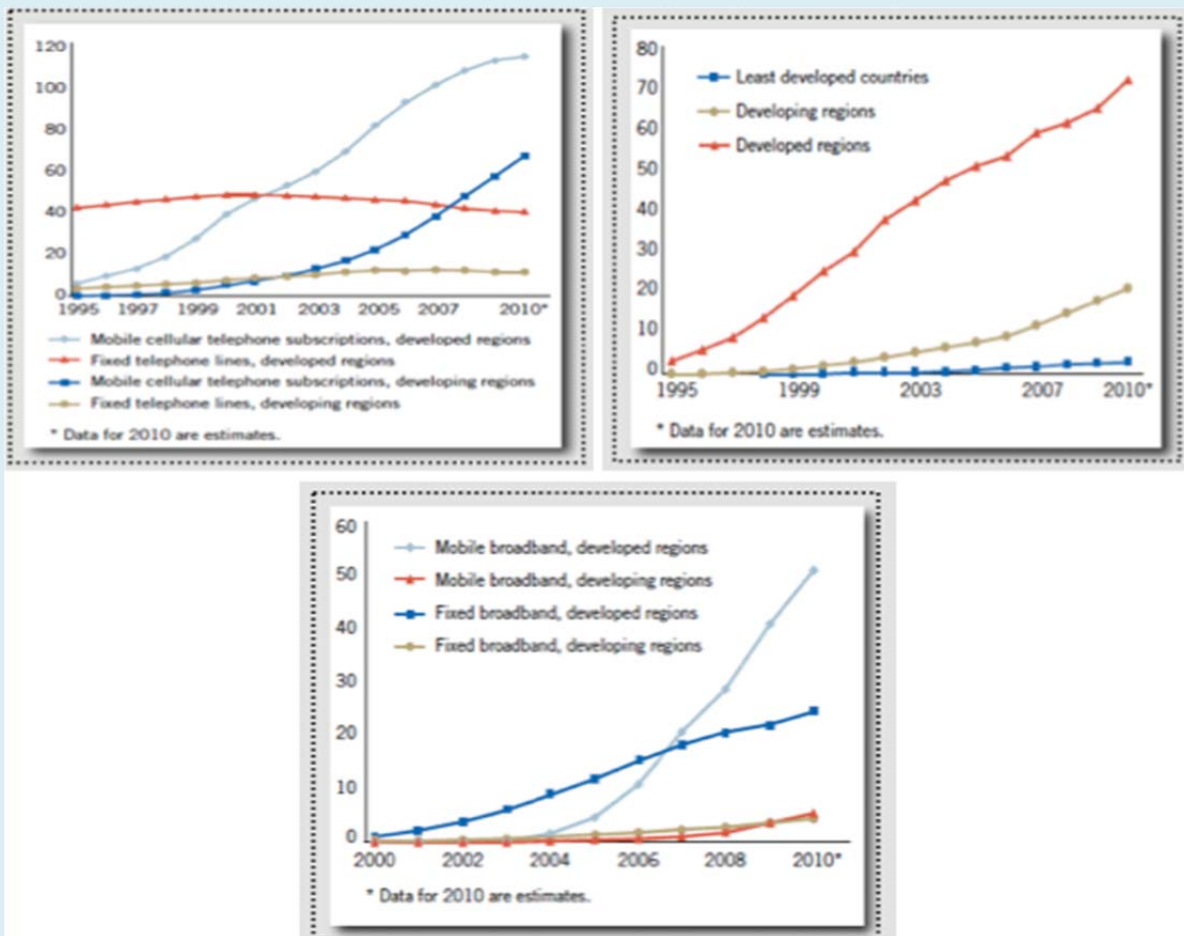
⁵ See www.un.org and www.unesco.org.

2.1 UN Millennium Development Goals

The UN Millennium Development Goals (MDGs) are comprised of eight specific targets for developing nations to achieve by 2015.⁶ Telecommunications and broadband falls with the eighth goal of developing a global partnership for development with sub-target 8(F) stating that ‘In cooperation with the private sector, make available the benefits of new technologies, especially information and communications’.

Measured against the agreed indicators by the number of fixed telephones, mobile cellular subscriptions and the number of Internet users per 100 population, significant progress has been made globally (Figure 1).

Figure 1: Fixed telephone lines and mobile cellular subscriptions - Internet users - broadband subscriptions (per 100 inhabitants)



Source: UN Millennium Development Goals Report, telecommunications indicators 2011⁷

⁶ These are namely: (1) Eradicate extreme poverty and hunger; (2) Achieve universal primary education; (3) Promote gender equality and empower women; (4) Reduce child mortality; (5) Improve maternal health; (6) Combat HIV / AIDS, malaria and other diseases; (7) Ensure environmental sustainability; and (8) Develop a global partnership for development.

⁷ <http://mdgs.un.org/unsd/mdg/News.aspx?ArticleId=59>

This masterplan is consistent with target 8F of the MDGs and following the successful achievement of the masterplan goals, will be a significant factor in reducing the digital divide between South East Asia and its more developed counterparts.

2.2 Broadband Commission

Until recently, broadband policy was largely the domain of national governments and the focus of regional initiatives. However, creation of the Broadband Commission for Digital Development in May 2010, a joint effort by ITU and UNESCO, is clear evidence of a shifting paradigm. The Commission was set up with the aim of engaging in 'advocacy and high-level thought leadership to demonstrate that broadband networks:

- are basic infrastructure in a modern society – just like roads, electricity or water;
- are uniquely powerful tools for accelerating progress towards the MDGs;
- are remarkably cost-effective and offer impressive returns-on-investment (ROI) in both developed and developing economies alike;
- underpin all industrial sectors and are increasingly the foundation of public services and social progress;
- need to be promoted by governments in joint partnership with industry, in order to reap the full benefits of broadband networks and services.⁸

Within the context of the masterplan, these conclusions and regulatory considerations are important as they provide both guidance and clarity. With respect to these considerations, the masterplan will be consistent with the focus of the Commission and its recommendations/policies.

The Commission debated the possible way of defining broadband and conceded that delineations such as upstream/downstream speeds are arguably inadequate due to rapid technological advances. Instead, they believed that focus on core concepts, such as *always-on* service (the user isn't required to make a new connection to the server each time) and *high capacity* (capable of carrying lots of data per second) would be preferred alternatives as they would not be as constraining nor subject to frequent revision.⁹

In the report, *Broadband: A Platform for Progress*¹⁰, the Commission discussed a range of issues for governments to consider when deploying broadband networks. Conclusions that emerged from the report included, *inter alia*:

- infrastructure policy should be goal oriented and not focused on particular technologies;
- pricing or other access barriers should be removed;
- associations between infrastructure and a type of service should be avoided;
- infrastructure sharing is beneficial and should be encouraged; and
- fibre-optic networks are likely the preferred backhaul network solution, but depending on national geography / topology, may need to be complimented by wireless infrastructure.¹¹

⁸ See www.broadbandcommission.org

⁹ See www.broadbandcommission.org/Reports/Report_2_Executive_Summary.pdf

¹⁰ www.broadbandcommission.org/Reports/Report_2.pdf

¹¹ *Ibid.*

The report identifies a number of considerations to be taken into account by governments and regulators in developing economies that are grappling with the challenges associated with increased broadband access. There are a number of areas in this regard that are of particular relevance to this wireless broadband masterplan. These are summarised in Table 1 below.

The Commission endorsed the ‘Broadband Challenge’ in October 2011 whereby broadband connectivity was recognised as a human right and a crucial driving force behind economic growth. Importantly, governments were urged to adopt policy platforms that would facilitate broadband network deployment and service uptake. Member States were advised against retaining policies that would limit market entry and tax ICT services unnecessarily. Governments were encouraged to promote coordinated standards of interoperability and achieve maximum utility for scarce radio spectrum. It was seen as necessary to review existing regulatory and legislative frameworks, many of which reflect outmoded 20th century models and ensure that information flows are free and unhindered.¹²

Table 1: Broadband challenges

No.	Issue	Details
1.	Attracting investment in broadband	This may include: <ul style="list-style-type: none"> • reduce investment / regulatory barriers; • encourage infrastructure sharing; • introduce innovative spectrum management mechanisms; and • amend regulatory frameworks to eliminate discriminatory rules that favour one company / industry over another.
2.	Addressing persistent gaps in the market	It is recognised that in cases where infrastructure deployment is highly expensive or impractical, the government may need to be proactive in addressing bottlenecks. Authorities also need to maintain cognisance over possible adverse implications of hyper-competition, which may dampen sector investment. The universal service fund may pose challenges as changing definitions of services may require the government to address issues of which entities are required to contribute.
3.	Funding broadband	The Commission stated that true access gap (a shortfall between market-based measures and universal access) may need to be addressed in circumstances where there is evidence that regulatory incentives and lower-cost network alternatives are not enough to encourage supply in certain instances. Governments may address these issues vis-à-vis remedies relating to issuing special licences in defined locations, funding local community initiatives, providing direct financial support to operators or mandating the deployment of broadband access networks. ¹³

The Commission adopted a set of four broadband targets to be achieved by 2015:

- i. all countries should have a national broadband plan / strategy or include broadband in their universal access / service definitions;
- ii. entry level broadband services should be made affordable in developing countries through adequate regulation and market forces (for example, amounting to less than 5 per cent of average monthly income).;

¹² www.broadbandcommission.org/Documents/Broadband_Challenge.pdf

¹³ *Ibid*

- iii. forty per cent of households in developing countries should have Internet access;
- iv. Internet user penetration should reach 60 per cent worldwide, 50 per cent in developing countries and 15 per cent in least developed countries.

It should be noted that ITU is optimistic that all of these targets will be either met or exceeded by 2015. In order to reap the benefits of wireless broadband, Myanmar must strive to meet and exceed these aspirational targets.

2.3 ASEAN ICT Masterplan 2015

Myanmar and its fellow wireless broadband masterplan pilot country Viet Nam (as ASEAN¹⁴ members) have committed to the ASEAN ICT Masterplan 2015. The masterplan is a broad, overarching policy-framework that is intended to guide ASEAN Member State ICT development over the next five years (see the summary in Appendix A). The policy has consequences for any wireless broadband masterplan adopted by signatory states, as the plan will need to evolve within the context of the broader ICT mosaic and strive for consistency.

Members have committed to a single strategic vision of enabling ASEAN social and economic integration and facilitate the transformation into a single market. For 2015, the following key outcomes have been set:

- i. ICT as an engine of growth for ASEAN countries;
- ii. recognition for ASEAN as a global ICT hub;
- iii. enhanced quality of life for peoples of ASEAN; and
- iv. contribution toward ASEAN integration.

2.4 Other global developmental trends in broadband policy and regulation

In recent years, several key trends have emerged with respect to broadband policy and regulation. Governments around the globe have become increasingly cognisant about the importance of high-speed networks and their link to economic growth. As a consequence, there has been a substantial increase in government participation and intervention within the ICT sector. Broadly speaking, this intervention consists of:

- the encouragement of private sector participation via improved access arrangements, simplified licensing and deregulation;
- the development of national broadband plans/policies;
- financial support in the form of subsidies, tax breaks, grants and loan assistance;
- expanding the scope of universal service obligations (USO) to encompass broadband services;
- updating regulatory regimes to take into account the convergence of media and communications; and
- redirecting universal service funds (USFs) to enable broadband in rural/isolated/low-income areas.

¹⁴ Association of Southeast Asian Nations www.aseansec.org

In addition, regulators are coming to terms with the need to prepare for a material increase in the demand for scarce spectrum. Global spectrum management arrangements are evolving to meet changing patterns of use and demand for spectrum. Following a trend that began in Australia, Japan, the United States, and New Zealand, steps are being taken to reduce the involvement of government and let market mechanisms govern the allocation and destination of use of spectrum including:

- the allocation of spectrum through price-based selection processes – especially auctions – or alternative proxy methods to impose apparatus charges which reflect the value of the spectrum;
- the owners of spectrum rights are increasingly free to decide which technology to use and which services to provide with it;
- the introduction of spectrum trading in some markets (in line with spectrum liberalization) is allowing spectrum rights to be allocated via market mechanisms to the users that value it the most; and
- the increasing prevalence of spectrum leasing arrangements which allows a spectrum owner to sub-lease, part or all of their allocated frequencies.

3. Myanmar and the wireless broadband market

Myanmar, one of the least economically developed regions in Southeast Asia is situated between rising economic stars China and India. At 676 578 square km, it is the largest nation in Southeast Asia as shown in Figure 2. Covered extensively by dense tropical rainforest, bordered by mountains to the north and rural plains in the centre, the country has extremely varied geography and climate.

Figure 2: Myanmar location and geography



Source: www.american.edu

While relaxed somewhat in early 2012, Myanmar is currently subject to a range of economic sanctions by the European Union, the United States and other countries, which have had the effect of constraining economic growth.¹⁵ Economic growth has been modest to strong over the past decade, peaking at 13.8 per cent in 2003 with 10.4 per cent for 2010.¹⁶ As of 2011, GDP is estimated to be USD 40.3 billion.¹⁷ GDP per capita is an estimated USD 2 989.

Following incremental steps towards economic liberalisation in the 1990s and 2000s, Myanmar, the fourth most populous nation in Southeast Asia, with a population of nearly 60 million people, has followed a similar trajectory of economic growth to its developing neighbours. With a predominantly rural/non-urban population, agriculture and services constitute nearly 75 per cent of Myanmar's GDP. The current unemployment rate is an estimated 6 per cent. Inflation continues to remain moderately high and threatens the country's purchasing power. As of 2010, the consumer price index was expected to rise by nearly 10 per cent.

In recent years, Myanmar has been the beneficiary of an exponential increase in foreign investment. Imports and exports increased 18.9 and 55.5 per cent, respectively, in 2010. Demand for the Kyat, the national currency, has seen it perform strongly against the US dollar (in 2010, Kyat per USD = 5.578).

At present, there are two functioning operators in Myanmar, all of which are nominally under the control of the government. MPT is a fully government owned operator and Yatanarpon Teleport Co., is a semi-government owned operator¹⁸.

3.1 Current market structure and competition

Table 2 outlines Myanmar's current telecommunications landscape. As can be seen, a variety of technologies are used. Nonetheless, the market remains significantly underdeveloped. Internet penetration in particular, remains extremely low.

The government is making moves to rollout telecommunications services in support of the national economy. This is in accordance with the new Myanmar ICT Development Masterplan 2011-2015. In April 2011, the Ministry of Communications, Posts and Telegraphs stated that MPT will extend 30 million more GSM mobile phone lines in cooperation with private companies over the next five years to reach a telephone penetration of 45 per cent.¹⁹

This extension project has commenced with a partnership with local companies (i.e. this partnership involves private companies investing in infrastructure building and repaid through revenue sharing.)

¹⁵ Such sanctions have also restricted the telecommunications equipment choices, vendor support and international connectivity.

¹⁶ See www.imf.org/external/pubs/ft/weo/2011/02/pdf/text.pdf

¹⁷ See www.adb.org/Documents/Books/Key_Indicators/2011/pdf/MYA.pdf

¹⁸ Note that Redlink (see www.redlink.net.mm) is an agent of YTP. See also www.mpt.net.mm and www.myantel.net.mm.

¹⁹ The current 30 million-line project has been partly split between ZTE and Huawei (they are the only suppliers in the country due to restrictions). Some 30 per cent of those lines will be initially W-CDMA capable (i.e. W-CDMA utilising the 900 MHz band).

Table 2: Summary of Myanmar's telecommunication infrastructure

INDICATOR	STATISTIC	INDICATOR	STATISTIC
Teledensity	<ul style="list-style-type: none"> 4.74% 	International Gateways:	<ul style="list-style-type: none"> 2 (NGN-IP-IGW / DMS-300 with IP Trunk 500 E1)
Total Tele lines	<ul style="list-style-type: none"> 2 871 265 (fixed lines incl: WLL: 866 084) (mobile lines: 2 276 000) 	International channels	<ul style="list-style-type: none"> 4627
National Backbone	<ul style="list-style-type: none"> Fibre between major cities 	Internet gateway	<ul style="list-style-type: none"> 1
Cross-border Fibre	<ul style="list-style-type: none"> India – Myanmar China – Myanmar Thailand – Myanmar Laos – Myanmar 		
International Links	<ul style="list-style-type: none"> Cable / satellite 	ISPs	<ul style="list-style-type: none"> 2 (MPT and Yatanarpon Teleport Co.)
Last Mile Links	<ul style="list-style-type: none"> Dedicated WBB access MPT satellite BB 	PSTN Exchanges	<ul style="list-style-type: none"> 913
Internet Hosts	<ul style="list-style-type: none"> 25 690 	Mobile Exchanges	<ul style="list-style-type: none"> 14
Internet Backbone Bandwidth	<ul style="list-style-type: none"> 4.385 Gbit/s 	Transit Exchanges	<ul style="list-style-type: none"> 11
Internet Subscribers	<ul style="list-style-type: none"> 52 071 FTTH users (6500) 	Microwave Stations	<ul style="list-style-type: none"> 340
Internet Users (% of pop)	<ul style="list-style-type: none"> 0.44 	Satellite terminals / stations	<ul style="list-style-type: none"> 2 065 (MPT satellite terminals)/ 1 (Intelsat Es) +11 (VSAT Stations)
Public Access Centres	<ul style="list-style-type: none"> 2 500+ 		

As Table 3 shows, there are approximately 1.3 million mobile subscribers in Myanmar utilising a variety of technologies. CDMA 2000 in the 450 MHz band has the widest coverage, followed by GSM in the 900 MHz band, which is largely present in the central plain (including the Yangon region).

Table 3: Subscriber base by mobile technology

Technology	Subscribers	Number of Cities
GSM	836 967	98
W-CDMA	28 000	1
CDMA 2000 (450 MHz)	698 060	210
CDMA 2000 (800 MHz)	382 750	19
Multi-carrier Will	150 000	12

Source: PTD, 2011

The current telephone penetration remains low because of the very high retail cost of both securing a connection and then on-going subscription costs. Such costs are being reduced by the government. This is explained in more detail in Box 1.

Box 1: Explanation of the Myanmar current high connection fees

The price of a mobile access in Myanmar is expensive at some USD 500 per ‘connection’. This may appear puzzling, but the reason for this, however, is quite simple.

Handsets themselves are cheap – between USD 20-50 in the market. The quoted USD 500 – which has been recently reduced to USD 250, is the cost of the SIM card. In essence, this is a SIM tax – with such monies used to pay the capital cost of the network, prior to any service revenues. The old system of fixed line deployment has been carried over by MPT to the mobile business. SIM cards are rationed in this way as well.

A Base Transceiver Station (BTS) can cost USD 50 000 and the cost of each site can double this amount, leading to a cost of USD 100 000 per fully loaded BTS. As the MPT is putting approximately 3 000 subscribers on each BTS the connection revenues it secures before call revenues equate to approximately USD 1 million. Even if the future price falls to USD 100 per connection then the upfront connection revenues would be USD 300 000. It would certainly need to fall to such levels or lower if the national telephone penetration target is to be met.

In short, Myanmar is similar to other countries in the South Asian market prior to the introduction of mass market (lower cost) telecommunication services.²⁰

3.2 Current retail market structure

MPT is the sole provider of mobile and fixed telephony in Myanmar. Yatanarpon Teleport (YT) is currently an ISP based operator. YTP has used another local company Redlink as its operating partner in providing WiMAX service (using 16d and 16e configurations) in Yangon and Bagan in the 2.5/2.6 GHz band, making it Myanmar’s first 4G service provider. Base stations can support 10 – 16 Mbit/s. Customers are offered 128 kbit/s.

Table 4 summarises YTP’s WiMAX data tariffs. As can be seen even the most basic plans would currently be beyond reach of a significant portion of Myanmar’s citizens.

Table 4: 4G data tariff

	Basic	Premium
Monthly Fee (USD)	30	155
D/L speed	512 kbit/s	3 Mbit/s
Usage quota	3 GB	Unlimited

On the commercial side, many business opportunities remain unexplored or unexploited. For example, the lack of international roaming²¹ means that Myanmar (and the MPT as the monopoly provider currently) forgoes between an estimated USD 20-30 million per annum in international roaming revenues. Such revenues would be significantly higher if tourism to Myanmar was to significantly increase – which is possible if the country was to fully re-integrate with the region and the world.

²⁰ Having said that it is arguable that their approach has a good basis in economics, albeit initially. They are securing the additional fees for those subscribers who are willing to pay and then they will drop the connection fee, so they are ‘following’ the demand curve and securing part of the consumer surplus.

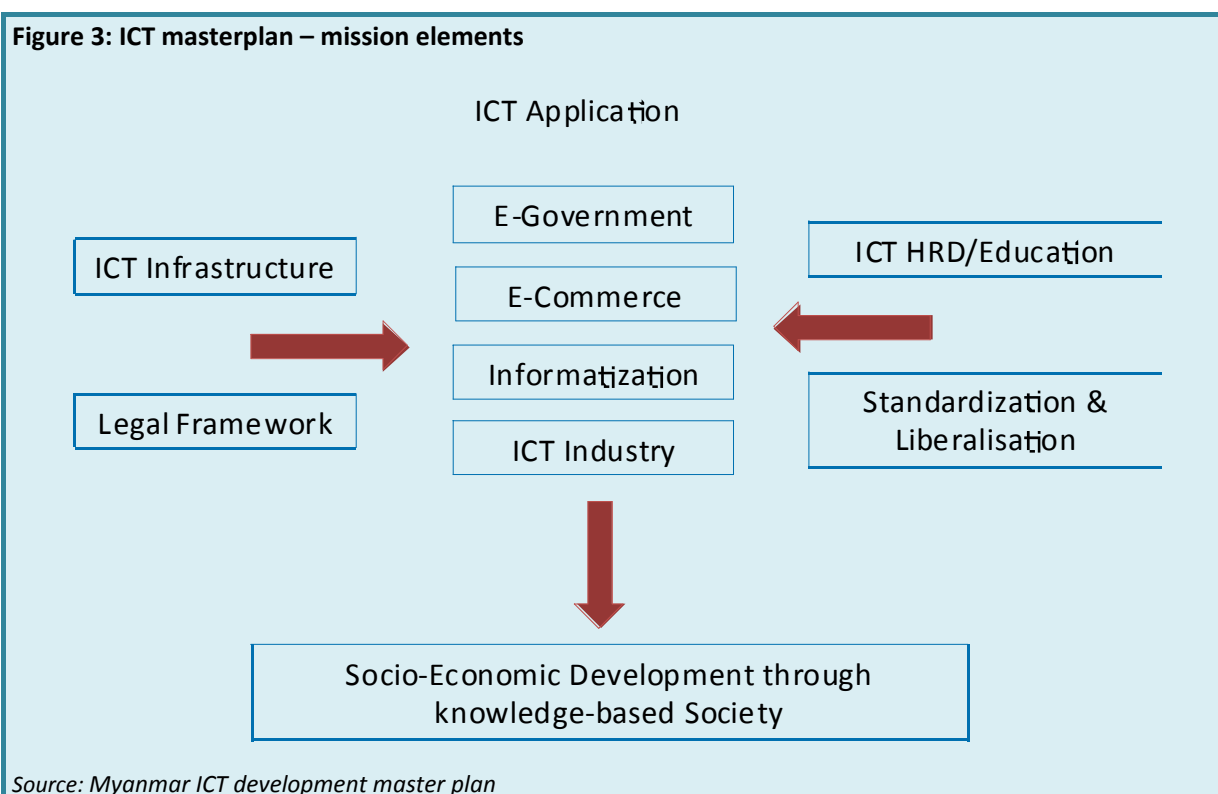
²¹ Not all operators (about 10) have international roaming agreements with MPT.

3.3 Current policy objectives/initiatives

In the past, Myanmar has issued a number of telecommunication sector policies aimed at, *inter alia*, increasing infrastructure deployment, improving affordability, enhancing regional cooperation / harmonisation and improving penetration.

The government has issued the Myanmar ICT Development Master plan (2011-2015). This plan followed the 2005-2010 masterplan, which was credited with increasing teledensity from 1 to 5.4 per cent. The new plan covers the following areas, which *inter alia*:

- Sets up ambitious short term and long term ICT strategies for all ICT areas to promote national economic development through information security.
- Specifies broad mission elements and emphasise the priority area of IT application, IT HRD and foundation for the IT industry. This is illustrated in Figure 3.



The vision of the masterplan is to construct a reliable ICT environment to facilitate the industrial base and to strengthen ICT utilisation capability.

The key objectives of the masterplan are as follows:

- achieve 15 per cent of teledensity by 2015 in fixed and broadband;
- achieve 45 per cent (30 million subscribers) by 2015 in mobile;
- strengthen ICT security;
- construct proactive ICT infrastructure;
- establish efficient migration strategy for network operator;
- be prepared for possible disasters for public safety; and
- set up network management and maintenance system.

3.4 Legal and regulatory framework

3.4.1 Overview

The Myanmar *Telegraphy Act 1885* and *Wireless Telegraphy Act 1933* as amended²² remain in force and regulate the Myanmar telecommunication sector. However, a new draft modern telecommunication law has been prepared by the PTD (please refer to Appendix B for an outline of the structure of the proposed law).

There are two other key laws that apply to the telecommunication sector:

1. The *State-owned Economic Enterprises Law 1989*.²³ It provides that the government has the sole right to carry out a range of economic enterprises as State-owned economic enterprises including Post and Telecommunications Service. However, in accordance with section 4 “The Government may, by notification, permit in the interest of the Union of Myanmar any economic enterprise which is prescribed under Section 3 to be operated solely by the Government to be carried out by joint-venture between the Government and any other person or any other economic organization or under conditions by any person or any economic organization subject to conditions”.
2. *Myanmar Special Economic Zone Law* dated 27 January 2011 also provides for the establishment of special economic zones which include information and telecommunication technology zones.²⁴

Following the introduction of the proposed draft *Telecommunication Law* the Myanmar telecommunication sector is likely to undergo significant regulatory change. The draft law contains modern elements including a requirement for access and interconnection (and infrastructure sharing), competition safeguards, a licensing structure similar to other ASEAN markets and a semi-independent regulator. The law currently proposes to adopt a similar model to Viet Nam where the regulator sits within the ministry structure. It is likely that the new legislation will provide an enabling framework to effectively pursue the objectives outlined in this masterplan.

It should be noted that the PTD is working on a number of pieces of subsidiary legislation including licensing, access and interconnection, spectrum etc. The PTD and the government are developing the key elements of subsidiary legislation to be completed with the new law. This is to enable the industry to have a complete regulatory scheme concurrently with or soon after the new law is promulgated by the Parliament of Myanmar (the Pyidaungsu Hluttaw).

3.4.2 Early market entry ahead of the new sector legislation

In the event of a delay in enacting new sector legislation, early market entry in support of the masterplan objectives remains legally possible, if desired by government. Any entity would be required to seek a licence under the old legislation and undertake a joint venture in accordance with the *State-owned Economic Enterprises Law*.

²² The Act was amended in 1995/96 to include fax machines and computers. Legislation available at www.mcpt.gov.mm/mcpt/telecoms.htm

²³ The State Law and Order Restoration Council Law No.9/89 dated 31 March 1989. Available at www.mcpt.gov.mm/mcpt/miscellaneous.htm

²⁴ See www.mcpt.gov.mm/mcpt/miscellaneous.htm-0

Section 5 of the Telegraph Act stipulates that ‘The telegraph authority constituted under the Telegraph Act shall be the authority competent to issue licences to possess wireless telegraphy apparatus under this Act, and may issue licences in such manner, on such conditions and subject to such payments as may be prescribed.’ A wireless licence permits the recipient to possess a ‘wireless telegraphy apparatus’.²⁵

In addition, under section 77 of the draft proposed Telecommunication Law, licences issued under the Myanmar Telegraph Act 1885 and the Myanmar Wireless Telegraph Act 1934 would be ‘deemed as licences issued under this Law and be effective until the expiry of the licence. Similar to the following:’ If the licensee is willing to continue with the service following expiry, the application shall proceed on the basis of the new law. Rules, notifications, instructions and orders issued under the old laws are to remain in effect insofar as they are not inconsistent with the new Law.

3.5 Spectrum utilisation

Spectrum is currently regulated and allocated on an administrative basis by the PTD in accordance with the *Wireless Telegraphy Act*, but as telecommunications services are not open to competition, demand for spectrum is significantly below similarly sized countries. Current key spectrum allocations are detailed in Appendix D.

3.6 Key challenges

The underdeveloped state of telecommunication infrastructure, low Internet and broadband penetration in Myanmar pose substantial challenges for the effective implementation of the wireless broadband masterplan. Other challenges include:

- The need for certainty regarding the draft *Telecommunication Law*. At present, there does not appear to be a firm timeline regarding the Bill’s introduction and passage in Parliament. Delays or amendments may pose obstacles for the implementation of the masterplan and reduce its positive impact.
- The absence of a transparent and consistent spectrum policy in Myanmar, while not posing any immediate issues may become problematic in the near future following growth in the provision of mobile services and broadband. While the MPT has in place a spectrum management group and the National Frequency Allocation Plan, there does not appear to be a mechanism in place for the protection of assigned frequencies and there is an absence of monitoring. This current regime would need to be augmented if the government wishes to attract investment in wireless broadband services and increased uptake.
- Myanmar is encouraged to increase its participation in regional and international harmonisation initiatives and utilise best practice guidelines. Within the context of the masterplan this will make the meeting of key government targets much more achievable.

However, it is these significant challenges which make a commitment to ambitious targets in the ICT masterplan all the more essential given the need for the nation to bridge the digital divide and ensure that Myanmar reaps the benefits of global trade and commerce and economic integration into Southeast Asia.

²⁵ There are currently no formal licensing regulations in force and licensing is regulated by various government agencies and/or through concession agreements. Further, there is also no competition or interconnection related regulations in force.

4. Medium to long term goals to optimise wireless broadband for Myanmar

4.1 Global mobile data traffic growth

Based on global statistics the number of wireless broadband subscribers has exceeded the number of fixed broadband subscribers and will continue on an explosive growth path based on current growth estimates. According to the Cisco *Visual Networking Index Global Mobile Data Traffic Forecast* overall mobile data traffic is expected to grow to 10.8 Exabytes (1 Exabyte=10¹⁸ bytes) per month by 2016 as shown in Figure 4.

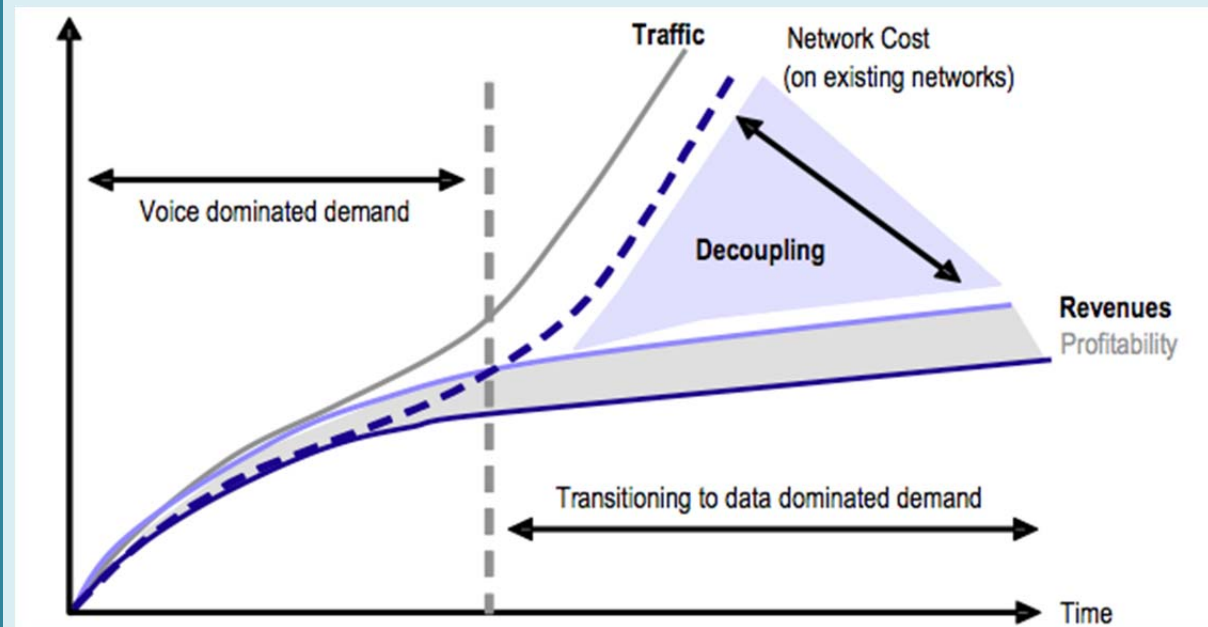
Figure 4: Overall mobile data traffic growth 2011 – 2016



Source: Cisco, VNI Report, 2012

As the industry embraces mobile broadband, data demand on the network is increasing rapidly, and operators need to find a cost efficient way to continue providing the service. A 10-fold increase in mobile data traffic could translate to a less than 10 per cent increase in revenue for operators. LTE serves as the common migration path for all existing mobile standards to address the cost challenge (see Figure 5).

Figure 5: Benefits of LTE: decoupling revenue and traffic



Source: UBS, 2009²⁶

4.2 Estimating Myanmar mobile growth

In Myanmar the situation is more difficult to forecast given the nascent nature of voice and broadband services in the country and almost non-existent wireless broadband service offerings. While the Government of Myanmar vision is to construct a reliable ICT environment to facilitate growth of the industrial base and to strengthen ICT utilisation capability, its key objectives are:

- to achieve 15 per cent of teledensity by 2015 in fixed and broadband; and
- to achieve 45 per cent (30 million subscribers) by 2015 in mobile.

²⁶ UBS Investment Research, Asia Telecom Sector: LTE Implications for Asian Mobile operators, 25 June 2009.

While these targets should be met assuming the country wide network deployment, they require a substantial fall in connection fees from the current USD 500 per local SIM to much lower pricing norms. On-going subscription for access and calls, SMS as well as wireless data pricing would also need to fall substantially. Achievement of ICT masterplan targets will necessitate a substantial fall in prices (as illustrated in Figure 6) otherwise the demand is unlikely to exist.

Figure 6: Connection price falls required to achieve the ICT masterplan penetration targets



Source: author

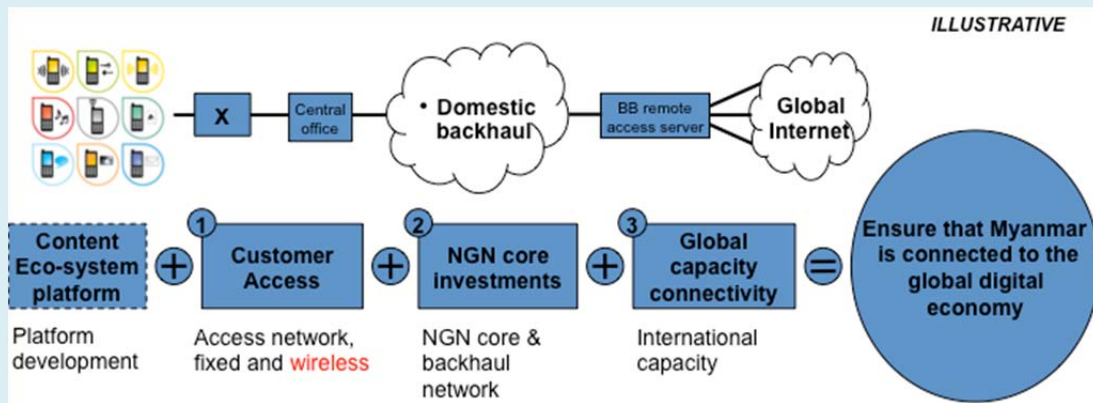
5. Key considerations for the wireless broadband masterplan

5.1 Enabling the wireless broadband end-to-end ecosystem

The key elements of the wireless broadband masterplan are to enable the end-to-end ecosystem which provides connectivity and content to consumers (Figure 7). While the focus of the masterplan is necessarily on the customer access networks, it examines key factors which are critical in facilitating broadband penetration in Myanmar:

- (i) policy and regulatory aspects including suggested introduction of competition (see section 5.2);
- (ii) attracting new investment to the sector (see section 5.3);
- (iii) technology aspects (see section 5.4);
- (iv) spectrum management aspects (see section 5.5);
- (v) international connectivity (see section 5.6);
- (vi) facilitating content and application (See section 6).

Figure 7: End-to-end broadband connectivity



Source: Author

5.2 Policy and regulatory aspects

Given the reliance on old legislation, there can be little debate that Myanmar should commit to legal/regulatory reform in the telecommunications sector in order to improve mobile service penetration and subsequently create an environment that is conducive to investment and uptake of wireless broadband services. Such reform would lay the groundwork for the growth of the MPT, and the possible entry of new operators in order to facilitate much needed investment in the sector.

This section explores the recommended changes to the Myanmar regulatory framework and new sector legislation.

5.2.1 The need for new legislation

The existing *Myanmar Telegraph Act 1885* and *Myanmar Wireless Telegraph Act 1934* are no longer relevant or conducive to the emergence of a modern communications system.²⁷

The importance of securing a modern legislative and regulatory framework will only increase as Myanmar continues to experience economic growth and integration with its regional and global counterparts.²⁸

²⁷ Even at the ministerial level, there is a case for signalling the change of approach by changing the ministry name from the Ministry of Communications, Posts and Telegraphs to either the Ministry of Communications or the Ministry of Communications and Multimedia or similar.

²⁸ Following the introduction of the new legislative arrangements, Myanmar, as a WTO Member, may wish to consider committing to the requirements of the 1997 WTO Agreement on Basic Telecommunications, which have since formed a benchmark of telecommunication regulation amongst Member States. Such a move would likely add additional clarity and transparency to the telecommunications framework and would further integrate Myanmar with the South Asia emerging economies.

5.2.2 The content of the new legislation

While a draft of the new sector legislation has been prepared it is worthwhile in this wireless broadband masterplan to outline the recommended form and content of a new statutory framework for the Myanmar telecommunication regime. There is also a need for the legislation to provide for the creation of a more independent telecommunication department (either the PTD or a successor organisation) as this will improve regulatory certainty and be consistent with global best practice.

Broadly speaking, the law should provide for at least the following areas.

- licensing;
- frequency / spectrum management;
- technical standards;
- consumer protection;
- competitive practices;
- universal service;
- access and interconnection / infrastructure sharing; and
- transitional arrangements.

Licensing

The licensing of operators and the determination of licence conditions is a fundamental component of sector regulation. A preliminary draft licence is attached as Appendix C. The licences must provide for the wholesale and retail of both facilities and services. Licensees should be able to enter into agreements with other licensees for access and interconnection to and from network facilities and services.

Telecommunication equipment/devices may be included within the definition of network facilities or form a separate category of licence.

General licence conditions ought to be specified in the law. This will ensure, *inter alia*, that the licensee abides by the radio spectrum policies and other applicable laws/regulations. The PTD should be granted the power to set and subsequently publish additional licence conditions, determine proper application procedures and set fees. It should also be granted the ability to monitor operator activities for compliance purposes.

Frequency / spectrum management

Given the current central role of wireless services in Myanmar's telecommunications environment and the fact that with increased voice and wireless broadband penetration wireless services will only increase in importance, a transparent and effective spectrum management framework is absolutely essential.

The PTD should be responsible for all aspects of spectrum management, including space services. A radio-license should be necessary to use spectrum in those frequency bands allocated to specific radio services (i.e. mobile telephony and broadband).

Technical standards

In addition to licence conditions, the PTD should set technical conditions for the operation of network facilities, services and devices to ensure harmony and compatibility with regional / global standards. Key functions and responsibilities of the ministry concerning technical standards should include:

- co-ordination, preparation and approval of technical telecommunication standards;
- co-ordination and communication with domestic and foreign organisations and institutions concerning technical telecommunication standards;
- developing and adopting a process for type approval of terminal equipment;
- testing the radiation of industrial, medical and scientific equipment and licensing for approval;
- establishing technical committees to facilitate the development of technical standards; and
- maintaining information on standards activities and a list of approved national standards.

Consumer protection

The legislation needs to mitigate issues relating to over-charging, poor quality service and the sharing of confidential information. These problems typically emerge to the detriment of end-users in situations where a telecommunication market is experiencing fast and sustained growth.

Licensees should submit tariff schemes to the PTD. In addition, subject to ministerial approval, the PTD ought to determine suitable consumer standards that shall apply to network service licences.

Competitive practices

If the government decides to allow the entry of new operators into the Myanmar market then new competition rules and/or regulations must be implemented in order to safeguard end-users and lay the foundations for an efficient and dynamic industry. Anti-competitive conduct for example, may result in the refusal to provide interconnection or access to infrastructure, discriminatory pricing or price fixing. The legislation optimally would prohibit anti-competitive conduct by licensees and the abuse of market power. The PTD should be able to issue competition rules and be able to direct the offender to cease the said conduct.

Universal service

In the past, universal service obligations have typically been applied to incumbent operators providing fixed-line telephony. In Myanmar's case, such an obligation is unlikely to facilitate further investment or an increase of teledensity. A universal service/coverage obligation should apply to service and facility licensees in order to encourage Capex and investment. When appropriate, the obligation could be expanded to encompass wireless broadband access.

Access and interconnection / infrastructure sharing

Interconnection/access to networks between the MPT and any new entrants would be essential to effective competition and the delivery of quality services to end-users. International experience shows that interconnection charges constitute a major portion of the operating costs of new entrants. As such, the effectiveness of new entrants in terms of competitive edge and commercial viability are very sensitive to the level of interconnection charges.

Interconnection policy is driven by the achievement of fair and equitable arrangements between operators. Access and interconnection shall be provided on an equitable and non-discriminatory basis and not be of a lower technical standard and quality relative to the licensee's own network facilities and services. The PTD should be mandated to approve any interconnection / access agreement between licensees.

Transitional arrangements

In the event that licences were issued prior to the new law coming into force, provision will be made to accommodate such arrangements made under the previous laws. This will aid clarity and reduce business uncertainty.

5.3 Attracting new investment to the sector

Given the well-established economic benefits of increased telecommunication and broadband penetration, there is a compelling case for Myanmar to quickly increase telephone penetration to support economic growth. As it stands, the state owned MPT is capital constrained and, even with innovative models, is highly unlikely to be able to commit to the substantial capital expenditure which is estimated to be certainly at least USD 1.5 billion and maybe greater than USD 2 billion in order to achieve the government's targeted telephone penetration of 45 per cent (with improved wireless broadband penetration).

Appendix D details a suggested two-stage process for introducing competition – with two new licensees preferred – in the Myanmar telecommunication sector, and generating significant one-off and on-going revenues for the national budget should such an approach be endorsed by government.

The allocation of licences and spectrum will likely provide substantial revenues for the Myanmar Government. If international precedent is followed, the government should expect anywhere between USD 300 to USD 500 million (or perhaps significantly more) for the initial licence allocations.

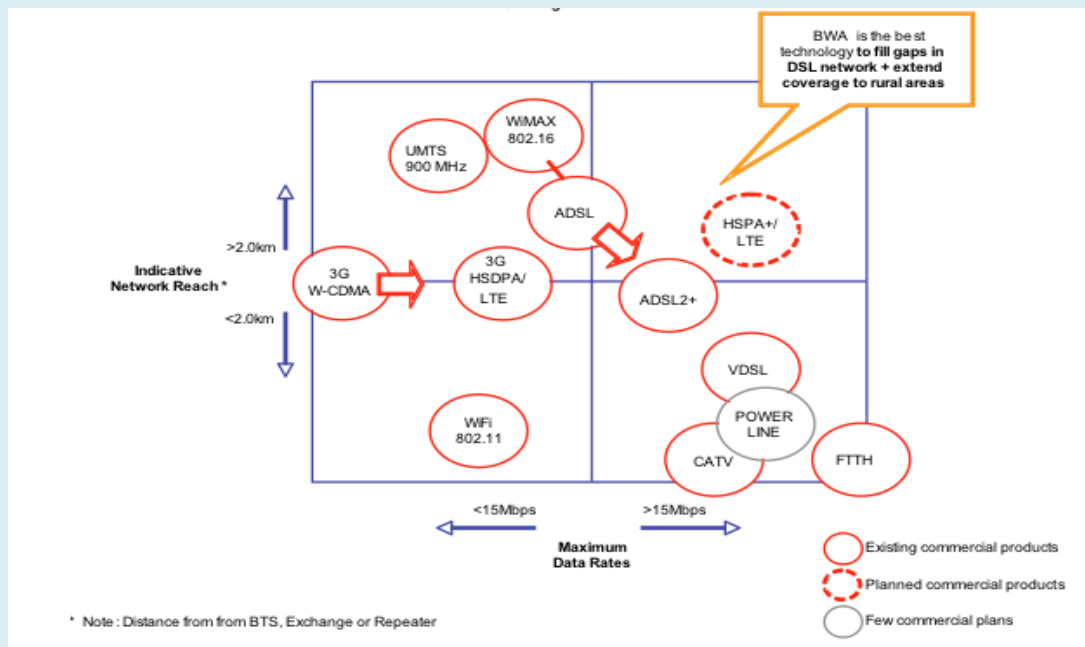
5.4 Technology aspects

While ITU advocates a technology-neutral approach, this does not mean that no particular mobile technology is preferred over another. What a technology-neutral approach does is to ensure that operators are not constrained to continuing supplying a particular service when cheaper and more efficient substitutes are available. When selecting a mobile technology and deploying it in a designated frequency band, it is important to consider whether the said technology is harmonised. Harmonised technology ensures interoperability and cheaper telecommunication equipment. This section will address the issues relating to technology harmonisation and canvas the major mobile technologies available for Myanmar.

The Myanmar Government ICT masterplan focuses on the expansion of telecommunication services without the specifying whether it has any preferred spectrum bands. The great benefit of lower spectrum ranges is increased propagation, which means broadband services are capable of reaching a larger geographic area and a higher number of people. This is particularly important for Myanmar, which will rely on the greater range achieved by lower frequencies to ensure maximum coverage (See comparison in Figure 8).

The government could exploit the technological benefits of the lower frequency bands as much as possible (e.g. including the 700 MHz and 1800 MHz bands) for the deployment of LTE technology. This will ensure that the country has the capacity to take advantage of 4G broadband services and the growth that is expected to take place in this area. In the following sections we examine GSM, W-CDMA, LTE, WiMAX, wireless offload and satellite technologies.

Figure 8: A comparison of different access technologies



Source: Author

5.4.1 GSM and W-CDMA

GSM

Myanmar's key wireless services operate on a range of bands reflecting either vendor support or other factors. Spectrum allocations are consistent with the majority of countries worldwide (GSM operates mainly on 900 and 1800 frequency bands, and CDMA in 450 MHz).

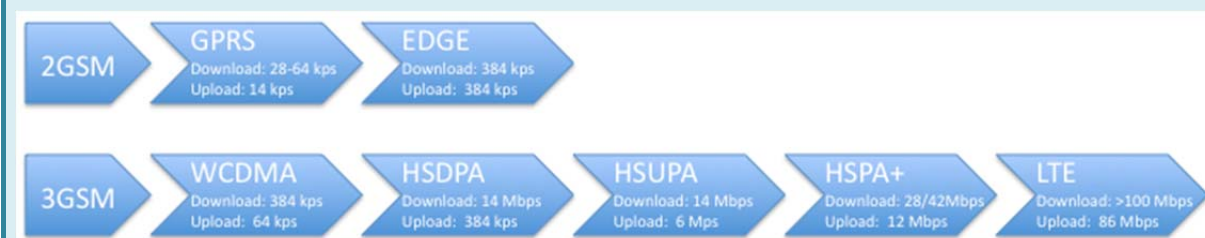
In the transition from 2G to 3G a number of standards have been developed, which are categorized as 2.5G. These are add-ons to the 2G standards and mainly focus on deployment of efficient IP connectivity within the mobile networks. Data access is provided by General Packet Radio Service (GPRS) and offers throughput rates of up to 40 kbit/s. As of Q2 2010, there were over 4.42 billion GSM subscriptions.²⁹

W-CDMA/HSPA

W-CDMA is the access scheme defined by ITU to be the main technical platform for UMTS or third generation mobile services. W-CDMA services are to operate within the following frequency bands: 1920 MHz – 1980 MHz and 2110 MHz – 2170 MHz. ITU had selected W-CDMA as one of the global telecom systems for the new IMT-2000 3G mobile communications standard. In W-CDMA interface, different users can simultaneously transmit at different data rates and data rates can even vary in time. W-CDMA is capable of delivering up to 384 kbit/s in outdoor environments and up to 2 Mbit/s in fixed indoor environment. W-CDMA is currently at release 9.

High Speed Packet Access (HSPA) is a set of technologies that allow W-CDMA operators to run their networks at broadband speeds. Peak downlink and uplink throughput is at 14.4 and 5.7 Mbit/s, respectively. HSPA+, which harnesses MIMO (multiple in, multiple out) enables peak data rates of up to 42 Mbit/s. The roadmap for wireless technology evolution from GSM to W-CDMA to LTE services is shown in Figure 9.

Figure 9: Wireless technology roadmap



Source: Ericsson and Qualcomm, 2009.

As of January 2012, there are reportedly 241 HSPA+ network commitments with 187 HSPA+ networks having been launched. Total subscribers amount to 822.4 million (including 469 million HSPA subscribers).³⁰

As case studies show (see Box 2), the cost of 3G coverage with UMTS900 can save operators between 50 to 70 per cent of mobile network costs (including Capex and Opex) versus UMTS2100, and it can more cost effectively provide 3G and mobile broadband services in rural and regional areas. There is also an added benefit of improved indoor coverage.

²⁹ www.gsacom.com/downloads/charts/GSM_market_share_global.php4

³⁰ www.gsacom.com/news/gsa_fastfacts.php4

Using the existing GSM infrastructure makes sense to achieve a rapid transition to widespread wireless broadband in Myanmar. The Myanmar Government has indicated, via the current tender process that it is willing to take a technology neutral approach and permit the use of GSM band to provision W-CDMA at 900 MHz.

Box 2: Case study: Optus UMTS900 network

In 2008, Australian carrier Optus launched the world's largest UMTS900 network. With almost 1 000 base stations, the network covers over 96 per cent of the population.

Given Australia's population distribution, fixed broadband penetration is relatively low and demand for wireless broadband high. Optus recognised this as an opportunity to compete with Telstra's national coverage and decided to expand its 3G network to enable high-speed data services. Optus had launched a UMTS2100 network in 2005, but UMTS900 was recognised as more cost effective for rural areas.

Deployment

Recognising the potential of UMTS900 to economically extend coverage to low-density areas, the regulator (ACMA) quickly approved the deployment.

From a strategic perspective, Optus chose to focus on areas where GSM usage was lower. It used its existing network infrastructure, overlaying coverage on existing 2G base stations and in urban areas, co-locating with UMTS2100.

Results

The use of UMTS900 technology enabled Optus to deliver a better quality network at a lower cost, with each base station covering a greater geographical area than UMTS2100 due to reduced path-loss. Using UMTS2100 to achieve the same coverage outcomes would have cost at least AUD 800 million. With UMTS900, capital expenditure was reduced to less than AUD 500 million.

In addition, the deployment delivered unexpected benefits to the 2G service. When re-farming the 900MHz spectrum, Optus' focus on site optimisation led to increased 2G performance in some cases.

The only barrier to further success noted by Optus was handset availability: at December 2008, just 7 of 34 of Optus handsets were compatible with UMTS900 but the operator has plans to increase this number.

5.4.2 LTE

LTE is the latest standard in the mobile network technology evolution that follows from the GSM/EDGE and UMTS/HSxPA network technologies. It is a project of the 3rd Generation Partnership Project (3GPP).³¹ The current LTE specification Release 9 provides downlink peak rates of at least 100 Mbit/s, an uplink of at least 50 Mbit/s. LTE supports scalable carrier bandwidths, from 1.4 MHz to 20 MHz and supports both frequency division duplexing (FDD) and time division duplexing (TDD). The next step for LTE evolution is LTE Advanced and is currently being standardized in 3GPP Release 10.

³¹ The 3rd Generation Partnership Project (3GPP) is collaboration between groups of telecommunications associations, to make a globally applicable third generation 3G mobile phone system specifications within the scope of the IMT-2000 project of ITU. 3GPP specifications are based on evolved GSM specifications. 3GPP standardization encompasses Radio, Core Network and Service architecture. See www.3gpp.org and for LTE specifically see www.3gpp.org/article/lte

In October 2010, ITU accepted and officially designated LTE-Advanced as an IMT-Advanced (4G) technology, while the 3GPP published Release 10 of the LTE standard in March 2011 and has frozen the set of features for LTE Advanced.³² One of the major reasons for aligning LTE with the call for IMT-Advanced is that IMT conforming systems were candidates for the spectrum bands identified at WRC07. Such moves made LTE a truly global standard compared with the fragmentation of earlier wireless standards. Commercialisation of LTE-Advanced systems are expected in the 2014-15 timeframe.

In January 2012, ITU confirmed the status of LTE-Advanced and Wireless MAN-Advanced technologies were both granted IMT-Advanced Technology status by ITU (See Box 3).

Box 3: ITU announcement on 4G technology

In January 2012, LTE-Advanced and Wireless MAN-Advanced technologies were both granted IMT-Advanced Technology status by ITU. After undergoing evaluation by ITU and meeting the specification requirements, the technologies are now officially accorded 4G status.³³

ITU is responsible for setting mobile technology standards worldwide. The approval signifies the next stage in the evolution of LTE, which is set to deliver vast improvements in speed and efficiency.

The new technology will be significantly faster than 3G, with speeds above 100 Mbit/s. It will also make more efficient use of radio-frequency spectrum, meaning higher data transfers will be possible with a lower bandwidth requirement. The new technology will facilitate the growing demand for data transfer over mobile networks.

According to the GSA, as of January 2012 there are 226 LTE network commitments in 76 countries and 59 pre-commitment trials. There were approximately 3.6 million subscriptions at this time. By 2015, an expected 744.2 million will subscribe to LTE.³⁴

5.4.3 WiMAX

WiMAX is the popular name of IEEE802.16 standard. It serves as both a fixed and wireless access technology. Coverage of 50 km and capacity of around 70 Mbit/s is a reality with this technology. It is, however, important to note that the capacity offered over long distances is only a fraction of the maximum capacity, and WiMAX as access technology is offered in distances of 5 to 10 km. WiMAX is thought of by some as a good complementary / competitive infrastructure to traditional broadband. Another important aspect is that 70 Mbit/s will only be achieved if frequency bandwidth of 20 MHz is allocated and assigned by the local authorities. Many regulators will probably assign smaller frequency bands to the potential WiMAX operators. A competing technology to the mobile version of WiMAX (IEEE.802.16e) is LTE.

By mid-2011, global subscribers (including fixed WiMAX) were said to number approximately 20 million. 59 million mobile WiMAX subscribers are expected by 2015.³⁵

³² 3GPP is setting the Release 11 requirements in 2011 with its completion scheduled for late 2012.

³³ ITU, 'IMT-Advanced standards announced for next-generation mobile technology', media release, 18 January 2012

³⁴ www.gsacom.com/news/gsa_fastfacts.php4 and www.electronics-eetimes.com/en/lte-subscribers-to-account-for-10-percent-share-by-2015.html?cmp_id=7&news_id=222910064

³⁵ www.fiercewireless.com/story/wimax-forum-trumpets-20m-global-subscribers/2011-08-17 & <http://www.eweek.com/c/a/Enterprise-Networking/Mobile-WiMax-Subscribers-to-Reach-59-Million-by-2015-Report-442841/>

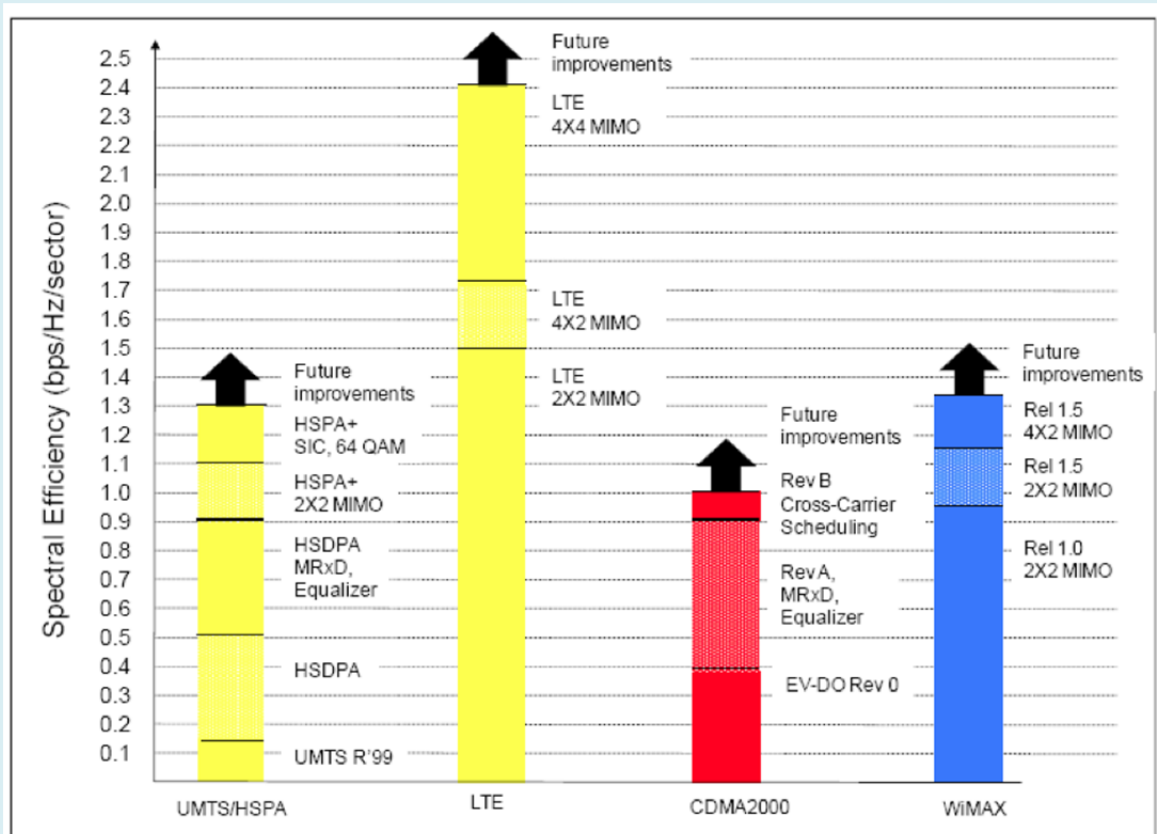
5.4.4 Why LTE is the recommended technology following 3G/W-CDMA?

LTE is acknowledged as the next step for a superior mobile broadband experience, targeting capacity and data rate enhancements to support new services and features requiring higher levels of capability and performance. LTE will enhance more demanding applications such as interactive TV, mobile video blogging, advanced games and professional services with significantly higher uplink and downlink data rates, supported by the necessary network architecture and technology enhancements.

Most importantly as shown in Figure 10, LTE is more spectral efficient than other air interface technologies. As such, LTE reduces the cost per GB delivered which is essential for addressing the mass market, and supports a full IP based network and harmonisation with other radio access technologies.

In a survey of major operators, the great majority (some 88 per cent) indicated that they were already considering LTE upgrades for their next generation networks, with likely deployments in 2011 and beyond. This is consistent with the fact that LTE has had rapid global acceptance with 49 commercial LTE networks having been launched in 29 countries, some 226 operators in 76 countries are investing in LTE and there are 59 pre-commitment trials in 17 more countries. It is also expected that at least 119 LTE networks will be in commercial service in 53 countries by the end of 2012.³⁶

Figure 10: Summary of downlink spectral efficiencies for various air interfaces and antenna schemes



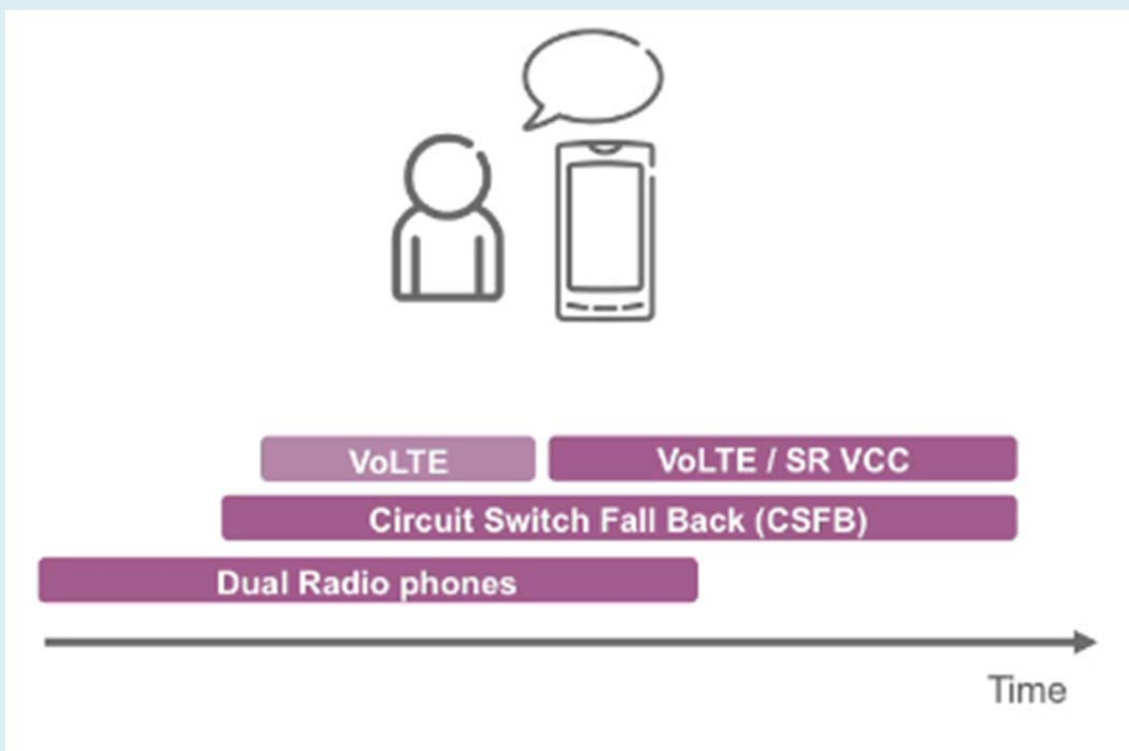
Source: 3G Americas, *MIMO and Smart Antennas for 3G and 4G Wireless systems, Practical Aspects and Deployment Considerations*, May 2010, page 58

³⁶ GSA, *GSM/3G Market/Technology Update*, 5 January 2012.

A possible complication in relation to voice over LTE seems to have been resolved with the first VoLTE call on commercial network (namely Verizon) in the world occurring in February 2011. It is expected that VoLTE should be widely available globally in 2012.

More broadly, there are a number of steps to provide optimal voice services on LTE networks and devices. Firstly, the current approach is to use dual radiophones that utilise the 2G networks in the mobile phone for all voice calls. Secondly, voice calls will be provided over LTE with circuit switch fall back (CSFB) to the 2G networks where necessary (e.g. no coverage). Lastly the ultimate approach will be to adopt Single Radio Voice Call Continuity (SRVCC) for VoLTE, which uses an IP Multimedia Subsystem (IMS) system for call anchoring and handover and is based on a third party call control mechanism. This allows a mobile phone with an on-going voice call to transition to the circuit-switch domain in the event of loss of LTE coverage. An IMS-based SRVCC provides QoS control, flexible charging, and better user experience. The options for addressing voice on LTE networks are detailed in Figure 11.

Figure 11: Options for addressing voice on LTE



Source: Informa Telecoms & Media and Ericsson, *LTE Early Launch Strategies: Who and Why? Webinar*, 21 June 2011

5.4.5 Wireless offloading

As wireless data and broadband services grow in Myanmar the PTD should safeguard the quality of wireless services by encouraging operators that adopt network offloading techniques. These include Wi-Fi offloading, Femtocell deployment, smart repeaters and distributed antenna systems. Network offloading should be facilitated by PTD policy as it alleviates capacity constraints, and is a sensible allocation of spectrum resources. Specifically, the ability to utilise open access spectrum (such as 2.4 and 5 GHz) to support those small number of cell sites/locations which face congestion has considerable merit. An analysis of the potential use of off-loading techniques should form part of the needs and valuation models for additional spectrum.

5.4.6 The role for satellite

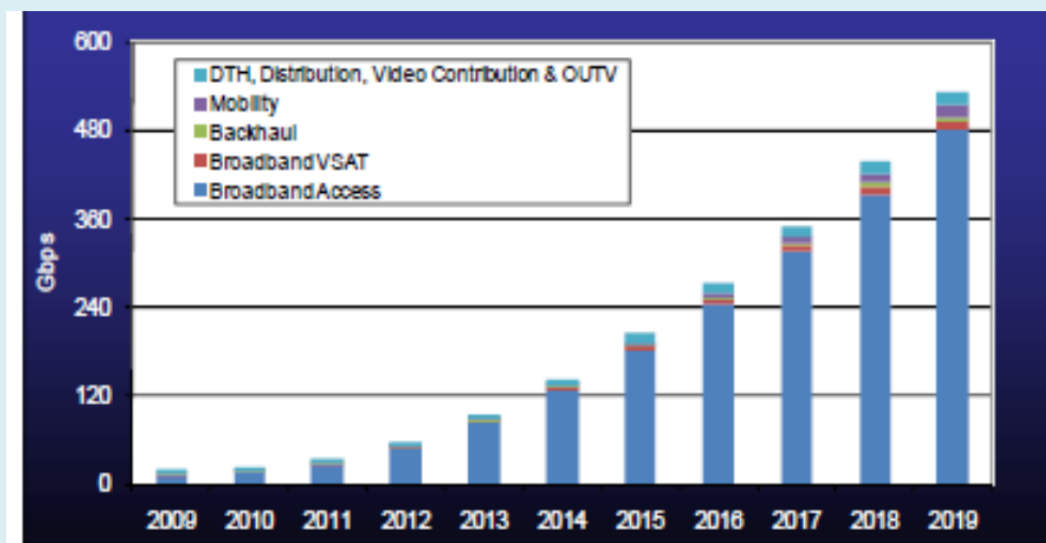
Satellites are a valuable part of the broadband infrastructure strategy. They are able to provide ubiquitous connectivity and are very well suited for areas which are either underserved or unserved by terrestrial networks. They are able to augment and combine with terrestrial network and once launched can accelerate the availability of high-speed Internet services in such areas. As an added bonus, satellite communication does not have any last mile issues and can provide a high degree of reliability in the event of disasters etc.

There has also been recent technological innovation in relation to satellite technology, similar in a way to wireless broadband communications. The new generation of satellite broadband systems known as 'HTS' (High Throughput Satellite) have a number of new features:

- spot beam technology, where switchable beams illuminate much smaller areas (100s of km² instead of 1000 km²);
- beam coverage forms a honeycomb / cellular pattern with frequency reuse;
- this concept of frequency reuse drastically increases overall capacity;
- use of Ka band leads to smaller antenna dishes; and
- satellite broadband services with frequency reuse, faster speeds and smaller dish antennas in Ka band drive down the costs to a much lower level.

HTS demand is likely to exceed 530 Gbit/s by 2019 (Figure 12). Core HTS applications include satellite broadband access, broadband VSAT backhaul and mobility.

Figure 12: Global HTS bandwidth demand by application



Source: www.nsr.com/

5.5 Spectrum management aspects

5.5.1 Background

ITU has been a driving force for over two decades for the development of global broadband mobile telecommunication system. International Mobile Telecommunications (IMT), supported by fixed telecommunication networks (e.g. PSTN/Internet) provides access by means of one or more radio links to a wide range of telecommunication services.

IMT is the generic ITU name for 3G/4G technologies. Radio spectrum below 1 GHz is optimum for the needs of developing countries, due to the ability to serve larger rural areas from a single cell site compared to spectrum above 2 GHz. The 2007 World Radio Conference made valuable strides in identifying additional spectrum for IMT, both below 1GHz and above 2 GHz.

The concept of identifying spectrum for potential use by IMT, in the ITU Radio Regulations, gives global equipment manufacturers some guidance on the range of frequency bands in which IMT services are likely to be deployed, leading to economies of scale and minimizing product costs. The identification “for those administrations wishing to deploy IMT” allows use by other services to which the spectrum is allocated and does not convey any priority for IMT over those other radio-based services. Appendix F details those IMT allocated bands.

IMT-Advanced provides a global platform on which to build the next generations of mobile services – fast data access, unified messaging and broadband multimedia – in the form of exciting new interactive services and applications. New studies/techniques are leading to increased spectrum utilization and spectrum efficiency and allowing spectrum resources to be shared between users. Those objectives are detailed in Box 4.

Box 4: Objectives for the efficient management of spectrum

Efficient management of the radio spectrum is a key component for the promotion of broadband access. In planning the implementation of IMT, the following objectives are desirable:

- to ensure that frequency arrangements for the implementation of IMT have longevity, yet allow for the evolution of technology;
- to facilitate the deployment of IMT, subject to market considerations and to facilitate the development and growth of IMT;
- to minimize the impact on other systems and services within, and adjacent to, the bands identified for IMT;
- to facilitate worldwide roaming of IMT terminals;
- to integrate efficiently the terrestrial and satellite components of IMT;
- to optimize the efficiency of spectrum utilization within the bands identified for IMT;
- to enable the possibility of competition;
- to facilitate the deployment and use of IMT, including fixed and other special applications in developing countries and in sparsely populated areas;
- to accommodate various types of traffic and traffic mixes;
- to facilitate the continuing worldwide development of equipment standards;
- to facilitate access to services globally within the framework of IMT;
- to minimize terminal costs, size and power consumption, where appropriate and consistent with other requirements;
- to facilitate the evolution of pre-IMT-2000 systems to any of the IMT terrestrial radio interfaces and to facilitate the on-going evolution of the IMT systems themselves;
- to afford flexibility to administrations, as the identification of several bands for IMT allows administrations to choose the best band or parts of bands for their circumstances;
- to facilitate determination, at a national level, of how much spectrum to make available for IMT from within the identified bands;
- to facilitate determination of the timing of availability and use of the bands identified for IMT, in order to meet particular user demand and other national considerations;

- to facilitate development of transition plans tailored to the evolution of existing systems;
- to have the ability for the identified bands, based on national utilization plans, to be used by all services having allocations in those bands;
- to enforce licensing conditions and adherence to licensed technical parameters; and
- to effect cross border coordination to eliminate / mitigate cross border interference situations.

5.5.2 Spectrum needs and frequency arrangements based on technology selection

Rec. ITU-R M.1768 contains the methodology for calculation of spectrum requirements for the future development of the terrestrial component of IMT-2000 and systems beyond IMT-2000. This generic methodology can be used for differing market for a range of cellular system architectures. Specifically, the technical process of estimating spectrum requirements for mobile communications has to be based on four essential issues namely:

1. definition of services;
2. market expectations;
3. technical and operational framework; and
4. spectrum calculation algorithm.

In the case of Myanmar, it is difficult to independently forecast the likely demand for wireless and WBB services with any certainty given:

- the current underdeveloped state of cellular mobile and broadband (including wireless broadband) markets;
- the lack of reliable statistics (e.g. in relation to income distribution etc.); and most importantly
- the fact that government decisions on the industry structure that will be adopted remain to be seen.

In such circumstances the key rollout target which needs to be catered for from a spectrum perspective is detailed in the Myanmar ICT masterplan. The ICT masterplan objective is to achieve a mobile teledensity of 45 per cent (i.e. 30 million subscribers).

Consistent with Appendix D,³⁷ to support this number of mobile subscribers and traffic, the aggregate total of spectrum allocated to wireless services should rise from its current very low level of 150 MHz to approximately 418 MHz in 2015.³⁸ Such an increase in spectrum allocations to wireless services can be easily accommodated in Myanmar. Furthermore, if mobile services growth in Myanmar is faster than predicted it is still possible to bring forward the allocation of additional 2100 MHz to 2015 (currently scheduled for 2018). This flexibility provides a 'spectrum insurance' for Myanmar.

³⁷ Even if the government does not support the introduction of telecommunications competition as detailed in Appendix D, additional spectrum is likely to be required by the MPT to meet the government's ambitious 2015 teledensity and rollout targets.

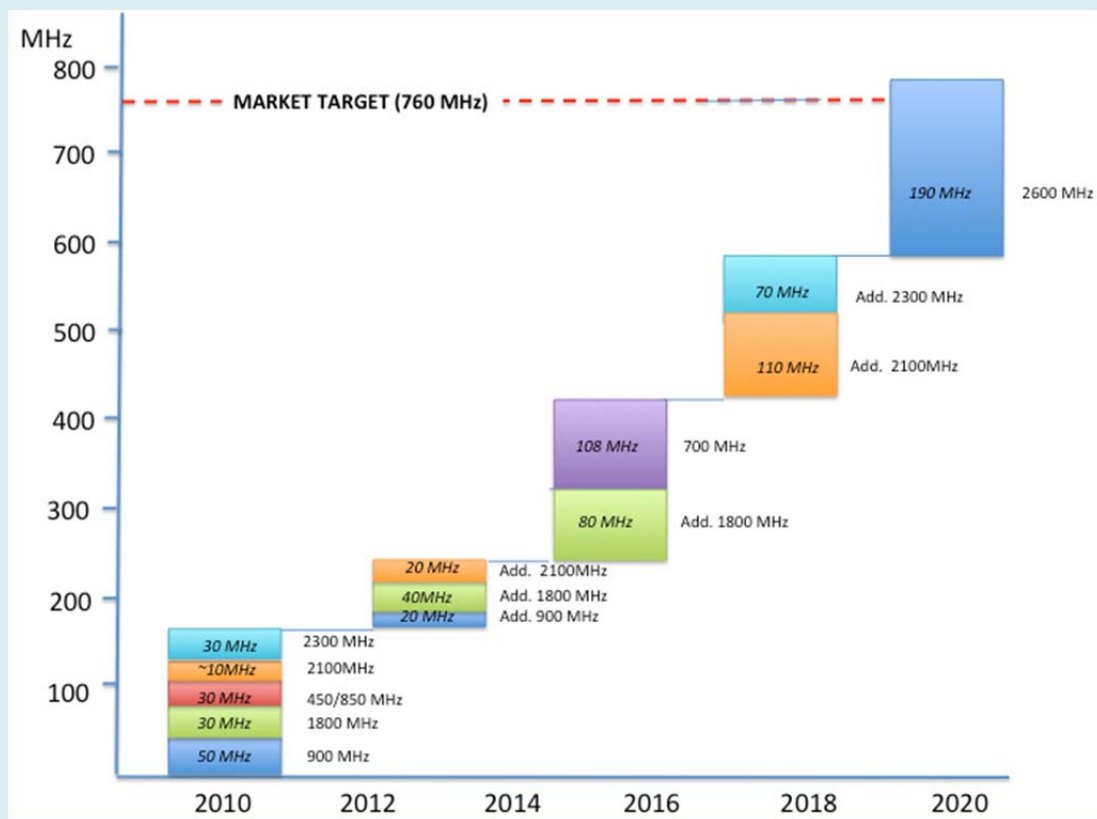
³⁸ This proposed spectrum allocation could be checked against the situation in Viet Nam which represents the fastest cellular mobile growth in the region (e.g. connections in 2005 rose from 10.5 million to 132.8 million in 2010), a figure over 11 times the 2005 starting penetration figure. This was been done utilizing an aggregate wireless spectrum allocation of approximately 390 MHz. Only now is the aggregate total of spectrum being allocated to wireless services being increased (e.g. in relation to the 2.3 and 2.6 GHz bands).

Importantly, the majority of the allocations can occur at lower spectrum bands below 2 GHz (especially below 1 GHz). This will mean a faster deployment with greater coverage in Myanmar. It should also mean more affordable services. The additional spectrum to be allocated and assigned from now until 2015 is detailed in Figure 13.

For the longer term up to 2020, this wireless broadband masterplan prefers an approach of using the overall spectrum requirements in a manner consistent with ITU-R Report M.2078 (2006).³⁹ In the case of Myanmar, on balance, the aggregate target for spectrum to be allocated to wireless services ought be the smaller market target⁴⁰ of 760 MHz of spectrum (Figure 13).

Ideally this would comprise the 450, 700, 900, 1800 and 2100 MHz allocations. It is likely that only in the 2018+ period that the 2.3 and 2.6 GHz band will be required. Having said, that given deployments of 2.3 GHz TD-LTE networks in Myanmar’s neighbours of China and India, there could be earlier demand for this spectrum band for TD-LTE.

Figure 13: Recommended aggregate spectrum allocations to wireless services up to 2020



Source: Author

³⁹ See ITU-R Report M.2078 *Estimated spectrum bandwidth requirements for the future development of IMT-2000 and IMT-Advanced*, 2007.

⁴⁰ This is due to its current level of development. Should the country experience rapid economic growth then this figure could be reviewed in 2015.

In terms of the best practice approach, ideally the Myanmar Government and the PTD should adhere to the ITU Global Symposium for Regulators 2005 Best Practice Guidelines for Spectrum Management to Promote Broadband Access when allocating spectrum for wireless broadband. Table 5 details a condensed form of these Guidelines.

Table 5: ITU GSR best practice guidelines for spectrum management⁴¹

No	Guideline objectives	Key Provisions
1.	Facilitate the deployment of innovative broadband services and technologies	<ul style="list-style-type: none"> • Reduce unnecessary restrictions on spectrum use • Adopt harmonised frequency plans defined by ITU-R recommendations⁴² • Reduce or remove regulatory barriers to market entry • Ensure operators have access to as wide a choice as possible for spectrum
2.	Promote transparent and non-discriminatory spectrum management policies	<ul style="list-style-type: none"> • Consult widely and publicly • Implement stable decision making processes • Publish forecasts of spectrum usage and allocation needs • Publish frequency allocation plans and overview of assigned spectrum • Clearly define and implement stable and predictable spectrum authorisation rules and decision-making processes and procedures
3	Embrace technology neutrality	<ul style="list-style-type: none"> • Facilitate spectrum use for fixed and mobile services • Provide guidelines to mitigate inter-operator interference • Adapt to technological convergence and avoid picking winners
4	Adopt flexible use measures for wireless broadband services	<ul style="list-style-type: none"> • Avoid onerous rollout and coverage obligations • Licence conditions that allow operators to provide a full range of converged services • Provide incentives for smaller new operators to deploy infrastructure at low cost • Adopt lighter regulation for rural and isolated areas • Allow secondary spectrum trading • Promote spectrum sharing
5	Ensure affordability	<ul style="list-style-type: none"> • Set reasonable spectrum fees • Design tender or auction processes to ensure affordability of services
6.	Optimise spectrum availability	<ul style="list-style-type: none"> • Facilitate the effective and timely access to spectrum • Spectrum pricing should not be pushed up due to restrictive supply • Accommodate new and emerging technologies
7.	Manage spectrum efficiently	<ul style="list-style-type: none"> • Ensure reliance on market forces, economic incentives and technical innovation • Allocate spectrum in an economically efficient manner • Promote and encourage usage of spectrum efficient technologies

⁴¹ www.itu.int/ITU-D/treg/bestpractices.html

⁴² Refer to the list of ITU-R Recommendations on IMT at www.itu.int/ITU-R/index.asp?category=information&rlink=imt-advanced-rec&lang=en. Harmonised frequency plans are contained in ITU-R Recommendation M.1036-4 (March 2012).

No	Guideline objectives	Key Provisions
8.	Ensure a level playing field	<ul style="list-style-type: none"> Prevent spectrum hoarding: regulators should set a maximum limit to the amount of spectrum one operator may obtain
9.	Harmonise regional and international standards and practices	<ul style="list-style-type: none"> Reflect global technical and security standards in national arrangements Ensure inter-operability for global roaming Implement policies and allocations that are consistent with regional and global best practice and standards
10.	Adopt a broad approach to promote access	<ul style="list-style-type: none"> Introduce supporting regulatory measures such as competitive safeguards, open access and universal service incentives Lower or remove import duties on broadband wireless access equipment Coordinate spectrum management policy and practice with other regulatory instruments (i.e. competition and trade policy, universal service measures etc.)

Source: ITU, GSR 2005 Best Practice Guidelines for Spectrum Management to Promote Broadband Access, www.itu.int/bestpractices

5.6 Additional connectivity aspects

As SEA-ME-WE 3 (see www.seamewe3.com) is currently the only international submarine cable system reaching Myanmar, landing at the Pyapon Cable Landing Station in Myanmar, further work and investment will need to be made to ensure sufficient and affordable international capacity is available to support wireless broadband demand in Myanmar.

The quickest and most immediate way this could be done is to connect to the SEA-ME-WE 4 (www.seamewe4.com) cable system at Cox's Bazar in Bangladesh. In the longer term, there will be need to ensure low cost, low latency, high speed long term international connectivity for the country.

6. Facilitating applications and content

6.1 Stimulating the content sector in emerging economies

It is arguable that there is a circular relationship between applications/content and broadband uptake. The higher the penetration of broadband services, the more data /content rich applications consumers demand; whilst the more attractive and relevant applications / content are, the more consumers will demand broadband in order to participate in those markets.

Naturally, given Myanmar's very low Internet penetration, policy makers should attempt to first address that problem before setting out to stimulate content in a drive to increase broadband uptake. There are a number of means through which the government can intervene in order to create an enabling environment for content production industries and ultimately drive demand for their services.

6.1.1 Educate content entrepreneurs

Governments can work to stimulate the domestic content sector by educating their national ICT workforce with the set of skills and outlook that are necessary for the requisite innovation and technical expertise required for the market to expand.

New courses at existing technical/educational institutions may be developed so as to encompass issues associated with applications/content. It may be necessary for the government to train teachers/trainers with a range of input skills for content production (e.g. graphic design, animation, information

technology). An example from Australia is shown in Box 5. Overseas expertise may need to be harnessed for the training of a skilled and dynamic workforce in areas such as management, finance and creative process development.

Box 5: Digital media courses at the Australian Film Television and Radio School⁴³

The Australian Film Television and Radio School (AFTRS) offers a number of specialist postgraduate courses within the digital media field of study.

A Graduate Certificate in 3D Animation provides “a comprehensive, specialist course designed to develop the professional skills of digital artists through production-focused learning... [and] course provides a thorough grounding in the art of 3D animation using AutoDesk Maya software. The course offers a number of modules aimed at giving students a grounding in both the technical and business side of the 3D animation sector:

- 3D Graphics Fundamentals;
- Character Animation Foundations;
- Collaborative;
- Creative Research;
- Industry Brief;
- Introduction to Running Your Own Creative Business; and
- Key Figures in Animation

...”

The government should also be open to obtaining overseas assistance in developing appropriate competency/skill measures and standards/certification.

6.1.2 Subsidise content production

In order to improve the supply of content, financial tools such as direct outlays and tax measures may be employed by the government. Each tool possesses unique policy design issues that must be properly addressed prior to implementation.

6.1.3 Regulatory options

Regulatory measures provide the means to stimulate content production with relatively low direct costs to governments. For example, local content rules may provide a domestic content quota – in Australia, this was a key driver behind the early development of content production.

As discussed in section 6.1.2, policy design issues, such as the location on the value chain where the intervention occurs and preferences for the type of content development will need to be considered.

⁴³ See www.aftrs.edu.au

6.1.4 Direct government action and leadership

Governments can take the lead to develop and deploy online/wireless services. If there exists good access to bandwidth and devices, online and wireless delivery can be a highly cost effective to provide information about government services and some of the services themselves in a much more equitable manner. Initiatives should not be limited to national governments: regional and local government can provide important and useful information to local residents and businesses.

Rewards / recognition is also suggested for areas related to rural communications development, content / applications development and 'broadband readiness' disclosures for residential and commercial developments.

6.2 The prevailing environment in Myanmar

The first computer ever bought and used in Myanmar was IBM's PDB-11 mainframe at UCC (Universities Computer Center) in January 1979, and the first computer company in Myanmar, Myanmar Computer Company (MCC), was founded in April 1989. This was followed by the first official e-mail service in Myanmar, which was launched in November 1997 by MPT. The first public WWW access was launched in 1998 by Business Online as www.bol.com.mm.

6.2.1 Local developments in ICT

The more significant ICT-related developments in Myanmar have included the completion of the first phase of the Yatanarpon cyber city, as well as the opening of the Myanmar ICT Park together with the Bagan International Data Communication Center and Teleport in January 2001. These have widely been considered to be an indication of the government's commitment to ICT development and a clear invitation to the international ICT community to invest in Myanmar. The establishment of the government fibre network linking all ministries and head offices of government agencies, and a data centre housing servers for all ministries, is also considered a significant ICT development in Myanmar.

MPT is considered the leader in providing email, web-hosting, web-browsing, server co-location, FTP, intranet services etc. Similarly, Bagan Cybertech established in 2000 is the biggest ISP in Myanmar. It is a virtual private network service and provides internet services to the general public via dial-up access. It launched its broadband wireless local loop (WLL) services in April 2002. The first private company named Redlink Communications was established in 2008 which launched portal site named as www.enjoy.net.mm. It provides a full range of data communication services across an integrated network infrastructure jointly cooperated with Yatanarpon teleport under the MPT.

6.2.2 Myanmar character code

The first Myanmar font was developed in 1988 for the GUI Environment (Mac) and the standardisation of the Myanmar character code set was approved in that year. Currently there are three types of fonts in use in Myanmar: ASCII-based fonts, partial Unicode fonts, and Unicode (Open Type) fonts. Some Myanmar script extension and minority languages were approved by the Unicode Consortium and published in Unicode Standard 5.1, however the implementation of the script has been delayed due to its complexity and the lack of uniscribe support in Microsoft operating systems. Despite this, the Myanmar Unicode and Natural Language Processing (NLP) Research Centre has successfully developed the Myanmar1 Unicode font according to Unicode Standards 4.1 and Myanmar3 Unicode font according to Unicode Standards 5.1.

6.2.3 Development of local content

Websites in Myanmar with local content include the major Internet-based news services like

- Eleven Media group (www.news-eleven.com/),
- Khit Lu Nge (www.khitlunge.net.mm), and MRTV-3 (www.mrtv3.net.mm/).

Entertainment websites include

- Myanmar football portal website Soccer Myanmar (www.soccermyanmar.com/),
- Myanmar Goal (<http://myanmargol.com/>) and
- Mtalk, (www.mtalk.net.mm/).

In the context of e-commerce,

- websites with business information (www.etrademyanmar.com.mm) (Box 6), and
- information about shopping centres (www.myanmarshopping.com/) are also prevalent in local content.

Box 6: eTrade Myanmar⁴⁴

eTrade Myanmar was established in January 2003 as business information and SMS content provider in Myanmar. Over 200 business websites and some other popular journals such as First Eleven, Premier Eleven, International Eleven, Weekly Eleven, Snap shot and Zaygwet, as well as government related websites have been designed, hosted and developed by eTrade Myanmar. It is also an internet content services provider for domain names and provides businesses with information ranging from foreign exchange rates to sporting commentary. It also provides a full suite of SMS services.

Government ministries and departments have websites with details of policies, speeches, laws, regulations, manuals, forms, and other information regarding each agency. These include the Ministry of Commerce (www.commerce.gov.mm/), the Ministry of Energy (www.energy.gov.mm/), and the Ministry of Communications, Post and Telegraphs (www.mcpt.gov.mm/).

The goal of e-education and awareness in Myanmar is to achieve an inclusive e-Myanmar society in which everyone has access to information services. The Myanmar Government aims to ensure that every child leaving school should be familiar with computers and be scientifically literate. The government is collaborating with the private sector and local communities to establish multimedia classrooms and small computer laboratories in high schools. Furthermore, IT learning centres, electronic resource centres and computer training centres are also being set up in colleges and universities. The Ministry of Education is developing an educational Intranet system linking all universities and colleges. It has also launched, in cooperation with the Ministry of Information, a data broadcasting system for distance education, with more than 150 learning centres established in various colleges, universities and institutes, and multimedia high schools.

Myanmar's commitment to ICT development is apparent in the establishment of the Yatanarpon cyber city, the government fibre network and e-government projects, computer universities in regional areas, public access centres in rural areas, and efforts at localisation.⁴⁵

⁴⁴ See www.etrademyanmar.com.mm/About/AboutUs.aspx

⁴⁵ www.digital-review.org/uploads/files/pdf/2009-2010/chap-32_myanmar.pdf

7. Conclusions and recommendations

7.1 Overview

Globally, the early stages of the mobile broadband revolution occurred in 2006/07 as key enablers, primarily around technology, began to converge. These enablers will continue to drive rapid adoption and market share gains of wireless broadband from fixed technologies, such as DSL. As indicated by the US Federal Communications Commission (FCC) broadband wireless services are having profound economic and social consequences even in developed country markets:

“Wireless mobility has become central to the economic, civic, and social lives of ... [our citizens]. We are now in the midst of a transition from reliance on mobile voice services to increasing use of and reliance on mobile broadband services, which promise to connect [our] citizens in new and deeper ways ... [the] mobile wireless market will be essential to realizing the full benefits to ... consumers and channeling investment toward vitally important national infrastructure. A vibrant mobile wireless market is also essential to driving innovation, not only within the mobile market itself, but also in markets – current and future – for which wireless mobility is a key enabler.”⁴⁶

For Myanmar, the opportunity from embracing wireless services including wireless broadband are profound. Wireless broadband – provided along with high speed international capacity – offers the promise of early economic, social and environmental benefits for Myanmar and its people.

Although technology neutrality is, and ought to be, a widely accepted principle for the efficient allocation of spectrum, the deployment of W-CDMA and LTE wireless technology with the capability of reaching the highest number of people should be seen as a priority for Myanmar and is endorsed under this wireless broadband masterplan.

In the case of Myanmar, arguably one of the last and certainly the largest wireless ‘greenfields’ market globally there are considerable economic and social opportunities for the country should it decide to ‘go wireless’.

This wireless broadband masterplan strongly supports the introduction of sector competition with the licensing of two cellular mobile competitors to the MPT and a substantial increase in the spectrum allocated to wireless broadband services in the country. With significant reserves of highly valuable and usable spectrum, the focus should be on ensuring that spectrum in the sub-2 GHz range (preferably below 1 GHz) is made available as soon as practicable. In particular, additional allocations of 900, 1800 and 2100 MHz should be made available in 2012/13 with the vacant 700 MHz band being allocated from 2014 when more affordable equipment and devices will become available. The aggregate total of spectrum allocated to wireless services in Myanmar should rise from its current very low level of 150 MHz to approximately 418 MHz by 2015 and then a total of 788 MHz by 2020.⁴⁷

⁴⁶ FCC, Notice of Inquiry, Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless including Commercial Mobile Services, Docket FCC 09-67, released 27 August 2009, page 2

⁴⁷ This proposed spectrum allocation could be checked against the situation in Viet Nam which represents the fastest cellular mobile growth in the region (e.g. connections in 2005 rose from 10.5 million to 132.8 million in 2010), a figure over 11 times the 2005 starting penetration figure. This was been done utilizing an aggregate wireless spectrum allocation of approximately 390 MHz. Only now is the aggregate total of spectrum being allocated to wireless services being increased (e.g. in relation to the 2.3 and 2.6 GHz bands).

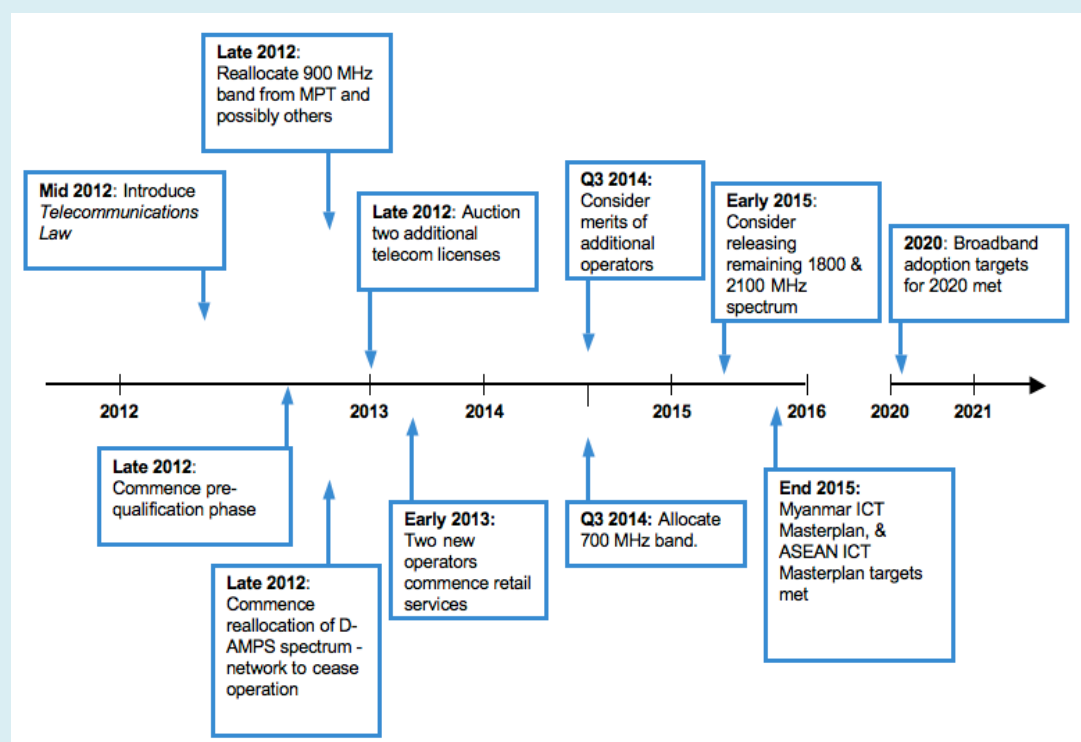
7.2 Roadmap for the government/regulator: Action items and timelines

The key milestones and actions for the Government of Myanmar and the PTD are detailed in Table 6 and Figure 14. Such milestones and actions are based on the government’s and ASEAN’s ICT masterplan and incorporate the Broadband Commission’s targets. In addition, the introduction of sector competition by the licensing of two new additional cellular mobile operators is proposed by early 2013.

Table 6: Key recommended action items

Date	Action
Mid 2012	<ul style="list-style-type: none"> Introduce draft Telecommunication Law
Late 2012	<ul style="list-style-type: none"> Commence pre-qualification phase Commence reallocation of D-AMPS spectrum – network to cease operation. Reallocate 900 MHz band from MPT and possibly other bands Auction two additional telecom licences
Early 2013	<ul style="list-style-type: none"> Two new operators commence retail services
Q3 2014	<ul style="list-style-type: none"> Consider merits of additional operators (expiry of two – year moratorium) Allocate 700 MHz band
Early 2015	<ul style="list-style-type: none"> Consider releasing remaining 1800 and 2100 MHz spectrum.
End 2015	<ul style="list-style-type: none"> 2015 Myanmar ICT Development masterplan targets met 2015 ASEAN ICT masterplan Targets met
2020	<ul style="list-style-type: none"> Adoption targets for 2020 met

Figure 14: Recommended timeline for action



Source: Author

Appendix A: ASEAN ICT Masterplan 2015

The following section elaborates on the areas of the ASEAN ICT Masterplan 2015 that have direct implications for the Myanmar wireless broadband masterplan.

Strategic thrusts for ICT policy

I. Economic transformation

Members are to create a conducive business environment that helps to attract trade, investment and entrepreneurship in the ICT sector. Leveraged investment in ICT will consequently be a driving force for growth in other key economic sectors.

Creating an enabling business environment necessitates the development of a framework to facilitate transparent and harmonised ICT regulations. Within the context of developing a wireless broadband masterplan, this action is significant as it will require the regulatory authorities of pilot nations to be cognisant of the regulatory practices in neighbouring states and implement new policies / regulations in such a way so as to maintain consistency with ASEAN nations.

II. People engagement and empowerment

A focus on people engagement and empowerment is intended to devote resources to the improvement of quality of life for ASEAN peoples through affordable ICT – especially in low income / remote areas where ICT access is considered to be a luxury. Member States have committed to ensuring access to affordable and seamless e-services, content and applications. This is to take the form of providing incentives / grants to promote such services. The value of wireless broadband lays in part through its ability to seamlessly access such services and applications in a convenient and highly practical manner. The promotion of these services will enhance the attractiveness for wireless broadband technology for users and operators alike.

III. Infrastructure development

Infrastructure development is a key component of ASEAN's ICT policy and is recognised as necessary for the successful implementation of the other strategic thrusts. Member States have committed to establishing an ASEAN Broadband Corridor. This will be achieved through a number of means including:

- i. identifying and developing locations in ASEAN Member States which offer quality broadband connectivity;
- ii. enabling seamless usage of broadband services and application across the ASEAN region to improve connectivity and services; and
- iii. promoting the diversity of international connectivity among ASEAN Member States.

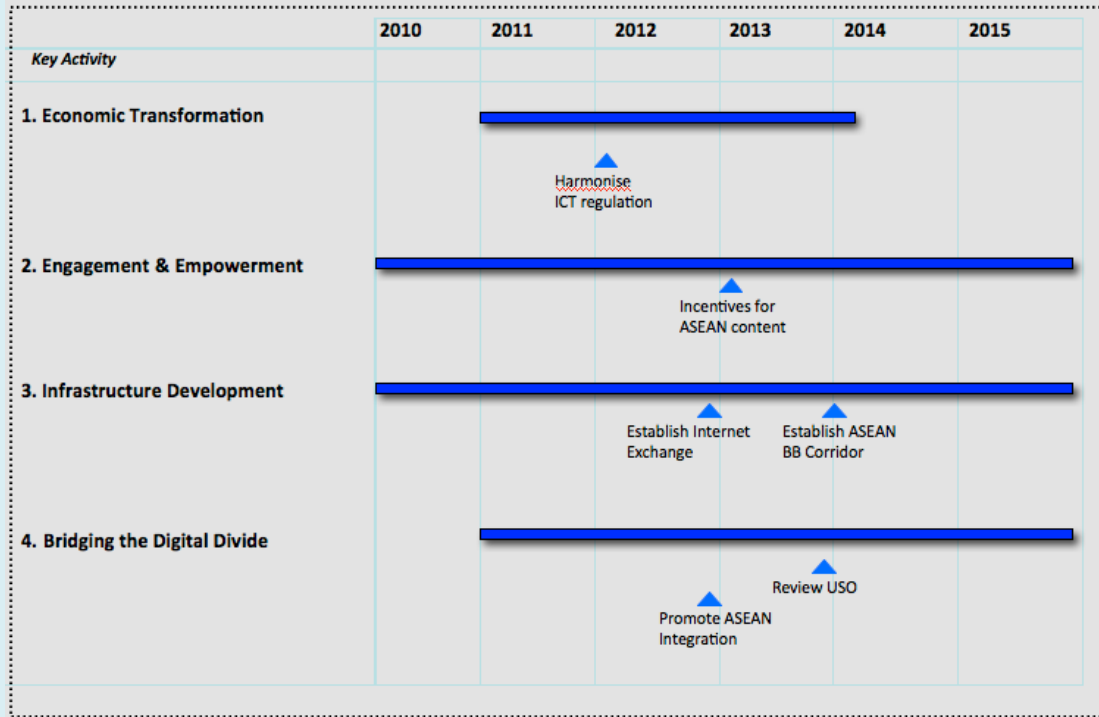
An ASEAN Internet Exchange Network has also been scheduled for completion. This will be achieved by establishing a regulator / operator forum to develop a platform to enable intra-ASEAN internet traffic and facilitating peering amongst ASEAN internet access providers to reduce costs and improve latency.

IV. Bridging the digital divide

Another important strategic thrust relates to the acknowledgment of imbalance of development amongst ASEAN Member States. This therefore necessitates a range of initiatives to be adopted that are focused on closing this development gap. Member States have agreed to review their USO / similar policies with a view towards including IT components and training as a part of USO funding. Furthermore, Members need

to ensure that ICT infrastructure covered under USO is broadband Internet capable. This will likely have positive implications for policies geared towards the deployment of mobile broadband infrastructure as it opens the door to a new avenue of funding.

Timeline



Source: ITU / ASEAN 2015 ICT Masterplan

Appendix B: Structure of the draft Telecommunication Law

[as at late 2011]

Chapter I – Title, Application and Definition;

Chapter II – Objectives of the Law;

Chapter III – Assignment of International Gateway;

- Ministry to have sole authority over international gateway assignments

Chapter IV – Licensing;

- Four services types covered by licence: (1) Network Facility Service; (2) Network Service; (3) Content Application Service; and (4) Application Service.
- Any person / organisation / enterprise from Myanmar or abroad is permitted to apply for a service licence. Licensees are permitted to enter into agreement with other licensees to share networks / infrastructure

Chapter V – Telecommunications Equipment Licence;

- The Ministry will determine the terms / conditions for an equipment licence

Chapter VI General License Condition;

- Licensees are to abide by, *inter alia*, the conditions set out by the Ministry and the radio spectrum plan.

Chapter VII Import and Export of Network Facility and Telecommunication Equipment by Authorisation;

- A certificate is required by the Ministry for the import / export of deemed equipment.

Chapter IX – Telecommunications Numbering Plan and Addressing Plan;

- Licensees must abide by the numbering & address plans.

Chapter X – Technical Standards;

- The Ministry shall determine technical standards for each of the four service types and the licensee is required to abide by the said standards.
- Any person distributing telecommunications equipment must apply to the Ministry to ensure they meet the technical standards.

Chapter XI – Consumer Protection;

- Licensees are required to submit tariff schemes to the Department for approval and conduct compliance reviews.
- The Department is empowered to determine additional consumer standards.

Chapter XII – Access and Interconnection;

- The Department is empowered to make rules on matters relating to access & interconnection. Access must be, *inter alia*, non-discriminatory and not be of a lower technical standard for quality than licensee's own network services / facilities.
- A service licensee may enter into an agreement with another licensee for access / interconnection, subject to Departmental approval.

Chapter XIII – Prohibition on Anti-Competitive Practices;

- Licensees must not engage in conduct that has the effect of substantially lessening competition.
- A licensee must not enter into an agreement / understanding arrangement for the purposes of fixing, market share and boycotting.

Chapter XIV – Dispute Resolution;

- Service licensees may refer disputes relating to the operation and provision of telecommunications services or network facilities to the Department where they are otherwise unable to resolve the dispute.

Chapter XV – Installation, Maintenance and Repair of Network Facilities;

- Licensees are granted legal authority to install / connect network facilities after obtaining legal authority to do so by the owner.

Chapter XVI – Inspection and Supervision;

- The Department is given authority to inspect / supervise the provision of services for the licence, manufacture / distribution of equipment and network service facilities in accordance this Chapter.

Chapter XVII – Taking Administrative Action;

- In the event of non-compliance, the Department may take a range of actions ranging from written warnings to licence termination.

Chapter XVIII – Offences and Penalties; and

- Penalties ranging from fines to imprisonment up to 15 years when committing an offence whilst providing telecommunications services or using equipment.
- Offences include, *inter alia*, affecting national security, law and order, community peace / tranquillity, sending / transmitting undesirable / indecent information etc.

Chapter XIX – Miscellaneous.

- The Ministry has the power to exempt persons from paying fees / obtaining a licence if deemed necessary.
- Licences issued under the previous framework that have not yet expired are deemed issued under the new law and effective until expiry.

Appendix C: Draft telecommunication services licence

[to be updated and amended upon the passage of the new sector legislation]

1. Grant of Licence

In exercise of the powers conferred by [insert section] of the *Telecommunication Law 2012* ("the Act") The Minister for Communications, Posts and Telegraphs (hereinafter referred to as "Minister") hereby grants a non-exclusive licence ("this Licence") to [Company X], a company duly incorporated in Myanmar whose registered office is situated at [ADDRESS] (hereinafter referred to as "the Licensee") to operate and provide the Licensed Services within Myanmar.

2. Interpretation

2.1 The terms in this Licence shall have the same meaning as prescribed in the Act, unless the contrary intention appears.

2.2 In this Licence, unless the contrary intention appears:

"Act" means the *Telecommunications Law 2012* as amended.

"Billing Process" means the Billing System and Metering System collectively.

"Billing System" means the totality of the equipment, data, procedures and activities which the Licensee uses to determine the charges to be made for usage of the Licensed Services.

"Competition Regulations" means the regulations pertaining to competition matters prescribed or to be prescribed by the MPT pursuant to the Act.

"Customer" means a person having a contractual relationship with the Licensee for the provision of the Licensed Services.

"Exempted Operator" means a person who has been granted an exemption from licensing pursuant to [insert Section] of the Act.

"Interconnection Agreement" means an agreement entered into between the Licensee and:

- (a) a Licensed Operator; and/or
- (b) an Exempted Operator;

pursuant to [insert Section] of the Act.

"Interconnection Regulations" means the regulations pertaining to interconnection matters prescribed or to be prescribed by the MPT pursuant to the Act.

"Licensed Operator" means a person who has been granted a licence under [insert Section] of the Act to provide or operate telecommunications service in Myanmar or to any place outside Myanmar any telecommunication service.

"Licensed Services" means the telecommunication services which are more particularly described in Schedule A.

"Metering System" means the equipment, data, procedures and activities which the Licensee uses to determine the extent of any Licensed Services which it has provided.

"Minister" means Minister for Communications, Posts and Telegraphs.

"PTD" means the Posts and Telecommunications Department and any successor organisation.

"Radio Frequency Spectrum Licence" means the licence granted to the Licensee to use the radio frequency spectrum for the purposes of operating and providing the Licensed Services.

- 2.3 Except where the contrary intention is expressed or arises by necessary implication in this Licence words referring to the masculine gender shall include the feminine gender and references to the singular include the plural and vice versa.
- 2.4 The interpretation of this Licence shall not be affected by any headings.
- 2.5 This Licence is subject to the provisions of the Act and is governed by the laws of Myanmar.
- 2.6 In this Licence, all references to an act (whether in conjunction with the title to that act or otherwise) or to the Act mean the legislation as in force from time to time or the legislation in place in whole or in part thereof as well as any subsidiary legislation, regulation, direction, codes of practice or any provisions thereof in force from time to time and those enacted or made (as the case may be) in place or substitution or modification in whole or in part of any other ordinance, the Act, subsidiary legislation, regulation, direction and codes of practice or provision thereof.
- 2.7 At any time, any terms or conditions of this Licence which are or declared by any court or tribunal of competent jurisdiction to be illegal, invalid or unenforceable in any respect under the applicable law shall be severed from this Licence to the maximum extent permissible by the applicable law without in any manner affecting the legality, validity or enforceability of the remaining terms and conditions of this Licence, all of which shall continue in full force and effect.
- 2.8 In the event of any conflict or inconsistency between the Schedule and the terms and conditions in another part of this Licence, the latter shall prevail.

3. Scope of the Licence

- 3.1 The Licensee shall operate and provide the Licensed Services within Myanmar.
- 3.1 The Licensee shall provide the Licensed Services to every person who requests for provision of such services within Myanmar.

4. Term of Licence

- 4.1 Subject to Conditions 29, 30 and 32, this Licence shall be valid for a period of 15 years from the grant of this Licence.
- 4.2 Upon the expiry of the initial term, this Licence may be further renewed for subsequent term of five (5) years or such other period as PTD thinks fit and in accordance with [insert Section] of the Act⁴⁸.

5. Licence Fees

- 5.1 The Licensee shall pay:
- (a) on the grant of this Licence, an approval fee of [] or such other amount determined by PTD under [insert Section] of the Act;
 - (b) annually thereafter a renewal fee of [] or such other amount determined by the PTD;
 - (c) royalty to the Government of such amount and at such time as specified by the PTD; and
 - (d) annually such amount specified by the PTD to a universal service fund.

⁴⁸ Amended to be consistent with the BTTB PSTN Licence (condition 3).

6. Description of Licensed Services

- 6.1 The Licensee shall not operate or provide any telecommunication service not described in Schedule A except with the prior approval of PTD.
- 6.2 In the event that the Licensee wishes to make changes to the Licensed Services, or introduce a telecommunication service, the Licensee shall provide PTD with such information as may be required for PTD'S consideration and obtain the approval of PTD prior to making any change to the Licensed Services, or introducing the new telecommunication service.

7. Licence replaces any other licence

- 7.1 This Licence replaces any other licence held by the Licensee in respect of the Licensed Services.

8. Licence is not Transferable

- 8.1 The issue of this Licence is personal to the Licensee and this Licence shall not be assigned, transferred, sublet or otherwise disposed to any other party except in accordance with [insert Section] of the Act.

9. Submission of Tariff

- 9.1 Prior to providing the Licensed Services, the Licensee shall submit to PTD a tariff containing the maximum and minimum charges for such Licensed Services for PTD consideration and approval.
- 9.2 The tariff submitted pursuant to Condition 10.1:
- (a) shall be in a form approved by PTD;
 - (b) shall be precise and sufficiently detailed to enable PTD to work out the nature and the amount of charges payable for the supply of the Licensed Services; and
 - (c) must:
 - (i) state the period for which it shall apply;
 - (ii) state the services and a description of the services that the Licensee proposes to offer during the term;
 - (iii) set out the details of the nature and amount of charges payable for the services, indicating where relevant, the services that are provided free of charge; and
 - (iv) where the charges vary in their nature or amount or both in relation to the services, the reasons why and how the charges vary.

10. Publication of Charges, Quality of Service Standards and Conditions of Licensed Services

- 10.1 The Licensee shall publish information about the Licensed Services and provides information covering *inter alia* details of its tariffs and fees, quality of service standards, provision of fault repair and other terms and conditions on which the Licensed Services are provided by:
- (a) sending a copy of the relevant details to PTD;
 - (b) making them available for inspection at its major places of business during normal business hours; and
 - (c) sending the appropriate parts thereof to any person who makes a request for it.

- 10.2 The Licensee shall provide a help-line service to its Customers whereby any Customer may receive information about any aspect of the Licensed Services.
- 10.3 The Licensee shall publish, at such intervals and in such a manner as PTD may specify, *inter alia* the description, the quality of service standards, the charges and terms and conditions on which the Licensed Services are provided.

11. Billing

- 11.1 The Licensee shall provide its Customers with periodic, accurate and timely invoices which reflect *inter alia* the itemised charges for each Licensed Service provided, the terms and conditions on which the Licensed Services is provided and the due date for payment.
- 11.2 The Licensee shall maintain in operation such a Billing Process in order to comply with Condition 11.1. For the purpose of clarification, the Licensee may at its discretion outsource the billing processes but shall at all times be responsible for meeting its billing obligations under this Licence.

12. Customer Service Standards, Consumer Protection and Handling of Complaints

- 12.1 The Licensee shall develop, publish and enforce guidelines for use by its personnel when handling enquiries and complains from or on behalf of any person to whom it supplies Licensed Services.
- 12.2 The guidelines must address *inter alia* the following areas:
- (a) procedures for handing of complaints;
 - (b) procedures adopted by the Licensee to ensure accuracy of a customer's account; and
 - (c) availability to customers of quality of service information relating to the Licensed Services.
- 12.3 The Licensee shall receive and consider any comment and complaint from or on behalf of any person who believes himself to have been treated unjustly or unfairly in relation to the Licensed Services.
- 12.4 The Licensee shall keep a complete record in writing of all comments and complaints received by it and submit it to PTD on demand. In addition, the Licensee shall keep a complete record in writing of information relating to invoices, charges, directories and inquiries received by it. The records shall be retained by the Licensee for not less than six (6) months.

13. Universal Service Obligation

- 13.1 The Licensee shall comply with the universal service obligations and contribute to the Universal Access Fund in accordance with the Act.

14. Access and Interconnection

- 14.1 Unless otherwise exempted by PTD, the Licensee shall where reasonably practicable, provide access to its Licensed Services, as the case may be, to other Licensed Operators and/or Exempted Operators on reasonable terms and conditions.
- 14.2 Pursuant to Condition 14.1, the Licensee shall enter into interconnection arrangements with other Licensed Operators and/or Exempted Operators on mutually agreeable terms and conditions, and in accordance with [insert Section] of the Act.
- 14.3 The Licensee shall comply with [insert Section] of the Act in relation to any interconnection dispute.

15. Operation of Radio Apparatus

- 15.1 The Licensee shall apply for and obtain all necessary rights and licences under the Radio Act or such other subsidiary legislations for the operation of any radio apparatus and shall abide by the conditions imposed thereunder, including the payment of licence fees.

16. Use of Radio Frequencies

- 16.1 Subject to the Radio Act and this Condition, the Licensee shall use the radio frequencies allocated and granted to the Licensee pursuant to a Radio Frequency Spectrum Licence to enable the operation and provisioning of the Licensed Services, and shall at its discretion, use any part of the radio frequencies allocated to it for the purposes of managing interferences.
- 16.2 The Licensee shall take all necessary steps to ensure that the radio-communication apparatus is safe and does not cause harmful interference to other existing radio apparatus in the same or other areas or radio frequency bands.

17. Technical Standards

- 17.1 The Licensee shall comply with the technical standards where such technical standards relate to the Licensed Services.

18. Compliance with Numbering Plans

- 18.1 The Licensee shall comply with PTD numbering plan on the usage, allocation and assignment of numbers in relation to the Licensed Services.
- 18.2 PTD may alter and/or relocate and reassign any mobile numbers given to the Licensee at any time provided that prior written notice has been given.
- 18.3 The Licensee may at its discretion, allocate addresses and numbers to its customers within its allocated addressing blocks.

19. Restriction against Anti-Competitive Conduct and Arrangements

- 19.1 The Licensee shall not engage in any conduct or enter into any agreement or arrangement which shall in any way prevent or restrict competition in relation to the provision of the Licensed Services by the Licensee.
- 19.2 The Licensee shall comply with the Competition Regulations issued by PTD.

20. Restriction on Discrimination

- 20.1 The Licensee shall not show undue preference towards, or exercise undue discrimination against any person or class of persons in relation to the provisioning of the Licensed Service or the charges for such Licensed Service

21. Ownership, Shareholding, Management and Merger Arrangements

- 21.1 The Licensee shall obtain the approval of PTD and observe and comply with the regulations promulgated by PTD relating to:
- (a) any change in the ownership, shareholding or management of the Licensee at which has the effect of transferring the control over the activities under this Licence; or
 - (b) any merger of the Licensee with any other Licensed Operator and/or Exempted Operator.

22. Direction by PTD

22.1 The Licensee shall comply with any directions issued by PTD in exercise of its powers, functions or duties under the Act or in this Licence.

23. National Emergency

23.1 Where required by PTD, the Licensee shall participate in any emergency, disaster or security activities in collaboration with other Licensed Operators and relevant agencies, organisations and Government departments. Any such emergency shall only extend for such period as may be reasonable given the circumstances.

24. Dispute Resolution

24.1 In the event that the Licensee fails to reach an agreement with other Licensed Operators and/or Exempted Operators on matters relating to the Act or this Licence, the Licensee may refer the matter in writing to PTD to resolve the dispute.

24.2 The decision of PTD shall be binding on the Licensee and the other Licensed Operators and/or Exempted Operators who are parties to the dispute.

25. Accounts

25.1 The Licensee shall maintain full and accurate books and accounting records reflecting all financial matters in accordance with sound and acceptable accounting practices.

25.2 The Licensee shall so far as it is reasonably practicable, prepare and deliver to PTD's separate accounting records as may be required by PTD from time to time. The Licensee shall comply with all directions issued by PTD in relation to accounting separation.

26. Provision of Information to PTD

26.1 The Licensee shall deliver at such time and in such manner as may be specified by PTD, all such documents, accounts, estimates, annual return or other information within its knowledge, custody or control as PTD may require in connection with the performance of its functions and duties under the Act.

27. Customer Privacy and Confidentiality

27.1 The Licensee and PTD shall keep confidential all information of the Licensee:

- (a) which is disclosed, communicated or delivered; or
- (b) comes to its knowledge or into its possession in connection with this Licence;

and must:

- (1) not use, copy, reproduce and/or reduce to writing or communicate or otherwise make available such information except for the purposes of this Licence or as required by the Act; and
- (2) not disclose or communicate, caused to be disclosed or communicated or otherwise make available such information to third person other than its directors, officers, employees and/or professional advisers to whom disclosure is necessary for the purposes of this Licence; and
- (3) apply thereto no lesser security measures and degree of care than those which applies to PTD's own confidential or proprietary information and which PTD warrants as providing adequate protection for such information from unauthorised access, copying or use.

28. Safety

- 28.1 The Licensee shall, in respect of all installations, equipment and apparatus possessed, maintained, operated or used in relation to the provision of the Licensed Services under this Licence, take all proper and adequate safety measures for the safeguarding of life or property, including safeguarding against exposure to any electrical or radiation hazard emanating from the installations, equipment or apparatus so used.
- 28.2 The Licensee shall comply with any direction of PTD in respect of any safety matter.

29. Variation or Amendment to the Licence

- 29.1 PTD may vary or amend any of the conditions of this Licence in accordance with [insert Section] of the Act.

30. Suspension or Cancellation of the Licence

- 30.1 PTD may suspend or cancel this Licence in accordance with [insert Section] of the Act.

31. Breach of Licence Conditions

- 31.1 Where the Licensee breaches any condition of this Licence, the Licensee shall be guilty of an offence and shall be convicted in accordance with [insert Section] of the Act.

32. Surrender of the Licence

- 32.1 In the event that the Licensee wishes to terminate this Licence or cease to operate or provide the Licensed Services, the Licensee shall notify PTD in writing at least three (3) months in advance.

33. Rights upon Suspension, Cancellation or Termination

- 33.1 Suspension, cancellation or termination of this Licence, in whole or in part, is without prejudice to any rights, liabilities or obligations which may accrue to the Licensee or PTD under this Licence or any written law at the date of the suspension, cancellation or termination, including a right of indemnity.

34. Governing Law

- 34.1 This Licence shall be governed and construed in accordance with the law of Myanmar.

35. Compliance with the Law and International Conventions

- 35.1 The Licensee shall, unless otherwise directed by PTD, at all times observe and perform the relevant requirements of the Act and Convention of the International Telecommunication Union including all regulations annexed thereto or made thereunder, and any other telecommunication agreements which may from time to time be acceded to by or on behalf of, or applied to, Myanmar.

36. PTD's Powers

- 36.1 In exercising its powers granted in terms of the Act, and this Licence, PTD shall:
- (a) act reasonably having regard to all surrounding circumstances;

- (b) prior to exercising its power, afford the Licensee every reasonable opportunity to be heard and make representations to PTD in respect of all relevant issues; and
- (c) at the request of the Licensee, furnish written reasons for any decision it makes in relation to this Licence.

Schedule

Spectrum Allocation

For the purpose of providing the Services, the Licensee shall use [2 x 10 MHz] paired spectrum in the 900 MHz band, [2 x 10 MHz] paired spectrum in the 1800 MHz band and [2 x 10 MHz] in the 2100 MHz band. The specific spectrum assignments are:

- [to be inserted – 880 – 890 MHz and 925 – 935 MHz];
- [to be inserted 1710 – 1715 MHz and 1805 – 1810 MHz]; and
- [to be inserted 1920 – 1930 MHz and 2110 – 2120 MHz].

Schedule

Network Rollout Requirements (Illustrative)

The Licensee shall meet the following network capacity targets:

Period ending	Location	Available Service Capacity
31 December 2012	Yangon	[to be decided]
31 December 2013	Yangon Mandalay / Sagaing Bagan Nay Pyi Taw	[to be decided]
31 December 2014	Yangon Mandalay / Sagaing Bagan Nay Pyi Taw	[to be decided]
31 December 2015	Yangon Mandalay / Sagaing Bagan Nay Pyi Taw Patheingyi	[to be decided]
31 December 2016	Yangon Mandalay / Sagaing Bagan Nay Pyi Taw Patheingyi Mawlamyaing Sittoung	[to be decided]

Schedule
Quality of Service Requirements
(Illustrative)

Billing Errors

The Licensee shall ensure that billing errors are within the following limits:

Period ending	% of Billing Errors
31 December 2012	0.8
31 December 2013	0.6
31 December 2014	0.5
31 December 2015	0.2
31 December 2016	0.1

Fault Clearance
Incidence of Faults
Answer to Seizure Ratio

Appendix D: Outline of recommended process to introduce sector competition and attract new investment

D.1 Overview

As indicated in the main body of the masterplan, to create viable competition and optimal environment in order to address both Myanmar's low teledensity and the digital divide, the introduction of sector competition is recommended. To ensure a competitive market with lower consumer tariffs it is recommended that at least two new mobile operators be licensed in Myanmar to compete against the MPT.

The key challenge is to design a process that will see:

- (i) The viable entry of two new licensees into the market that will be able to compete with the MPT for the provision of both mobile voice and wireless broadband services.
- (ii) The securing of significant one off and on-going fees for the Myanmar Government. Part of the funds raised could be used to provide MPT with a significant capital injection so that it can quickly grow in competition with the two new entrants.

To address these twin challenges, a two stage process is preferred with a first stage pre-qualification of short listed bidders to be followed by an auction. Following a successful licensing process, the market will also be suitably primed for the allocation of additional spectrum, and/or the possible entry of a second round of new providers by 2015 or 2016.

D.2 Pre-qualification phase

The process that could be followed for the introduction of two additional providers of mobile/wireless services in Myanmar as detailed below. The procedures may be divided into a number of key steps, namely:

- (i) preliminary steps;
- (ii) request for proposal ('RFP') process;
- (iii) establishing an evaluation team;
- (iv) budget planning / consulting;
- (v) defining the investment opportunity;
- (vi) inviting applications from prospective applicants;
- (vii) preparing an applicant information package;
- (viii) developing an evaluation and ranking criteria; and
- (ix) receiving and considering applications.

D.2.1 Preliminary steps

Valuable spectrum is currently severely under-utilised in Myanmar and the government must commit to an initial reallocation of GSM 900 MHz band spectrum. Table D.1 shows the radio spectrum that is assigned to the MPT for cellular services.

Table D.1: Spectrum allocated for mobile/wireless services

Service	Spectrum Assignment
GSM	890 – 915 MHz 935 – 960 MHz 1,885 – 1,910 MHz 1,965 – 1,990 MHz [2100 MHz]
CDMA	825 – 835 MHz (mobile) 870 – 880 MHz (fixed)

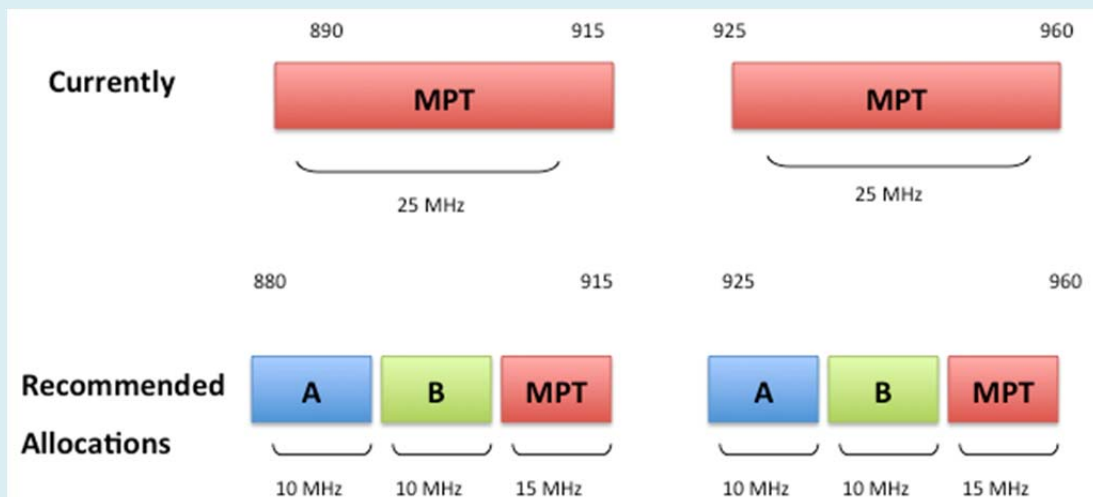
A reassignment (i.e. refarming) of certain spectrum is necessary to enable the entry of new competitors into the Myanmar mobile market. Such a refarming would include:

- a reassignment of the current 900 MHz spectrum allocated to MPT; and
- the expiry of assignment of D-AMPS spectrum in the 800 MHz band.

Reallocation will serve the dual purpose of migrating users from dated 1.5G technology and providing the additional bandwidth necessary (namely by freeing up the e-SGM band) to facilitate new entry and competition for competitor services which are able to provide 3G connectivity.

The MPT currently holds 2 x 25 MHz – the entire GSM 900 band – of paired 900 MHz band frequency. In order to secure an acceptable competitive environment, the PTD should commit to allowing two operators to secure a footing in the market. Consequently, this will necessitate two separate 2 x 10 MHz allocations to prospective new entrants. Following the conclusion of the pre-qualification phase, the new allocation would see two operators with 2 x 10 of 900 MHz band spectrum, while MPT would retain 2 x 15 MHz of 900 MHz spectrum including any guard bands (approximately 200 KHz between operators). A total of 2 x 35 MHz of 900 MHz band. This would be done as early as possible so it has a time to transition to the new arrangements. The process is illustrated in the Figure D.1.

Figure D.1: Allocation of 900 MHz band spectrum (with e-GSM)



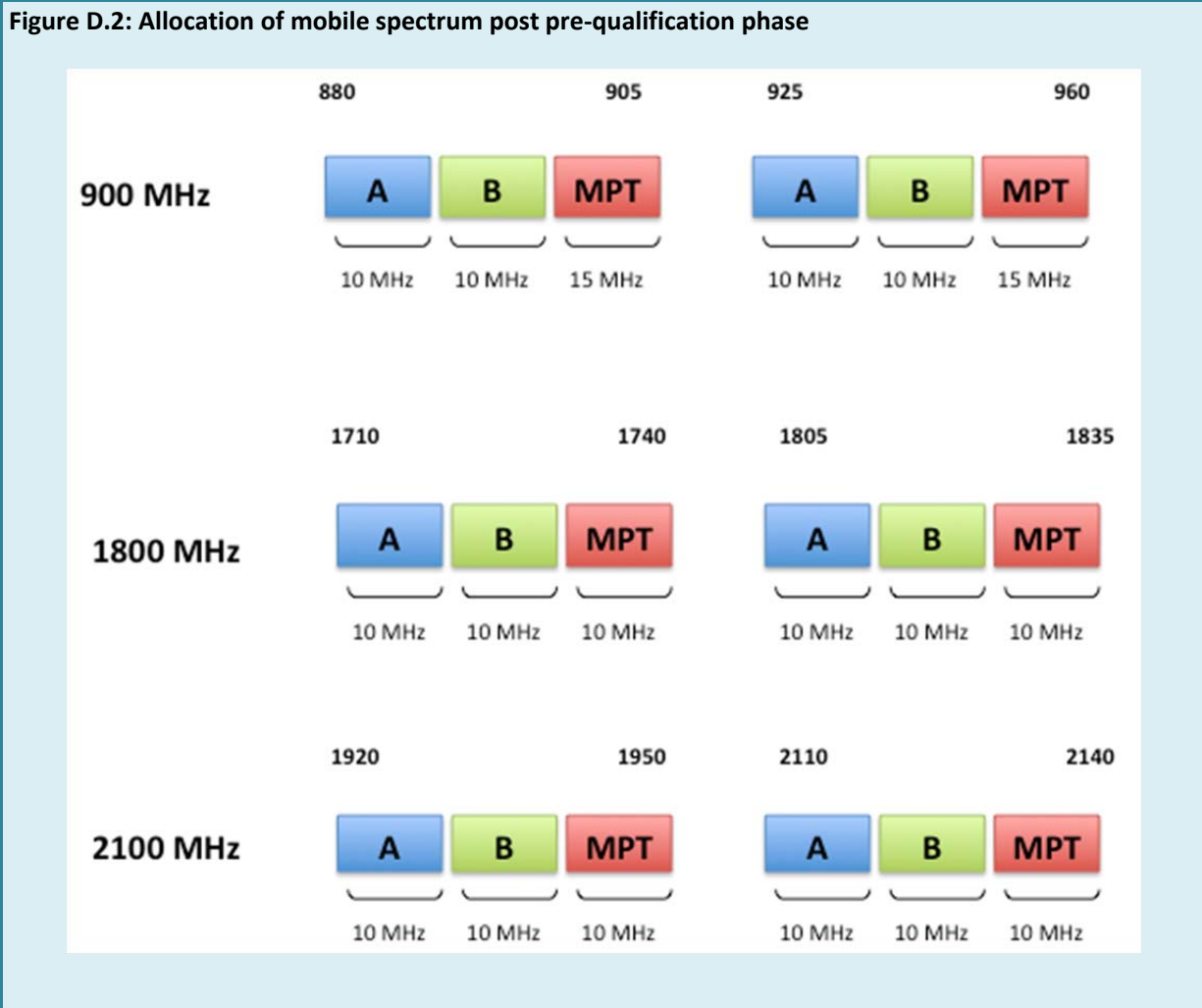
The PTD should highlight to potential applicants that a two-year exclusivity will be provided on additional telecommunications licences. This will help ensure that licensees assume the capital expenditure and risk that is necessary to generate effective competition and infrastructure that is capable of meeting Myanmar’s communications needs.

Box D.1 provides a draft call for applicants for a mobile wireless licence in Myanmar.

It is recommended that 2 x 10 MHz of 1800 MHz spectrum and 2 x 10 MHz of 2100 MHz spectrum should also be issued to the successful new licensees in the 1800 and 2100 MHz bands respectively. Thereby giving each operator a total of 2 x 30 MHz of paired spectrum in three bands in order to provide for both coverage and capacity as well as voice and data services. This is sufficient to meet capacity constraints in the short to medium term and also ensure cross-border interoperability. In order to optimise spectrum utilisation and avoid hyper competition, the remaining spectrum in these bands should not be allocated until at least post 2014.

In the PTD should also consider the future of the remaining 1800 and 2100 MHz bands. An RFP should be held and applicants given the opportunity at least 12 months later to state whether they wish additional spectrum in these bands to be bundled with their frequency or alternatively have it issued via staggered process. The capacity demands of 4G LTE means that the allocation of these bands for mobile services is a necessity and must be completed sooner rather than later – preferably before the allocation of 700 MHz frequency and if operators project sufficient demand during the allocation of 900 MHz band spectrum.

Figure D.2 shows the spectrum holdings of each operator post 900, 1800 and 2100 MHz allocations.



D.2.2 Request for proposal (RFP) process

A draft call for proposals from suitably qualified applicants for a Myanmar cellular wireless licence is provided in Box D.1.

Box D.1: Preliminary draft call for applicants

Draft call for applicants for Myanmar cellular wireless licence (pre-qualification phase)

The Government of the Union of Myanmar is committed to the liberalisation, growth and development of its telecommunication sector. In particular, the Government wishes to introduce two new independent operators to provide a nationwide GSM mobile and wireless broadband cellular services. The Government will seek applications from interested parties to take up the investment. There will be a pre-qualification phase including eligibility criteria for successful applicants, set out below, with allocation then taking place via auction.

The key parameters of the investment opportunity are as follows:

- Two New Operators

The Government will authorise only two new operators to provide mobile cellular services. The Government will not issue any further authorisation for the provision of mobile cellular services for at least 2 years from their licensing.

- Nationwide Coverage

Licensees will be authorised to provide services throughout the territory of Myanmar. The areas covered and the rollout timetable should be proposed by applicants. Approval of local Government for the installation of network infrastructure will be required [to confirm].

- Wireless Technology

Each of new operators will be provided with 2 x 10 MHz of 900 MHz spectrum, 2 x 10 MHz of 1800 MHz and the right to acquire 2 x 10 MHz of 2100 MHz radio frequency spectrum. The rights offered will be technology neutral permitting the successful applicant to deploy WCDMA at 900 MHz and/or LTE at 1800 MHz.

- Eligible Applicants

Applicants must be Myanmar registered companies or joint venture companies. Foreign investment will be permitted up to 90 per cent of the share capital of the applicant

- Services

The new operators will be required to provide interconnection with all other operators. It may provide its own international and domestic transmission links or lease capacity from MPT. The applicant will be expected to undertake commercial negotiation with these operators concerning interconnection.

- Performance Bond

The new operators will be required to post a performance bond equal to 10% of the expected capital expenditure incurred in the first two years after the licence is granted.

D.2.3 Project evaluation team

To ensure their efficient execution, the overall licensing procedure must be planned and undertaken according to a set timetable and with tasks assigned to an appropriate working group comprising representatives from the Ministry, the PTD, MPT and other arms of government as may be required or appropriate. Such a working group may be called the License Evaluation Committee (LEC) and would function under the overall supervision of the Minister for Communications, Posts and Telegraphs.

The LEC must represent the relevant arms of government and have, either within the individual team members or in available support staff, the necessary expertise to make an effective evaluation of the applications. Importantly, the LEC must have a leader and be able to make those decisions that are necessary to perform the evaluation.

Under the direction of the Ministry and PTD, members would work to a timetable setting out key milestones. The leader would be accountable for managing all aspects of the task and ensuring that project outcomes are delivered on time.

The LEC would be expected to manage the licensing exercise as a specific project. That is, the process requires dedicated staff empowered to undertake and complete the project within the parameters of:

- specific objectives and outcomes;
- a set timetable; and
- specific human and financial resources.

D.2.4 Budgetary planning / consulting

The PTD will need to undertake a budgetary planning process and advise the Ministry of the anticipated expenditures that the pre-qualification phase will entail. The services of an external consultant may be required to assist the PTD with the planning and allocation of tasks.

D.2.5 Defining the investment opportunity

This step involves documenting the details of the investment opportunity. This involves determining the precise parameters of the investment that is being offered to investors.

D.2.6 Encouraging applications from prospective applicants

The publicity associated with opening up the Myanmar telecommunications market for new entrants and the resulting financial opportunities will be significant factors in driving applications from prospective applicants.

This part also requires matching the requirements of investors with the characteristics of the investment opportunity. In turn this may mean structuring the investment opportunity in such a way to ensure that the needs or requirements of key potential applicants are provided. For example, tax concessions might be made available to the successful applicant. Prospective applicants need to be assured of regulatory certainty. Efforts need to be made to provide both English language and Myanmar documentation, with the applications to be made in English.

In order to create a favourable investment climate, the government should consider relaxing foreign investment laws as it is highly likely that the interested parties will not be local. This may take the form of allowing say 90 per cent ownership with a graduating sell-off requirement to occur over a defined period of time.

D.2.7 Preparing applicant information package

This step involves the preparation of an applicant information package. This package provides all the basic information that a potential investor requires to make an assessment of whether to submit an application and how an application should be made.

Relevant information to be provided in an applicant information package will include:

- the government telecommunication policy statement and its commitments relevant to the investment opportunity, e.g., a commitment to not licence any additional cellular mobile operators for three years;

- the Telecommunications Law and regulations pursuant to the Telecommunications Law which concern the investment opportunity (assuming the passage of the new Law);
- basic facts about Myanmar and the investment climate – population, GNP per capita, population density and age profile population, climatic conditions, teledensity, industry structure, regulatory structure, etc.;
- sample licence that would be awarded;
- the form of application, i.e., the information to be included in an application;
- evaluation criteria that will be used to assess applications;
- timetable to be followed in the application evaluation process;
- instructions on how applications are to be lodged, i.e., date, place, payment of application fees etc.; and
- the process for dealing with queries from applicants.

It should be recognised that the process of licence application evaluation is necessarily a subjective task requiring judgements to be made. The degree of subjectivity can, however, be reduced through a carefully managed process which requires licence applications to be structured and presented in a common format to facilitate ease of comparison.

D.2.8 Developing application evaluation and ranking criteria

Evaluating applications may take the form of a two-step process. Step 1, a shortlisting criteria involves a checklist to ensure that only complete and genuine applications proceed to the next stage.

This shortlisting criteria for a telecommunications licence opportunity may be set out in four parts:

- financial capability;
- technical capability;
- management and technical expertise; and
- corporate governance.

A suggested ranking criteria is provided in Table D.2. The framework is applied by evaluating each application and awarding highest point to the application that best fulfils the criteria.

Table D.2: Ranking criteria

Ranking Criteria	Relative Weighting	Numeric Weighting
Technical Quality	High	20%
• Network coverage		
• Grade of service		
• Network interconnection		
• Network design and configuration		
Financial Capability	High	20%
• Financial soundness		
• Extent of financial commitment		
• Access to financial resources		
• Business plan		
Customer Service and Support	Medium	15%
• Service range		
• Customer segmentation		
• Retail and service outlets		

Ranking Criteria	Relative Weighting	Numeric Weighting
Implementation Schedule	Medium	15%
<ul style="list-style-type: none"> • Network roll out plan 		
<ul style="list-style-type: none"> • Ability to acquire and manage telecommunications sites and facilities • Ability to manage major infrastructure projects 		
Management and Technical Expertise	Medium	15%
<ul style="list-style-type: none"> • Experience in operating public telecommunications services 		
<ul style="list-style-type: none"> • Knowledge of Myanmar’s business environment 		
<ul style="list-style-type: none"> • Management support • Technical support and personnel 		
Industry Development	Medium	10%
<ul style="list-style-type: none"> • Local employment opportunities 		
<ul style="list-style-type: none"> • Local supply • Staff training and development 		
Corporate Governance	Low	5%
<ul style="list-style-type: none"> • Corporate structure 		
<ul style="list-style-type: none"> • Shareholders’ agreements 		

D.3 Auction processes

Assuming there are multiple applicants who pre-qualify, the PTD will need to select the most appropriate means of allocating the licences to best placed bidders. While a ‘beauty contest’ could be utilised, the optimal approach which is consistent with global best practice is to allocate the licences by auction. It should be noted that the same price based methods may also be employed for the subsequent allocations of spectrum solely – including the 700 MHz spectrum and any remaining 1800 and 2100 MHz spectrum.

In an auction, licences are awarded by bidding between competing applicants either for a licence with spectrum or spectrum separately. Auctions award licences to those who value them most highly while simultaneously generating revenues for the PTD.

However, as is the case with an unrestricted spectrum market, auctions may raise competitive concerns if not combined with an active competition policy and limits on how much spectrum an entity may purchase.

Market forces do not ensure economic efficiency or maximize consumer welfare in markets that are not competitive because a dominant service provider or group of providers have market power.

While auctions are the assignment mechanism best suited to providing an initial economically efficient distribution of the spectrum resource, they will not ensure that spectrum continues to be used in an economically efficient manner in the future.

As with other resources, economists recommend that spectrum users be allowed to transfer their spectrum rights (whether assigned by auction or some other assignment mechanism) and that spectrum users have a high degree of flexibility in the choice of the consumer services that they provide with their spectrum.

Auctions have the advantages of awarding licences to those who value them most highly, while simultaneously generating revenues. When auctions are used to assign licences within a given allocation structure, licences are awarded to those who value them the most only within the confines of the

allocation structure. Other expected benefits associated with auctions may be fairness, transparency, objectiveness, and the speed with which licenses can be awarded. Auctions can reduce the opportunities for favouritism and corruption in the competition for spectrum, promote investment, and promote technological advancement.

However, in order to promote competition, it may be necessary to impose additional safeguards, for auctioned services. For example, in some situations some or all of the potential bidders may be dominant service providers who are endeavouring to strengthen their monopoly positions. Restrictions on eligibility to participate in an auction or limits on the amount of spectrum that any entity may win can alleviate this problem, although this may limit the number of participants.

The types of auctions are summarised in Box D.2.

Box D.2: Types of auctions

There is a surprisingly wide array of choices of forms an auction may take. The choice of auction mode will vary with the nature of licenses made available, the number and nature of firms with an interest in theirs and the regulator's or government's objectives:

- **Simultaneous ascending auction (SAA)** – where blocks of spectrum are awarded to the highest bidder remaining who has exceeded the opening price set by the regulator;
- **Descending-price auction (Dutch auction)** – where the ultimate price paid is determined after succeeding descending rounds from an initial high price set by the regulator;
- **First-price sealed-bid auctions** – where participants submit their bid without any information on prices and the highest bidder wins;
- **Second-price sealed-bid auctions** – similar to the previous method except the second highest price is selected;
- **Simultaneous ascending auction (SAA) sealed-bid hybrid auctions** – where SAA is used in the first several rounds and first-price sealed-bid is used in the final round.
- **Simultaneous multi-round ascending auctions** – this format is used when there are many spectrum lots to be allocated together across a range of different geographic areas and there are different band segments.

All lots are simultaneously on offer over multiple rounds of bidding. Bidders may bid on any lot or combination of lots in each bidding round. At the end of each round high bids are disclosed and all bidders can bid again in the next round to become the high bidder. In general, after a round with no more bids, the bidders holding the high bids in the previous round win the lots.

D.4 Benefits of sale for government

The reallocation of spectrum will likely provide substantial revenues for the Myanmar Government. Appendix E indicates that if international precedent is followed, the government should expect anywhere between USD 300 to USD 500 million (or perhaps significantly more) for the initial two licence allocations. It should be noted that even the GSMA the peak cellular mobile industry association considers that allocating licences and spectrum by way of auctions is optimal in that it:

- can generate significant revenues for governments as a contribution to the community;
- well-designed auctions can provide spectrum regulators with a means of ensuring that spectrum is efficiently used by being allocated to those who are best able to use it;
- there is often surprisingly little difference between allocating spectrum to optimise its use (i.e. efficient allocation) and the maximization of revenue where competition for spectrum is vigorous.

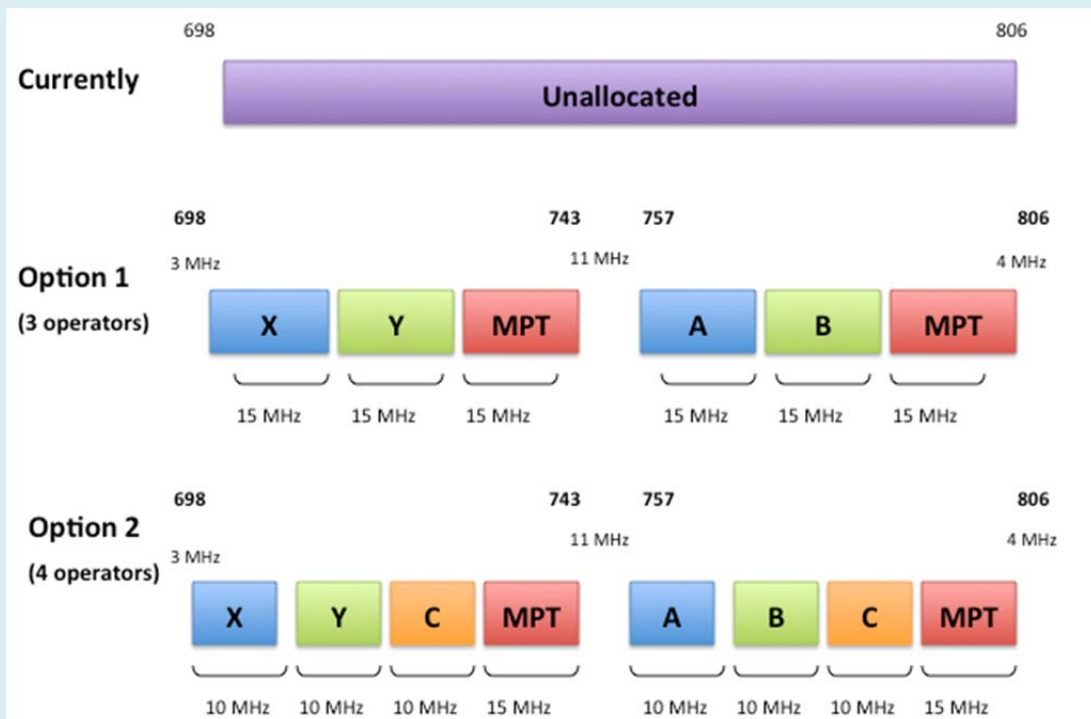
D.5 Subsequent allocations of spectrum

Following the introduction of competition into the Myanmar mobile service market, by 2014/2015 the PTD may decide to release more high-demand spectrum on a technology-neutral basis following the expiry of the proposed two-year telecom licence moratorium. Consequently, the government could expect to earn more revenue from the sale of spectrum due to increased demand and revenues which are being generated by the sector.

Myanmar is in the enviable position of having an unallocated 700 MHz band due to the non-existence of UHF television. This lower-band spectrum is valuable due to its capacity, geographical coverage and international harmonisation efforts; it is highly suitable for mobile broadband. It is expected that there will be sufficient capacity so as to not warrant the allocation of 2.6 GHz spectrum at least until late in the decade.

In relation to the specific allocations to be made in the 700 MHz band, the PTD may wish to consider guaranteeing the MPT an allocation of 2 x 15 MHz. By this stage the MPT should be regularised and required to pay licence fees and follow the same process as other operators. At this stage, the PTD may weigh the costs and benefits of possibly allowing the entry of an additional operator to bid for spectrum. This may be beneficial if the market has matured sufficiently by this stage. The process is illustrated in Figure D.3

Figure D.3: Allocation of the 700 MHz band



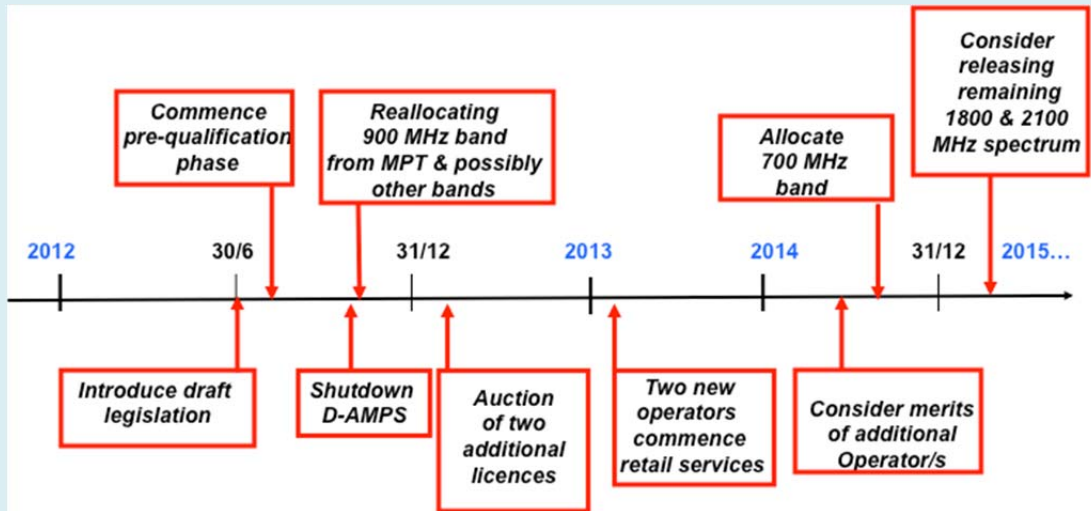
Source: ITU

The PTD will also have to consider releasing further spectrum in the 1800 and 2100 MHz bands in the medium to long term, subject to demand, competition and capacity factors.

D.6 Suggested licensing process timeline

The suggested licensing process is detailed in Figure D.4. While this suggested timeline is ambitious is it certainly more than do-able.

Exhibit D.4: Licensing process implementation timeline



Source: ITU

Appendix E: Spectrum pricing in Myanmar

Implementing an effective spectrum pricing policy is beneficial in two aspects. Firstly, it provides a steady stream of revenue for the government arising from one-off and annual licence fees. Secondly, it creates an environment that facilitates the best utilisation of scarce spectrum resources through ensuring that only the enterprises which place the highest value on certain spectrum are in possession of it due the existence of an auction-based / bidding framework.

Table E.1 displays international precedent regarding pricing and upfront fees for recent spectrum allocations.

Table E.1: Spectrum releases, pricing and upfront fees in various administrations in the region

Nation	Population (m)	Allocation Type	Allocation Details (band)	Date	Spectrum Allocated (paired)	Total upfront fee (USD million)	Price / MHz (USD million)	Price / MHz/ Population (USD)
India ⁴⁹	1 180	Auction	2100 MHz	2010	15-20 MHz	10 938	729.2	0.61
Pakistan	166	Renewal	900/1800 MHz	2004	13.6 MHz	291	21.4	0.128
Nepal	28	Auction/ Renewal	900/1800 MHz	2009	19 MHz	270 ⁵⁰	14.21	0.507
Sri Lanka	20	Renewal	900/1800 MHz	2008 ⁵¹	13.5 MHz	5	0.37	0.018
Indonesia	234	Auction	2100 MHz	2006	90 MHz	1 000	11.1	0.047
Singapore	5	Renewal	900 MHz	2008	30 MHz	5.4	0.18	0.036
			1800 MHz		60 MHz			
		Auction	1800 MHz	2011	5 MHz	17.1	3.42	0.687
Hungary	10	Renewal	900 MHz	2007	8 MHz	49.43	6.18	0.617
Bulgaria	23	n.a.	1800 MHz	2008	10 MHz	11.53	1.15	0.050
Egypt	78	Auction	2100 MHz	2006	20 MHz	3 004	150.2	1.925
Hong Kong (China)	7	Auction	1800 MHz	2009	5 MHz	5.99	1.2	0.171

Source: Windsor Place Consulting analysis of industry sources, March 2011

⁴⁹ Licenses issued on a regional basis. 5 MHz paired per license issued. 'Total upfront fee' represents fee for all 5 MHz licences.

⁵⁰ Actual payment is we understand much less.

⁵¹ Granted in 2006 but effective in 2008.

Assuming the MPT undertakes to reallocate 2 x 10 MHz of its GSM 900 MHz band, it is possible to quantify a reasonable spectrum and licence fee that bidders should expect to pay. Based on Myanmar’s estimated GDP per capita of USD 1 200 per annum a figure of USD 0.40 – 0.50 per MHz per million population is justifiable. As Table E.2 shows, similar prices were levied in equivalent Indian states of Haryana, Punjab, Himachal Pradesh and Kerala during the 2010 3G spectrum auctions.

Table E.2: 2010 Indian spectrum auctions

Circle	5 MHz Paired licenses issued	USD Total	Price / MHz (USD)	Population (2011)	GDP per capita (USD) (2010)	Price per MHz / million pop (USD)
Haryana	3	143 307 268	9 553 817	25 353 081	1 663	0.38
Punjab	4	276 433 183	13 821 659	27 704 236	1 312	0.50
Himachal Pradesh	4	31 960 521	1 598 026	6 856 509	1 063	0.23
Kerala	3	201 189 034	13 412 602	33 452 106	1 250	0.40

Exchange rate used: IND : USD = 46.59485 as at 10 May 2010

It is estimated that the granting of two or three new telecommunications licenses would mean that the government would secure at least USD 300 to 500 million in upfront payments. The figure may indeed be much higher if there is a significant keenness on a number of foreign operators to enter the Myanmar market.

Appendix F: Frequency arrangements for implementation of IMT

Recommendation ITU-R M.1036-4 dealing with Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications (IMT) in the bands identified for IMT in the Radio Regulations (RR) provides guidance on the selection of transmitting and receiving frequency arrangements for the terrestrial component of IMT systems.

The frequency arrangements are recommended from the point of view of enabling the most effective and efficient use of the spectrum to deliver IMT services – while minimizing the impact on other systems or services in these bands – and facilitating the growth of IMT systems.

General considerations regarding technological aspects:

- IMT (IMT-2000 and IMT-Advanced) radio interfaces currently include two modes of operation – frequency division duplex (FDD) and time division duplex (TDD);
- there are benefits in the use of both FDD and TDD modes in the same band; however, this usage needs careful consideration to minimize the interference between the systems, especially, if flexible FDD/TDD boundaries are selected, there may be a need for additional filters in both transmitters and receivers, guard bands that may impact spectrum utilization, and the use of various mitigation techniques for specific situations;
- that selectable/variable duplex technology is considered to be one technique that can assist in the use of multiple frequency bands to facilitate global and convergent solutions. Such a technology could bring further flexibility that would enable IMT terminals to support multiple frequency arrangements;
- when frequency arrangements cannot be harmonized globally, a common base and/or mobile transmit band would facilitate the development of terminal equipment for global roaming. A common base transmit band, in particular, provides the possibility to broadcast to roaming users all information necessary to establish a call;
- guard bands for IMT systems should be minimized to avoid wasting spectrum;
- when developing frequency arrangements, current and future advances in IMT (e.g. multimode/multiband terminals, enhanced filter technology, adaptive antennas, advanced signal processing techniques, techniques associated with cognitive radio systems, variable duplex technology and wireless connectivity peripherals) may facilitate more efficient use and increase overall utilization of radio spectrum; and
- on the aspect of frequency availability it is recommended that administrations make available the necessary frequencies for IMT system development in a timely manner.

The frequency bands identified for IMT services (that accommodate all the technologies) are shared bands with footnotes:

<u>Band (MHz)</u>	<u>Radio Regulation Footnotes identifying the band for IMT</u>
450-470	5.286AA
694-790/698-806* /790-862*	806 – 960 ADD 5.3XX, MOD 5.313A, MOD 5.317A
1 710–1 885, 1 885-2 025	5.384A, 5.388
2 110-2 200	5.388
2 300-2 400	5.384A
2 500-2 690	5.384A
3 400-3 600	MOD 5.430A, 5.432A, 5.432B, 5.433A

World Radio Conference – 1992

World Administrative Radio Conference –2000

World Administrative Radio Conference – 2007

World Administrative Radio Conference – 2012 (Allocation shall enter into force immediately after WRC 2015)

* 790-862 MHz (Allocation for Region 1& 3)

698-790 MHz (Allocation for Region 2 & 9 countries in Region 3: Bangladesh, China, Rep. of Korea, India, Japan, New Zealand, Papua New Guinea, Philippines, and Singapore)

By taking these Radio Regulations footnotes and relevant resolutions into account, administrations have the flexibility to decide on using these bands at the national level according to each administration's evolution/migration plan.

A minimized number of globally harmonized frequency arrangements in the bands identified for IMT-2000 by one or more conferences will:

- facilitate worldwide compatibility; and
- facilitate international roaming.

Annex 1 (Sections 1 to 6) of Recommendation ITU-R M.1036-4 describes the frequency arrangements for implementation of IMT in the bands identified for this service in the Radio Regulations (RR).

The order of the frequency arrangements does not imply any priority. Administrations may implement any of the recommended frequency arrangements to suit their national conditions. Administrations may implement all or part of each frequency arrangement.

It is noted that administrations may implement other frequency arrangements (for example, arrangements which include different duplex schemes, different FDD/TDD boundaries, etc.) to fulfil their requirements. These administrations should consider geographical neighbouring deployments as well as matters related to achieving economies of scale, facilitating roaming, and measures to minimize interference.

Administrations should take into account the fact that some of the different frequency arrangements in the same band have an overlap of base station transmitter and mobile station transmitter bands. Interference problems may result if different frequency arrangements with such overlaps are implemented by neighbouring administrations.

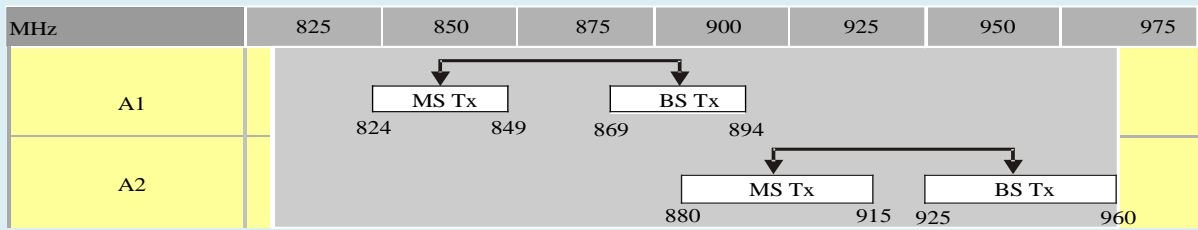
Annex 1 describes ten frequency arrangements for the implementation of IMT in the band 450-470 MHz. The number of frequency arrangements help to accommodate incumbent operations, while maintaining a common uplink/downlink structure (uplink in the lower 10 MHz, downlink in the upper 10 MHz) for FDD arrangements.

The recommended frequency arrangements for implementation of IMT in the band 698-960 MHz are summarized in Table F.1 and in Figure F.1.

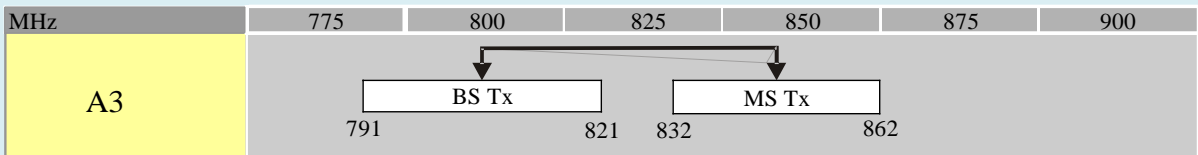
Table F.1: Paired Frequency arrangements in the band 698-960 MHz

Frequency arrangements	Paired arrangements				Un-paired arrangements (e.g. for TDD) (MHz)
	Mobile station transmitter (MHz)	Centre gap (MHz)	Base station transmitter (MHz)	Duplex separation (MHz)	
A1	824-849	20	869-894	45	None
A2	880-915	10	925-960	45	None
A3	832-862	11	791-821	41	None
A4	698-716 776-793	12 13	728-746 746-763	30 30	716-728
A5	703-748	10	758-803	55	None
A6	None	None	None		698-806

Figure F.1: Frequency arrangements for the 698 to 960 MHz band

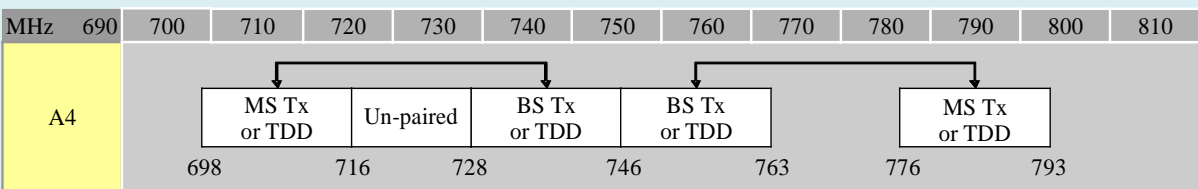


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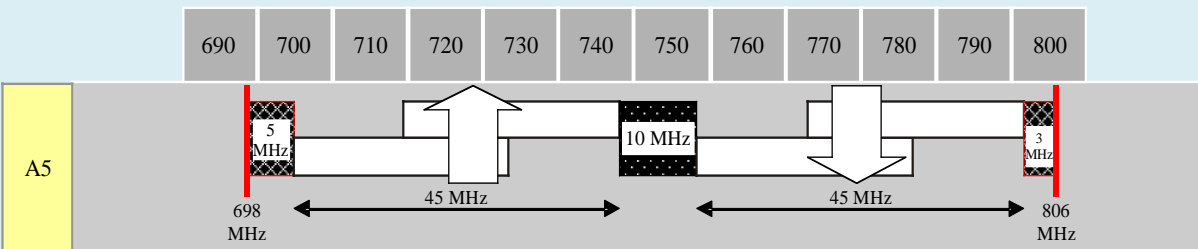


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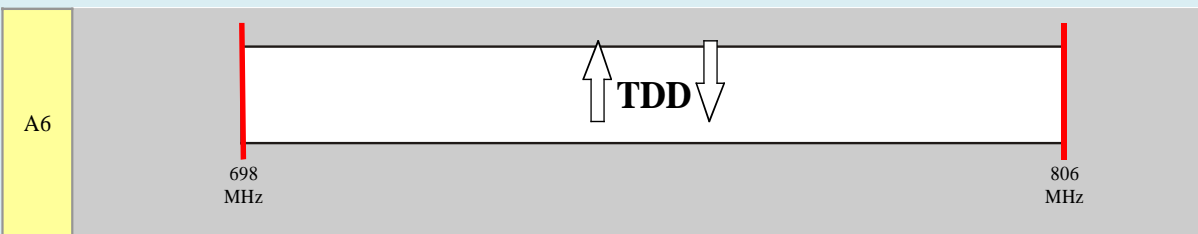
Source: ITU



M.1036-03-Ann2



M.1036-04-Ann2



M.1036-05-Ann2

Source: ITU

Due to different usages in 698-960 MHz between regions, no common solution is possible.

In the arrangement A3, reversed duplex direction (mobile transmit in upper band and base transmit in lower band) provides better conditions for coexistence with the lower adjacent broadcasting service.

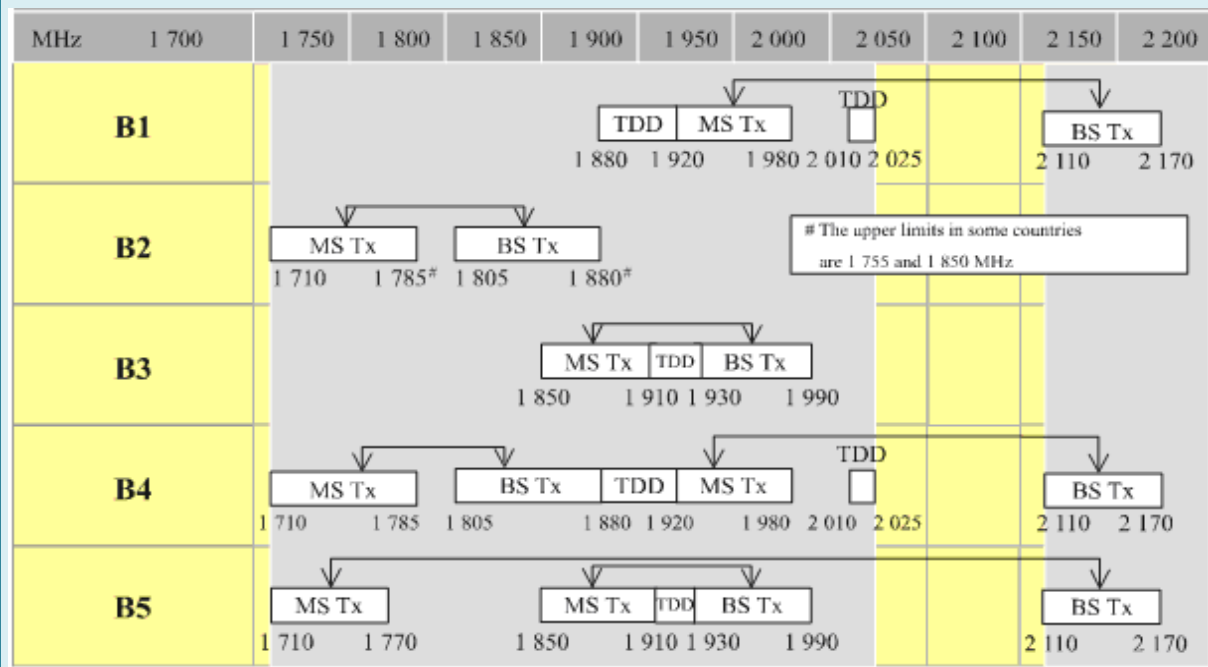
In arrangement A4, administrations can use the band solely for FDD or TDD, or some combination of FDD and TDD. Administrations can use any FDD duplex spacing or FDD duplex direction. However, when administrations choose to deploy mixed FDD/TDD channels with a fixed duplex separation for FDD, the duplex separation and duplex direction as shown in A4 are preferred.

In A5, 2 x 45 MHz FDD arrangement uses sub blocks with dual duplexer solution and conventional duplex arrangement. Internal guard bands of 5 MHz and 3 MHz are provided at the lower and upper edge of the band for better co-existence with adjacent radio communication services.

In A6, taking into account the external 4 MHz guard band (694-698 MHz), a minimum internal guard-band of 5 MHz at the lower edge (698 MHz) and 3 MHz at the upper edge (806 MHz) needs to be considered.

Frequency arrangements in the band 1710-2200 MHz are depicted in the Figure F.2.

Figure F.2: Frequency arrangements in the 1710-2200 MHz band.



Source: ITU

In bands 1710-2025 MHz and 2110-2200 MHz three basic frequency arrangements (B1, B2 and B3) are already in use by public mobile cellular systems including IMT. Based on these three arrangements, different combinations of arrangements are recommended as described in B4 and B5.

Frequency arrangements in the band 2300-2400 MHz and 2500-2690 MHz are summarised in Figure F.3.

Figure F.3: Frequency arrangements in the 2300 to 2400 and 2500 to 2690 MHz bands

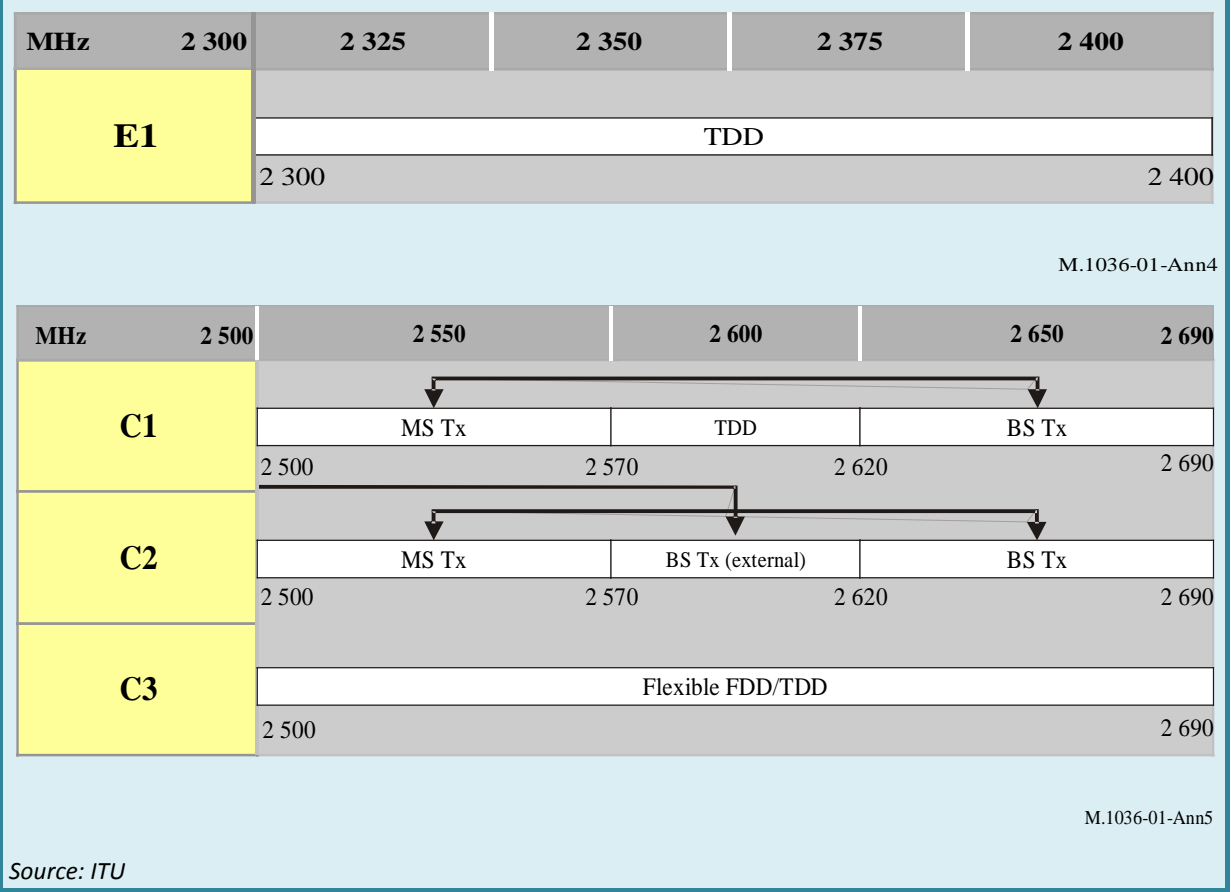
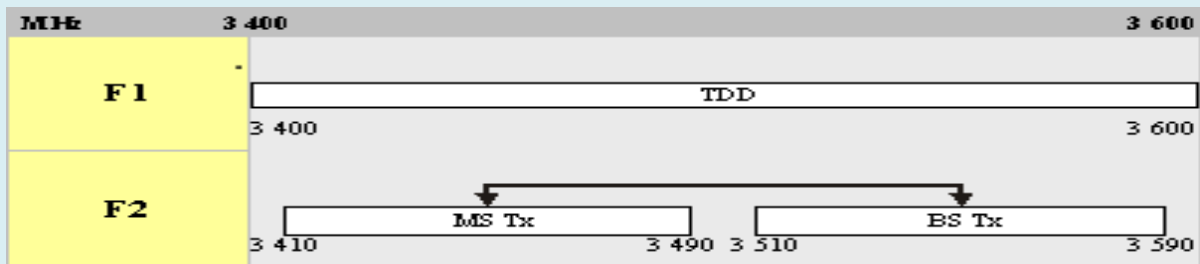


Figure F.4 describes frequency arrangements for the band 3400 to 3600 MHz.

Figure F.4: Frequency arrangements in the 3400 to 3600 MHz bands

Frequency arrangements	Paired arrangements				Un-paired arrangements (e.g. for TDD) (MHz)
	Mobile station transmitter (MHz)	Centre gap (MHz)	Base station transmitter (MHz)	Duplex separation (MHz)	
F1					3400 – 3600
F2	3410 – 3490	20 MHz	3510-3590	100 MHz	None



Source: ITU

Annex 1: List of acronyms and abbreviations

<i>3GPP</i>	<i>The 3rd Generation Partnership Project</i>
<i>ACMA</i>	<i>Australian Communications and Media Authority</i>
<i>APT</i>	<i>Asia Pacific Telecommunity</i>
<i>ARPU</i>	<i>Average Revenue per User</i>
<i>AWS</i>	<i>Advanced Wireless Services</i>
<i>BWA</i>	<i>Broadband Wireless Access</i>
<i>EGAN</i>	<i>3GPP Enhanced Generic Access Network</i>
<i>FCC</i>	<i>US Federal Communications Commission</i>
<i>FDD</i>	<i>Frequency Division Duplexing</i>
<i>GCF</i>	<i>Global Certification Forum</i>
<i>GPRS</i>	<i>General Packet Radio Service</i>
<i>GSM</i>	<i>Global System Mobile</i>
<i>HSPA</i>	<i>High Speed Packet Access</i>
<i>ITU</i>	<i>International Telecommunication Union</i>
<i>ITU-R</i>	<i>ITU Radiocommunication Sector</i>
<i>IWLAN</i>	<i>Interworking Wireless LAN</i>
<i>LTE</i>	<i>Long Term Evolution</i>
<i>M2M</i>	<i>Machine to Machine</i>
<i>MBMS</i>	<i>Multimedia Broadcast/Multicast Service</i>
<i>MDGs</i>	<i>Millennium Development Goals</i>
<i>Ministry</i>	<i>Ministry of Communications, Posts and Telegraphs</i>
<i>MPT</i>	<i>Myanmar Posts and Telecommunications</i>
<i>MVNO</i>	<i>Mobile Virtual Network Operator</i>
<i>OOB</i>	<i>Out-of-band</i>
<i>PPP</i>	<i>Public private partnership</i>
<i>PSTN</i>	<i>Public Switched Telephone Network</i>
<i>PTD</i>	<i>Posts and Telecommunications Department within the Ministry</i>
<i>RAN</i>	<i>Radio Access Network</i>
<i>RLANS</i>	<i>Radio Local Area Networks</i>
<i>SMS</i>	<i>Short Message Service</i>
<i>SRSPs</i>	<i>Standard Radio System Plans</i>
<i>TDD</i>	<i>Time Division Duplexing</i>
<i>UMA</i>	<i>Unlicensed Mobile Access</i>
<i>UMTS</i>	<i>Universal Mobile Telecommunications System</i>
<i>WBB</i>	<i>Wireless Broadband</i>
<i>W-CDMA</i>	<i>Wideband Code Division Multiple Access</i>
<i>Wi-Fi</i>	<i>Wireless Fidelity</i>
<i>WiMAX</i>	<i>Worldwide Interoperability for Microwave Access</i>
<i>WRC-07</i>	<i>World Radiocommunications Conference 2007</i>
<i>WRC-12</i>	<i>World Radiocommunications Conference 2012</i>

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