Regulatory Update
(Next Steps for Faster Broadband and 5G Adoption)

Seint Seint Aye
Director
Posts and Telecommunications Department

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Contents

Telecom Sector Liberalisation started in late 2012

Adoption of new rules/policy	▪ *Telecommunications Law 2013* issued October 2013 ▪ Five Rules (Licensing, interconnection, Competition, Numbering, Spectrum) ▪ Guidelines on Provision of International Gateway Services ▪ Other relevant rules (short range device, power limit, band plan, etc)
Institution Reform	▪ Separation of Posts from Telecoms ▪ Creation of Information Technology and Cyber Security Department (ITCS) within MOTC ▪ Independent Myanmar Communications Regulatory Commission to be established (Law Drafted). In the interim, PTD is responsible authority ▪ Corporatization of MPT (Law was enacted and yet to come into effect) and currently joint operation with Sumitomo and KDDI from Japan.
Nationwide Operators	▪ 5 February 2014 issued 2 new Integrated Nationwide Licenses (TML & OML) ▪ 24 March 2015 issued MPT Integrated Nationwide License (MPT) ▪ 12 January 2017 issued 4th Integrated Nationwide License (TIM)
Regional Operators	▪ TDD 2600 MHz in late 2016 via Auction
Licensing Regime	▪ 4 license categories: NFS(I), NS, NFS(C) and AS ▪ Total Number of Licences: > 180

Significant Reform Achievements

Indicator	Before Telecom Reform	2019
Nationwide Telecom Operator	- MPT	- 4 nationwide licensees plus regional broadband licensees
Telephone density	- About 13%	- 127.75 %
Internet Users / Penetration	- Less than 2 million	- 45.37 million (85.83%)
National Fiber Backbone	- 7600 Km at 2013	- More than 69,000 km
International Submarine Cable	- SEA-ME-WE-3	- SEA-ME-WE-3,(2000) - SEA-ME-WE-5 (13-12-2016) - AAE1 (Ongoing Project)
Cross-border Fiber	- China (Muse), - Thailand (Myawaddy)	- China (Muse), - Thailand (Myawaddy, Tachilek, Three Pagoda, Mawtaung) - India (Tamu) - Laos (Tachilek)
International Bandwidth	- 30 Gbps in 2013	- 626.3 Gbps
International Gateway	- 1	- 14 Nos (including 4 Operators)
Mobile Sites	- Less than 3,000	- More than 22,000 Sites
Mobile Broadband Speed	Not known	- From Opensignal Report May 2019, download speeds from 14.0 to 18.9 Mbps with 4G availability up to 92.9%
Smartphone penetration	-	- 80% of Total Mobile Handset
Coverage (Population/ Geographic)	-	- 94.18% (Population) / 64.24% (Geographic)

IMT Spectrum Landscape in Myanmar Today

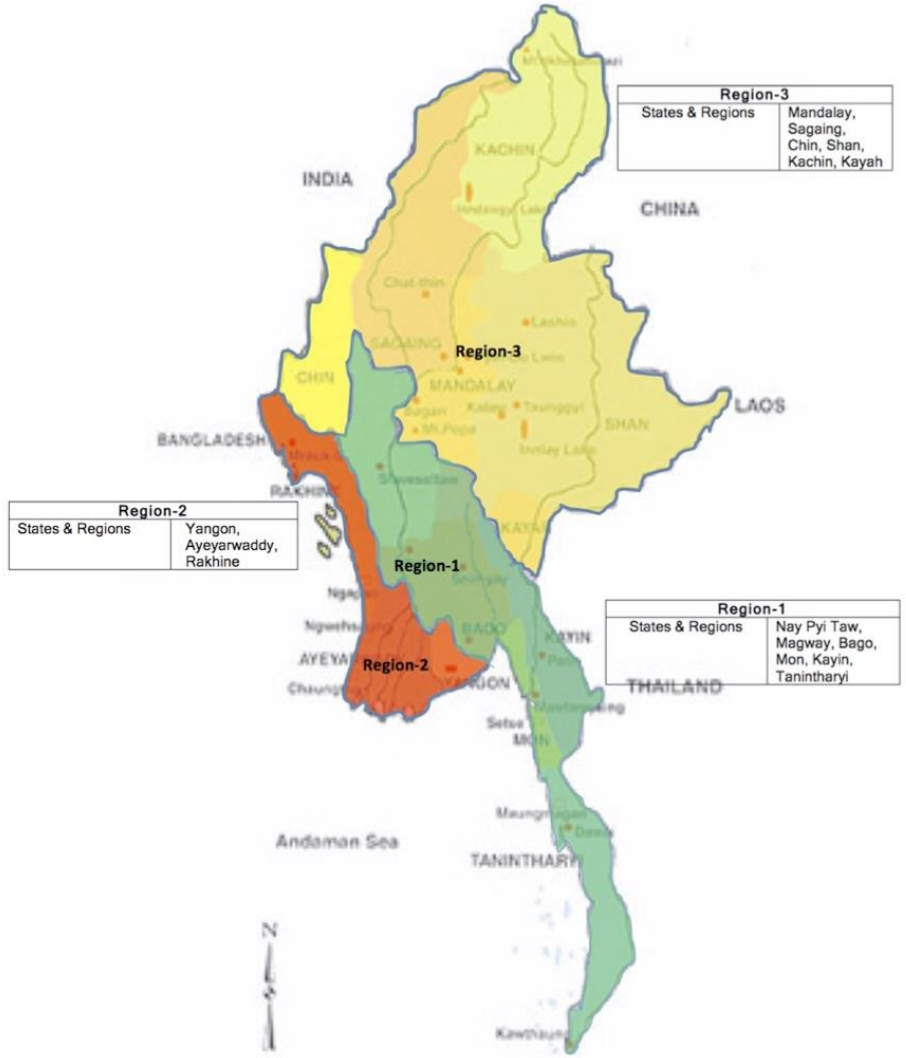
MHz	MPT	telenor	ooredoo	mytel / TIM
2100	15+15 MHz (FDD) 3G/4G	15+15 MHz (FDD) 3G/4G	15+15 MHz (FDD) 3G/4G	15+15MHz (FDD)
1800	20+20 MHz (FDD) 4G	20+20 MHz (FDD) 4G	20+20 MHz (FDD) 4G	15 + 15 MHz (FDD)
900	10+10 MHz (FDD) 2G/3G	7.5+7.5 MHz (FDD) 2G/3G	7.5+7.5 MHz (FDD) 3G	5+5 MHz (FDD)
800	6.25 +6.25 MHz (FDD) 2G/3G			
450	3.75 + 3.75 MHz (FDD) 2G			
Total	110 MHz	85 MHz*	85 MHz	70 MHz

IMT Spectrum Landscape in Myanmar Today (2)

Successful spectrum auction of regional 2.6 GHz spectrum in 2016

MHz	TDD Lot 1 20MHz	TDD Lot 2 20MHz
	2575 MHz	2595 MHz — 2615 MHz

Region 1	FORTUNE BROADBAND, Global Technology Group
Region 2	ananda
Region 3	ananda



Myanmar Broadband Market Overview

Mobile Network Operators

- Myanmar has four mobile network operators ('MNOs') which collectively account for the major share of market activity:
  - Myanmar Post and Telecommunications ('MPT')
  - Ooredoo Myanmar
  - Telenor Myanmar
  - Mytel

Wireless Broadband Operators

Operator	2.6 GHz Spectrum Region
Fortune International Ltd	Region 1 (Nay Pyi Taw, Magwe, Bago, Mon, Tanintharyi)
Global Technology Co., operating under the "5BB" brand name	Region 1
Amara Communications Co. Ltd, operating under the "Ananda" brand name	Region 2 (Yangon, Ayeyawaddy, Rakhine) Region 3 (Mandalay, Saigaing, Chin, Shan, Kachin, Kayah)

- The 2016 2.6 GHz spectrum auction enabled three operators to emerge in the wireless broadband ('WBB') space.
- Myanmar also has a number of WBB operators which use public or unlicensed spectrum though use of such spectrum carries operating risks such as interference and congestion.

Myanmar Broadband Market Overview

Fixed Infrastructure Providers

- Major suppliers in this market segment include Myanmar Speedlink, Welink and Ocean Wave.
- Such operators deploy fibre optic cable underground or overhead on their own or existing poles.

Internet Service Providers

- There is a large number of Internet Service Providers (ISPs) who provide retail broadband services to end users. These operators do not operate their own networks as such, but buy wholesale broadband network capacity from the fixed and wireless broadband infrastructure providers and re-package this for their retail customers.

Infrastructure Providers

- Major infrastructure providers in Myanmar include Irrawaddy Green Towers ('IGT'), Apollo, Edotco, Myanmar Fibre Optic Communications Network Co. Ltd ('MFOCN') and Eager Communications.

International Capacity Providers

- In 2016 the PTD began accepting applications from foreign owned operators for licences to supply International Gateway ('IGW') services.
- Myanmar now has a large number of operators that provide IGW services for service operators,

National Broadband Vision: Background

- MoTC and PTD recognize the fundamental importance of broadband services to drive Myanmar's economic and social development.

- This recognition has played out in the adoption of various broadband policy positions and various actions including the introduction of competition, the introduction of new rules and the release of frequency spectrum in recent years.

- This has resulted in a significant uptake of broadband services in Myanmar to the point where **broadband penetration currently stands at around 82%.**

- The PTD notes that while this is a significant achievement there is more that can be done. In particular, Myanmar's broadband penetration is:
  - Below that of many of its ASEAN peers;
  - Heavily skewed to mobile (3G and 4G) broadband; and
  - skewed to the major population centres of Yangon, Mandalay and Nay Pyi Taw.

Key Steps Required to Facilitate Broadband Connectivity

Setting Broadband Targets

- Set targets are intended to be both aspirational and achievable.
- Achieving the targets will require all stakeholders to commit to them and to take positive actions towards their achievement including making broadband services in Myanmar affordable.

Issuing New Rules Addressing Telecommunications Right of Way

- Following broad consultation the *Facilitating Telecommunications Rights of Way Rules* will be promulgated.
- Rules aim to regulate the establishment of underground and overground telecommunication infrastructure

Facilitating Fixed Broadband and 5G Infrastructure Deployment

The PTD will be tasked to investigate way to facilitated fixed broadband infrastructure deployment including but not limited to:

- the establishment of a national infrastructure database to permit ‘check before you dig’ services;
- encourage greater infrastructure sharing for broadband and 5G deployment based on other ASEAN models; and
- develop in-building telecommunications standards customised for Myanmar.

Key Steps Required to facilitate Broadband Connectivity

Releasing More IMT Spectrum For Wireless Broadband And 5G Deployment

- Knowing that there will be sufficient spectrum in the future to support both 4G and 5G service offerings, MNOs in Myanmar can confidently make the necessary long-term investments in digital infrastructure.

Improving The Quality Of Broadband Services

Creating new QoS standards through

- a new technical standard applying generally in accordance with Section 24 of the Telecommunications Law; and/or
- a requirement to publish quality of service/quality of experience of broadband services Information utilise Condition 13.12 of the Operating Licences.

Facilitating Myanmar Centric Content And Applications

- deployment of digital learning centres in regional areas;
- driving Internet based government service delivery; and
- encouraging local language content and applications development.

Setting Targets for Broadband Connectivity

- **PTD is going to set broadband population penetration targets by network platform and region to work towards over the next five years.**

- **Universal Service Strategy (2018-2022) in Myanmar (To be adopted)**

  - Objectives of the USS include the availability of broadband internet services to all people in Myanmar and the specific target of 95 percent coverage at 5Mbps by 2022
  - When the USS was promulgated in January 2018, coverage was at approximately 80 percent.

- The Ministry established the Universal Service Fund (USF) which is charged with implementing the USS

- A target average speed of 100Mbps by 2024 for 50 percent of fixed and wireless broadband services, which would align Myanmar with regional exemplars.

Strategies for Achieving Broadband Targets (1)

In order to reach the targets it has set and ensure the on-going benefits to Myanmar's citizens from broadband service, the PTD believes that multiple coordinated strategies need to be implemented.

The following key strategies are considered to be designed to address various obstacles and impediments that, if not overcome, limit Myanmar's broadband service capacity.

Reduce the costs of network infrastructure

- Adopt national guidelines for obtaining approvals
- Adopt a one stop approval process
- Create a national database of telecommunications infrastructure
- Encourage infrastructure sharing
- Develop in-building telecommunications standards.

Facilitate the development of Internet content and usage

- Deployment of DLCs in regional areas
- Encouraging local language content and applications development
- Driving Internet-based government service delivery

Strategies for Achieving Broadband Targets (2)

Provide more radio spectrum to support broadband services

- Ensuring that there is sufficient radio spectrum available to operators is essential for effective broadband service deployment
- The PTD is currently consulting with industry on the review of Myanmar's spectrum roadmap

More spectrum and better utilisation lead to better economic outcomes

TECHNICAL BENEFITS

- significant bandwidth increase
- supports asymmetric use patterns
- highly efficient spectrum use
- lower capex & opex compatitable with low ARPU market
- pre-positioning for new technologies

MICROECONOMIC BENEFITS

- improved quality of service
- new services & businesses
- encourages domestic app companies
- faster deployments
- availability and affordability
- maintaining leading service quality
- low cost upgrade path

MACROECONOMIC BENEFITS

- higher productivity
- more innovation
- more app economy companies
- getting to the app economy sooner
- creater competitiveness
- more jobs, lower unemployment
- economic growth
- higher living standards

The followings are 5G Candidate Spectrum Bands currently we seen

Best Coverage	Coverage + Capacity	Super Capacity

- ✓ 900MHz
- ✓ 850MHz
- ✓ 700MHz

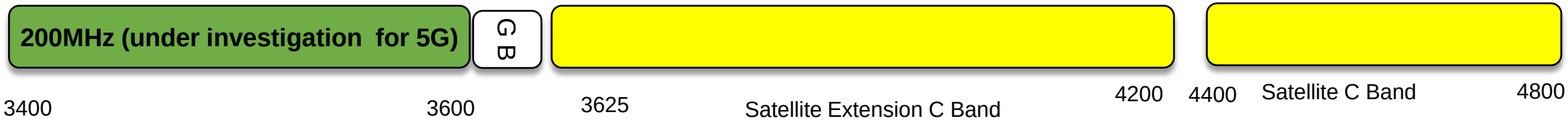
- ✓ 2.6 GHz
- ✓ 2.3 GHz
- ✓ 2.1 GHz
- ✓ 1.8 GHz
- ✓ 1.4 GHz
- √3.5 GHz
- √3.3 GHz
- √4.8 GHz

- ✓ 26GHz
- ✓ 28GHz
- ✓ 38GHz

WRC-19:
50GHz
80GHz
…

Current Middle Band Spectrum in Myanmar

Current Status of C - Band



Current Status of 2.6 GHz Band: 150MHz B.W is reserved out of 190MHz

Band 41 is considered

Region 1

Region 2

Region 3

Current Status of 2.3 GHz Band: 90MHz reserved(free)

Challenges to release IMT spectrum

- The challenge is to release IMT spectrum at reasonable prices in a way which reflects the new spectrum paradigm that:

(i) larger contiguous blocks of IMT spectrum are needed and

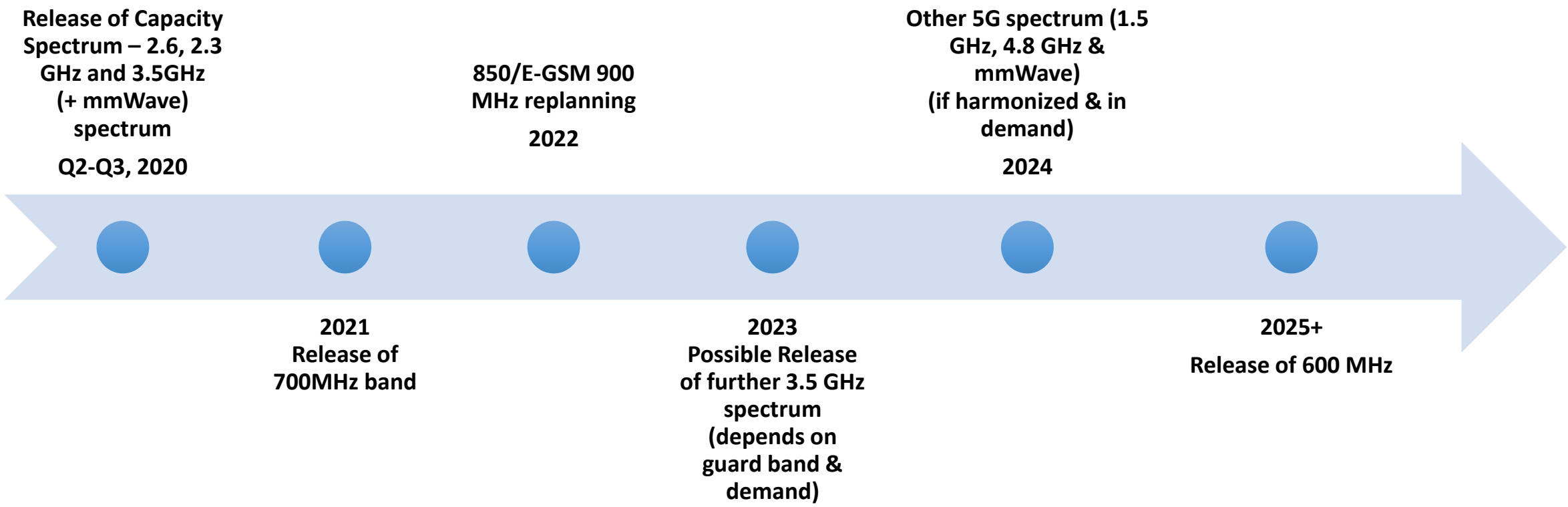
(ii) in overall terms with release of 5G NR, especially post WRC-19, the total of IMT spectrum needed by an individual mobile network operator (MNO) and the market overall will significantly rise.

- Myanmar can avoid the challenges that other countries are facing in relation to legacy spectrum management decisions if it takes good decisions now in relation to the release of future IMT spectrum.

Releasing Spectrum for Broadband Deployment

- As of April 2019, Myanmar has released almost 400 MHz of IMT spectrum.

Tentative Schedule of additional IMT Spectrum in Myanmar



Strategies for Achieving Broadband Targets (3)

Enhancing Quality of Service

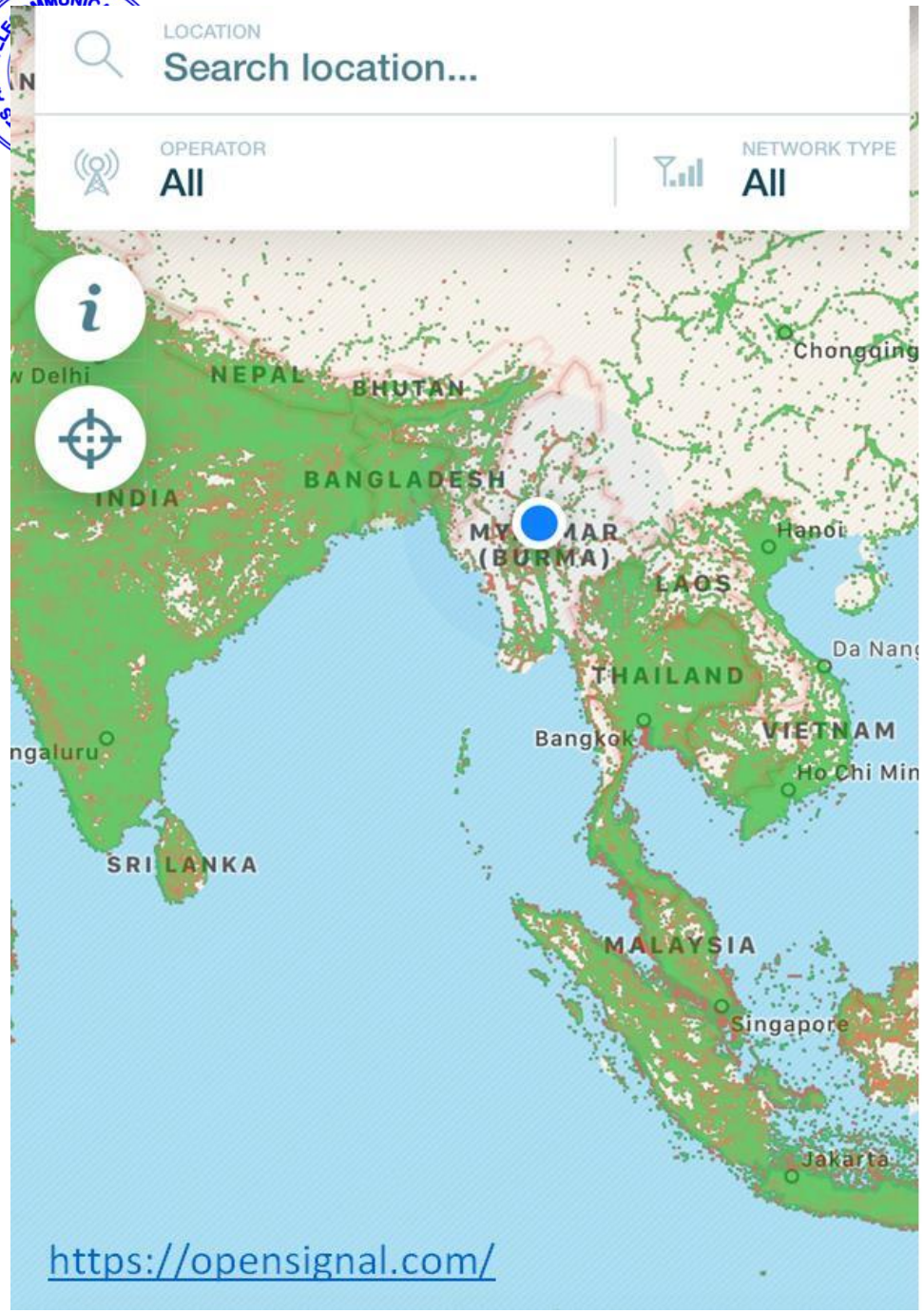
('QoS') refers to the ability of a network or service to satisfy the end user.

"The totality of characteristics of a telecommunications service that bear on its ability to satisfy stated and implied needs of the user of the service." - ITU

By early 2020, following industry consultation, PTD to impose additional requirements in order to improve the QoS/QoE of services. Either through:

a. promulgating a new technical standard in accordance with Section 24 of the Telecommunications Law; and/or

b. the utilise Condition 13.12 of the Operating Licences to require the Publication of Quality of Service Information.



… Next Step for regulatory actions

Connecting the remaining *unconnected* (USO)

Establishment of independent regulator and transitioning into MCRC

Enforcing QoS and taking care of consumer issues

Develop *open access* framework and coordination on implementation

Develop appropriate framework for *vibrant* but *sustainable* competition

Thank You