

Appendix

IMT Spectrum Harmonisation in ASEAN: Building digital infrastructure through spectrum planning towards 2030

February 2026





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The Association of Southeast Asian Nations (ASEAN) was established on 8 August 1967. The ASEAN Member States are Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor Leste and Vietnam. The ASEAN Secretariat is based in Jakarta, Indonesia.

This study, led by GSMA with the support of Windsor Place Consulting and industry partners Ericsson, Huawei and Nokia, was carried out from March 2025 to December 2025 under the framework of the ASEAN Digital Masterplan 2025. The objective is to support ASEAN Member States (AMS) in their spectrum planning processes by providing relevant and up-to-date market, technical and industry information, and best practices in spectrum management.

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Appendix A.

Regulatory frameworks for harmonisation

A1.1 Optimising IMT spectrum harmonisation through legislation and regulation

IMT spectrum harmonisation is optimised when sound regulatory frameworks are in place. Given the range of legal frameworks in the ASEAN region, identifying best practices in relation to spectrum harmonisation can shed light on exemplar spectrum regulation and provide guidance for individual ASEAN Member States (AMS) that are still developing their regulatory regimes. Best regulatory practices that AMS should adopt include:

- **IMT spectrum roadmaps**, which provide regulatory certainty around meeting future spectrum demand. An effective roadmap typically identifies key IMT spectrum in consultation with relevant stakeholders, approaches for clearing spectrum and possible mitigation measures, technical definitions and restrictions, assessing the value of spectrum, the design of spectrum awards and award implementation.¹
- **Spectrum re-farming**, which involves the repurposing of frequency bands previously assigned for older technologies for use by new generations of mobile technologies. Regulatory arrangements that allow for spectrum re-farming can therefore provide regulators with greater flexibility to effect changes in the existing assignment of spectrum.²
- Legal frameworks that permit **spectrum trading** enable defragmentation, a process whereby spectrum holdings are traded or swapped between mobile network operators (MNOs) so that all holdings within a band are brought together. Contiguous larger spectrum blocks achieve higher efficiency and, in turn, permit the more competitive deployment of new technologies such as 5G³ and in the future, 6G.
- While mobile services have traditionally followed exclusive licensing regimes, frameworks that allow for **spectrum sharing** can complement these regimes by allowing access to new bands in rural areas or in areas without existing networks. The regulatory implementation of spectrum sharing must nonetheless be properly designed for it to function properly. As such, the GSMA has found that spectrum sharing will only be useful if the proposed band is harmonised for mobile use and available in sufficient quantities given a particular technology (e.g. wide bands are needed for 5G use).⁴
- **Technology-neutral** spectrum licences are important because they give MNOs the flexibility to introduce new technologies that are typically more spectrally efficient (and cost effective) in response to market demand and their own network roadmaps. Without this, uncertainty and delays may hinder network investment, affecting roll-out, service quality, costs and connectivity.⁵
- **Reasonable spectrum charging**, which takes account of market forces to set modest minimum prices, prioritises the full and efficient utilisation of spectrum resources, helps MNOs manage risk and adopts a long-term perspective.⁶

¹ GSMA. (December 2024). [Accelerating 5G and 5G-Advanced in Thailand: A Roadmap for Success](#); GSMA. (April 2022). [Roadmaps for awarding 5G spectrum in the APAC region](#).

² ACMA. (February 2016). [Mobile broadband strategy – the ACMA’s spectrum management strategy to address the growth in mobile broadband capacity](#).

³ Australian Mobile Telecommunications Association. (June 2024). [Spectrum Policy Paper – How mobile spectrum is essential to Australia’s prosperity](#).

⁴ GSMA. (June 2021). [Spectrum Sharing: GSMA Public Policy Position](#).

⁵ GSMA. (April 2022). [Roadmaps for awarding 5G spectrum in the APAC region](#).

⁶ GSMA. (February 2017). [Effective Spectrum Pricing: Supporting better quality and more affordable mobile services](#).

Regional spectrum management legislation and regulation

Many ASEAN countries have made considerable progress through recent updates and amendments to their spectrum laws, regulations and guidelines, including Indonesia (2020), Thailand (2021), Lao PDR (2022), Singapore (2022), Vietnam (2022), Malaysia (2024), Timor-Leste (2024) and most recently the Philippines (2025).

In the case of **Indonesia**, the Omnibus Law on Job Creation (*Omnibus Law 2020*) made a number of important changes with respect to spectrum management issues,⁷ *inter alia*:

- Introduced significant changes to Indonesia's telecommunications sector regulatory framework by permitting telecommunications operators to cooperate in spectrum sharing for new technologies and to transfer spectrum rights to each other. It granted the central government the authority to regulate spectrum sharing arrangements among Indonesian operators.
- In Section 60A, provides that the migration of terrestrial television broadcasting from analogue technology to digital technology shall be completed no later than two years from the enactment of the Law and hence freeing up the digital dividend in the 700 MHz band. The ASO in Indonesia greatly assisted spectrum harmonisation in the southern part of ASEAN, including allowing Malaysia and Singapore to also assign this band for IMT services.
- In Section 34, clarifies some previously unclear provisions in existing regulations, for example, as to who should pay the annual radio frequency spectrum fee to the state (i.e. the spectrum user or the licence holder).
- Article 71 of the Omnibus Law allows the holder of a Radio Frequency Band (in Bahasa Indonesia Izin Pita Frekuensi Radio (IPFR)) licence for telecommunications networks to transfer the rights to use radio frequency spectrum to other network operators.

In **Thailand** in November 2021, an amendment to Section 30, paragraph 1 of the Act on Organization for Assigning Frequency Waves and Regulating the Radio Broadcasting Business Television and Telecommunications (No. 3) B.E. 2562 was announced by a Royal Decree. The Royal Decree supports the spectrum management by the MNOs including:⁸

- Providing more flexible criteria for the MNOs to apply additional business licences, transfer spectrum licences and obtain spectrum licences via other methods apart from auctions.
- Allowing the spectrum holders to trade their spectrum ranges, making it easier to come up with the partnership deal for spectrum usage.

The Office of the NBTC has also drafted four new regulations to support the Royal Decree which covers the amendments to the spectrum management, criteria for applying for a business licence, criteria for spectrum licence transfer, as well as the rules for assignment of spectrum bands via other means other than by auction. The key driver for such amendments was the return of the 2.6 GHz band spectrum by MCOT for IMT services given the importance of the optimal use of spectrum and recognition of the convergence of technologies.⁹

In **Singapore** in 2022, the IMDA updated its *Spectrum Management Handbook*. The handbook provides a comprehensive overview of the IMDA's spectrum management activities, focusing on achieving efficient and effective spectrum assignment and utilisation. Key areas covered include Spectrum Allocations and Band Plan, Frequency Assignment Criteria and Application Procedures, Licensing and Application, Temporary Use of Radio Frequencies and Spectrum Fees.¹⁰

⁷ Herbert Smith Freehills Kramer. (29 October 2020). "[Omnibus Law Heralds Major Changes to Indonesia's Telecommunications Regulatory Regime](#)".

⁸ Bangkok Global Law. (December 2021). "[The New Royal Decree supports deal of True-Dtac regarding telecom spectrum management](#)".

⁹ Bangkok Post. (24 November 2021). "[Decree aids telcos' spectrum management](#)".

¹⁰ Infocomm Media Development Authority. (2022). [Spectrum Management Handbook](#).

In **Lao PDR**, as part of the passage of the Law on Telecommunications (Amended) No. 05/NA dated 16 November 2021 (the “Telecom Law 2021”), which replaced the previous Law on Telecommunications (Amended) No. 09/NA dated 21 December 2011, the radio spectrum for telecommunications purposes was revised to be within the frequency range of 8.3 kHz to 3,000 GHz.¹¹ The assignment and use of the radio spectrum are stipulated under the Law on Radio Frequency No. 17/NA dated 5 May 2017. This is in addition to the decision on frequency wave inspection of November 2020¹² and announcement updating type approval and labelling requirements effective in August 2023, which include a requirement for suppliers to secure an importation licence from the Lao DPR Ministry of Technology and Communications.¹³

Vietnam has also updated its spectrum laws with the recent passage and implementation of the *Law on Telecommunications* No. 24/2023/QH15 and *Law on Radio Frequency* No. 09/2022/QH15 in 2023 and 2022, respectively. Some of the key amendments to the laws include the issuing of a master plan on the division of frequency bands into one or more than one frequency band block for each type of radiocommunication system, and on assignment of such frequency bands to one or more than one organisation for use under specific conditions. The aim is for radio frequency use rights to be effectively assigned to foster a competitive environment in the telecommunications sector.

In **Malaysia** in late 2024, as part of more extensive amendments to *Communications and Multimedia Act*, minor amendments to section 172 were made so that any spectrum plan developed by the MCMC must now be published.¹⁴ In addition, in Section 157, the fine for use of spectrum without assignment was increased to MYR 100,000 (USD 22,500) per day after conviction.

Timor-Leste has also made amendments to its spectrum laws. In 2024, *Decree-Law No. 31/2024* amended the *Decree-Law No. 15/2012*, which clarified licensing types for radio spectrum use and introduced individual, network and general licences. The purpose of the amendments was to reduce uncertainties in interpretation by more clearly identifying the types of radio frequency spectrum usage licences.¹⁵

In the case of the **Philippines**, the recent lapsing into law of the *Konektadong Pinoy Act* in 2025 creates a more modernised framework for the management of spectrum. This includes a legislative requirement to develop a spectrum roadmap, rules and procedures for spectrum recall, joint spectrum use and technology-neutral licences. Notwithstanding these developments, the *Republic Act No.3846*,¹⁶ known as the *Radio Control Law 1931*, is outdated legislation that has yet to be replaced with modern legislation to manage radiocommunications in the Philippines.

Table 1 summarises the key features of ASEAN legislation, regulations and decrees applying to spectrum management in all AMS. Such legal frameworks are the legal basis for securing spectrum harmonisation in the region and, as required, could be further updated, augmented and strengthened to facilitate such an outcome. Further details on individual AMS are provided in Appendix B.

11 VDB Loi. (24 May 2022). “Amended Telecommunication Law – Lao PDR”.

12 See: https://www.laotradeportal.gov.la/upload/files/Legal_1624267898.pdf

13 Logistics Cluster. (2023). *Lao People’s Democratic Republic – 3.4 Telecommunications*.

14 Christopher & Lee Ong. (January 2025). *An Overview of Key Changes Introduced by the CMA Amendment Bill*.

15 Decree-Law No. 31/2024.

16 [Republic Act No. 3846](#).

Table 1:

Summary of spectrum legislation in ASEAN

Indicator	Brunei	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
Radiocommunications or spectrum laws	Telecommunications Order 2001 Telecommunication (Radiocommunication) Regulation 2013	Law on Telecommunications (NS/RKM/1215/017) Sub-Decree No. 217 on the Organization, Management, and Distribution of Radio Frequencies	Law No. 36 of 1999 on Telecommunications Omnibus Law 2020	Law on Telecommunications (Amended) No.09/NA Law on Radio Frequency No. 17/NA dated 5 May 2017	Communications and Multimedia Act (1998) Communications and Multimedia (Spectrum) Regulations 2000	Telecommunications Law of 2013 Spectrum Rules (2016)	Republic Act no. 7925 Republic Act No.3846 Memorandum Circular No. 3-3-96 Konektadong Pinoy Act 2025	Telecommunications Act 1999 Telecommunications (radiocommunications) Regulations	Organization to Assign Radio Frequency and to Regulate Broadcasting & Telecommunications Services (2010) Radio Broadcasting, Television & Telecommunications Businesses Act 2010	Law on Telecommunications No. 24/2023/QH15 Law on Radio Frequency No. 42/2009/QH12
Regulator	Authority for Info-communications Technology Industry (AITI)	Telecommunication Regulator of Cambodia (TRC)	Ministry of Communication and Digital Affairs (Komdigi)/ Direktorat Jenderal Infrastruktur Digital	Telecommunications Regulatory Authority (TRA)	Malaysian Communications and Multimedia Commission (MCMC)	Posts and Telecommunications Department (PTD)	National Telecommunications Commission (NTC) Department of Information and Communications Technology of the Philippines (DICT)	Info-communications Media Development Authority (IMDA)	National Broadcasting and Telecommunications Commission (NBTC)	Ministry of Science and Technology/ VNTA/Authority of Radio Frequency Management (ARFM)
Regulator independence	Yes	Partly	No regulator	Partly	Yes	No	Yes	Yes	Yes	Partly
IMT spectrum roadmap	No	No	No	No	Yes	Yes	Within 1 year of IRR of the Konektadong Pinoy Act becoming effective (Nov 2026)	No	Yes	Yes. New National Radio Frequency Master Plan (Oct 2025)
Legislative requirement for spectrum efficiency	Yes	Yes	No	N/A	Yes	Yes	Yes	Yes	Yes	Yes
Spectrum technology neutral	Yes	Partly (5G permitted from 1 Jan 2026)	Yes	Yes	Partly except for 5G	Yes	Yes	No	Yes	Yes
Term of spectrum licences	20 years	Up to 30 years but annual spectrum licences	10 years	Typically annual renewal	Up to 20 years, depending on type of assignment	15 years	Indefinite	15 years	15 years	Up to 15 years
Spectrum sharing	Yes	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes, with conditions	NA
Spectrum trading	Yes	Yes, conditions apply	Yes	Yes	Yes, conditions apply	Yes, subject to PTD approval	No	Yes	No	Yes, for auctioned spectrum after 5 years
Spectrum re-stacking	Not necessary as one licensee	No. 900 and 1800 MHz bands need restacking	Yes, often	To be confirmed	Yes	Currently contiguous	Needed in a number of IMT bands	Yes	Currently contiguous	Currently contiguous
Regulator's ability to reclaim unused spectrum	Yes	Yes, conditions apply	Uncertain	Yes	Yes	Yes, conditions apply	Yes	Yes	Yes, with compensation	Yes

AMS might also benefit from implementing spectrum relocation funds given the ongoing difficulties in refarming spectrum bands in many markets. Such approaches have proved to be an excellent way globally to facilitate such refarming spectrum based on actual

costs for replacement networks and devices rather than what are often over-inflated negotiated prices. The applicable legal mechanisms for spectrum relocation funds in selected markets are summarised in more detail below.

Box 1: Spectrum relocation funds

The use of relocation funds could be a possible future legislative measure undertaken across ASEAN to facilitate the harmonisation of spectrum in the region. A relocation fund, once created, pays for the costs of spectrum re-organisation and refarming, circumventing the continuing challenges of spectrum being returned to government for prompt reallocation.

A relocation fund has been implemented in France with the Fond de Réaménagement de Spectre (FRS),¹⁷ managed by the Agence Nationale des Fréquences (ANFR). The fund provides advances to incumbent spectrum users that must incur costs to modify equipment when relocating to a different frequency band. The FRS is codified into French law through Articles R20-44-11, R20-44-6, R-20-44-18 and R20-44-14.¹⁸

Funding comes from contributions from public bodies (as regulated by finance annual law), contributions from private bodies for spectrum redeployment purposes (i.e. the beneficiaries of the spectrum that is released as a result of the relocation are responsible for contributing money to the fund) with the ANFR managing and overseeing the process.¹⁹ The financing of the spectrum is decided on a case-by-case basis. The procedure is detailed below:

1. The band user that is being forced to relocate from a frequency band must request assistance from the FRS (Article R20-44-14 10).
2. The ANFR evaluates the cost of relocation to ensure that the sums requested by the user fall within the FRS' regulatory framework and that they correspond to market prices (R20-44-11 9).
3. The Agency submits the results of this evaluation to the Spectrum Redevelopment Fund Advisory Committee (CFRS), which then consults the beneficiaries of the new band use and relevant stakeholders. The committee then issues an opinion on the redevelopment project in question, on the amount of the FRS, the financing agreements and the draft resolutions of the Agency's Board of Directors determining the repayment terms (Article R20-44-18 6). In practice, the CFRS has yet to issue an unfavourable opinion.
4. The Board of Directors deliberate on the advisability of engaging the FRS and on the amount of financing (Article R20-44-14-10). The final decision lies with the Director General (Article R20-44-18 6).

The obligation to reimburse the FRS is included in the authorisations that are issued to MNOs.²⁰

17 ANFR. [Le fonds de réaménagement du spectre](#).

18 See: https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000021544697/2010-01-13; https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000006466412; https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000025622853; and https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000029983016.

19 ANFR. [Le fonds de réaménagement du spectre](#).

20 ANFR. (2 February 2021). See: <https://www.anfr.fr/liste-actualites/actualite/le-fonds-de-reamenagement-du-spectre-un-outil-qui-sest-avere-indispensable-a-la-mise-a-disposition-de-la-bande-35-ghz-pour-la-5g>.

Figure 1

Relocation fund management in France

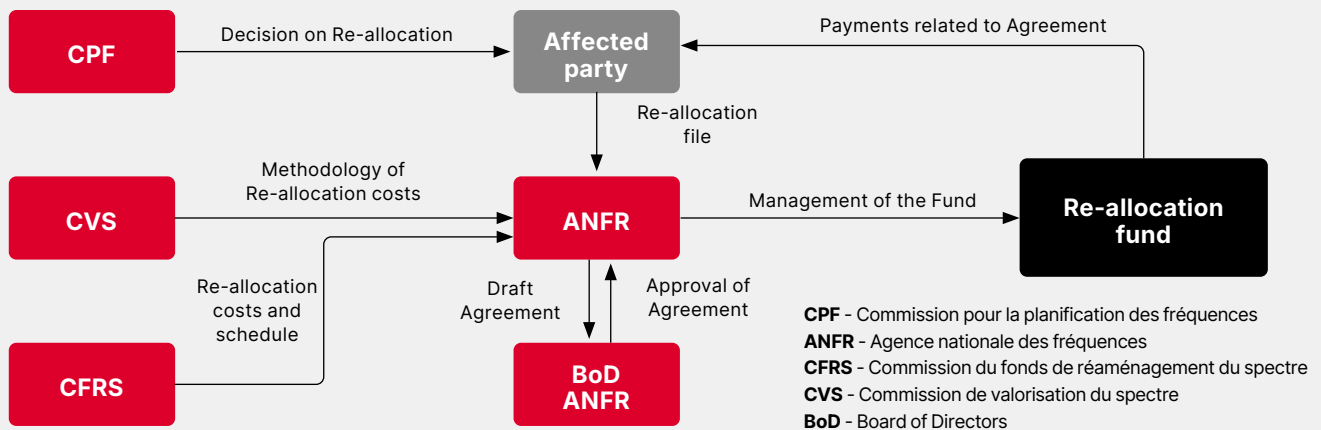


Table 2:

Examples of successful spectrum deployment in France

System	Spectrum quantity	Transferred from	
GSM 900	50 MHz	Defence	1998-2002
GSM 1800	150 MHz	Defence	
UMTS 2 GHz	140 MHz	Defence, France Telecom	
Wifi 2.4 GHz	83,5 MHz	Defence	
Wifi 5 GHz	455 MHz	Defence, Weather forecast, CNES, ARCEP in sharing	2008-2012
UMTS 2,5 GHz	190 MHz	Defence	
IMT 790 MHz	72 MHz	CSA, Defence (830-862 MHz)	
Total MHz	1140,5 MHz		

Source: ANFR

The total cost of restructuring the operation of the 2.6 GHz band was estimated at €25 million (including VAT). For the 800 MHz band, the total cost was estimated at €118 million (including VAT). On 1 January 2013, the successful MNOs were required to pay a third of these costs.

More recently, in November 2021, the 3.4–3.8 GHz band was repurposed using the fund, granting access for use by MNOs. Various public entities (including the military/defence) had to migrate from the band to clear the 3.5 GHz band for 5G technology use. The total cost of repurposing the band was more than €73 million, and the change took place in less than two years.²¹

The United States has also implemented a Spectrum Relocation Fund,²² administered by the Office of Management and Budget in consultation with the National Telecommunications and Information Administration. The funds are available to pay for the relocation or sharing costs of “an eligible Federal entity”. Funds can be used for a variety of purposes, whether for general use (which includes for research purposes) or more specifically to improve the efficiency and effectiveness of federal spectrum use.

21 ANFR. (2 February 2021). See: <https://www.anfr.fr/liste-actualites/actualite/le-fonds-de-reamenagement-du-spectre-un-outil-qui-sest-avere-indispensable-a-la-mise-a-disposition-de-la-bande-35-ghz-pour-la-5g>.

22 See: 47 USC 928: Spectrum Relocation Fund.

A1.2 Analysis of IMT spectrum harmonisation through legislation and regulation

This section discusses the findings of the regulatory review of spectrum legislation in ASEAN. The review found that all AMS have a dedicated telecommunications regulator, although the mere existence of a regulatory body does not guarantee its independence from the government. For instance, Indonesia, Vietnam and Myanmar's regulators are not independent from government administration and operate within existing ministries. While remaining accountable to the legislature or other government bodies is important either way,²³ an independent regulator better promotes fair competition and increases the likelihood of decision-making and being perceived as serving the public interest.²⁴

Licensing terms are crucial in that they delimit the field of technical and financial opportunities available to policymakers wanting to achieve spectrum harmonisation. Several features, as explained earlier in this section, are particularly important in this process. Regarding the technology-neutrality of spectrum licences, our review drew positive conclusions from the fact that a high proportion of AMS have such a licensing system in place. Similarly, spectrum sharing and spectrum trading are a common feature across ASEAN legislative frameworks. Conditions on spectrum trading were widespread, which involve first seeking ministerial or regulatory approval to effect a transfer of spectrum rights.

A1.3 International best practice

Some best practice examples can be drawn from recent legislative reforms undertaken by the Australian Government. In 2020, Australia reformed its spectrum laws through the *Radiocommunications Legislation Amendment (Reform and Modernisation) Act 2020*. The reforms were a response to the recommendations of the 2015 Spectrum Review.²⁶

Some aspects of these reforms may prove quite instructive to AMS seeking to implement legislative features that will best facilitate spectrum harmonisation. Inter alia, some of the reforms included:

- The implementation of longer-term spectrum licences valid for a maximum of 20 years, which were included because longer validity periods better facilitate a high degree of international harmonisation.

By contrast, there were gaps across the different licensing regimes in terms of the inclusion of a legislative requirement for spectrum efficiency. While most countries have included a provision to this effect, countries such as Lao PDR and Thailand seemingly have not. There are clear benefits to enshrining spectral efficiency as a legal standard according to which regulatory bodies must operate. Such a standard encourages transparency on policy objectives and evidence-based decision-making, in addition to providing an avenue for oversight by the legislature and the courts.

Many countries in ASEAN have not codified the regulator's power to restack spectrum. Spectrum restacking allows for the defragmenting and shifting of spectrum to create adjoining or connective spectrum holdings.²⁵

However, nearly all regulators are empowered by legislation to reclaim unused spectrum, which permits the reallocation of spectrum bands that are not being actively used to potentially more effective applications. The ability for regulators to recall spectrum is crucial to achieving the harmonisation of spectrum bands as it makes it possible for policymakers to clear and repurpose unused spectrum for harmonised use.

- Longer-term licences were seen as a positive complementary feature to the availability of technology-neutral frameworks and secondary trading.
- The Australian Communications and Media Authority (ACMA) gained decision-making powers in relation to making unencumbered spectrum available for spectrum licensing (by making a marketing plan), by re-allocating spectrum through the issuing of spectrum licences, apparatus licences or both, and by setting limits in consultation with the competition regulator.

23 The World Bank. (2000). *Telecommunications Regulation Handbook*.

24 Digital Regulation Platform. (9 March 2020). "[Regulatory independence: how to achieve it and how to maintain it](#)".

25 Crozier, R. (6 July 2021). "[Telstra and TPG restack mobile spectrum in Australian first](#)". IT News.

26 ACMA. (2021). [Update to FYSO 2020-2021: Reform implementation](#).

Furthermore, Australia exhibits best practice principles on spectrum management through the release of an annual spectrum roadmap. The regulator ACMA's latest roadmap, the *Five-year spectrum outlook 2025–2030*, contains an extensive examination of future IMT spectrum bands and making such spectrum available.²⁷

While Australia operates in a different geographical and demographic context, these reforms point to potentially useful best practice principles for AMS as they move towards spectrum harmonisation.

Appendix B.

Spectrum laws and regulation in ASEAN

Spectrum regulation – through various laws and subsidiary legislation – enables the efficient use of radio frequency spectrum in accordance with other key policy priorities, such as bridging the digital divide, supporting the digital economy and facilitating economic development. This appendix summarises the existing

laws and regulatory frameworks applying to spectrum management for each ASEAN Member State, a critical aspect to facilitating IMT spectrum harmonisation in the region. The 10 AMS are assessed in alphabetical order below.

B.1 Brunei Darussalam

The Authority for Info-communications Technology Industry of Brunei Darussalam (AITI) is a statutory body in charge of spectrum planning in Brunei. AITI ensures the effective and efficient use of the spectrum by planning, regulating, monitoring and administering, as well as internationally coordinating its use in accordance with ITU Radio Regulations.

The applicable spectrum management regulatory tools are:

- *Telecommunications Order 2001, a subsidiary of Telecommunication (Radiocommunication) Regulation 2013* that provides for the management of radio frequency spectrum
- *Telecommunications (Radiocommunication) (Amendment) Regulations 2022*
- *Brunei Darussalam Radio Spectrum Plan (2019)*
- *Telecommunications (Exemption from Sections 33,34(1)(b) and 35) Notification, 2018* which provides that certain frequency bands can be used without prior authorisation or a licence for example, by devices that use Wi-Fi and Bluetooth.

AITI assigns the right to use spectrum for radiocommunications services, including IMT, through the issuance of spectrum rights or, alternatively, by issuance of apparatus licences. A person may not make use of spectrum without the relevant apparatus licence. Radiocommunications equipment must conform to relevant standards and technical requirements.²⁸ Licences are technology-neutral.²⁹

A person granted spectrum rights may use any specified part of the spectrum for a period of 20 years or less as specified by the AITI. Various assignment methods are available to the Authority, which may use auctions, tenders, assignments for a pre-determined fee or negotiated fee. AITI retains the power to exclude any person from obtaining spectrum rights, for instance, where it is in the public interest, and may also grant spectrum rights subject to conditions. Spectrum sharing and spectrum trading may be authorised by the Authority, and it may also suspend or cancel spectrum rights.

²⁷ ACMA. (2025). *Draft Five-year Spectrum Outlook 2025–30 – consultation*.

²⁸ Sections 24, 28 Telecommunications Order, 2001.

²⁹ ITU Datahub 2022. See: <https://datahub.itu.int/data/?i=100057&e=BRN>.

The Telecommunication (Radiocommunication) Regulation 2013 permits the voluntary and compulsory resumption of spectrum rights. The Authority may ‘resume’ spectrum rights under an agreement entered into with the rights holder. The power to resume is defined by the Act as revoking or varying any condition relating to the range of frequencies contained in the granting of the spectrum right, the duration of the spectrum right or the geographical area covered by the grant.³⁰ In the case of compulsory resumptions of spectrum rights, the Authority must give notice to the rights holder that includes information on the compensation payable to them. Any person aggrieved by the resumption decision may appeal it to the Minister whose decision over the matter is final.³¹

B.2 Cambodia

In the Kingdom of Cambodia, the *Ministry of Posts and Telecommunications (MPTC)* is responsible for the country’s telecommunications policies, strategies and laws across the country,³³ including spectrum assignments

Launched in 2021, *Digital Economy and Society Policy Framework 2021–2035* aims to “build a vibrant digital economy and society by laying the foundations to promote digital adoption and transformation in all social actors including the state, citizens, and businesses, to accelerate new economic growth and promote social welfare in the new normal.”³⁴ The Cambodian government sees the digital sector as both a key engine for growth and a support system for other industries, ensuring long-term economic sustainability. Digital transformation means leveraging ICT and digital advancements to boost productivity and economic efficiency.³⁵

The Telecommunication Regulator of Cambodia (TRC), established by Article 8 of the *Law on Telecommunications (NS/RKM/1215/017)*, operates as an independent entity overseeing the sector. Its duties include implementing national broadband policies, ensuring service quality and fair competition, managing numbering plans and regulating spectrum licensing.

By contrast, the Authority has the discretion to change or withdraw assignments to a licensee without any reason and without paying compensation.³²

On 1 September 2019, Unified National Networks (UNN) officially took over all network infrastructure operated by (then) telecommunications providers DST, TelBru, Progresif and Brunei International Gateway (BIG), to consolidate and modernise all the transferred networks and deliver highly resilient, quality services to the entire nation. As such, all IMT spectrum licences are currently assigned to UNN.

As a key policy measure under Digital Connectivity, Cambodia seeks to develop a comprehensive legal and regulatory framework for the management of radio frequency spectrum resources. This initiative, designated as a short-term objective, falls under the jurisdiction of the Committee on Digital Government within the MPTC.³⁶

The applicable legal regime

Cambodia’s spectrum management is governed by the *Law on Telecommunications (NS/RKM/1215/017)*, promulgated on 17 December 2015. This comprehensive law outlines the regulatory framework for the telecommunications sector, including the management of radio frequency spectrum.³⁷

Chapter 8 of Cambodia’s *Law on Telecommunications* sets out the framework for managing radio frequency resources. According to Article 47, the radio frequency spectrum is classified as a national resource, meaning it is not subject to sale but may be leased or authorised for use through licensing, in line with this law and other applicable regulations. The MPTC is designated as the competent authority responsible for the management of this spectrum. The organisation, management and allocation of radio frequency spectrum shall be determined by sub-decree.³⁸

30 Section 22 Telecommunication (Radiocommunication) Regulation 2013.

31 Section 23 Telecommunication (Radiocommunication) Regulation 2013.

32 Section 31 Telecommunication (Radiocommunication) Regulation 2013.

33 See: [Brief about MPTC](#).

34

35 Ibid, p. 3.

36 Ibid., p. 73.

37 [Law on Telecommunications 2015](#).

38 Ibid., Article 47, Article 48.

Under Article 48, the MPTC is responsible for planning the national radio frequency spectrum, which includes (a) preparing a table of allocated frequencies; (b) regulating access to frequency bandwidth and signal interference; and (c) monitoring and evaluating the use of radio frequency bandwidth. The TRC is empowered to issue regulations to resolve issues involving licence holders, in accordance with *Prakas* issued by the MPTC. Furthermore, all individuals and entities must comply with the national radio frequency spectrum plan.³⁹

Sub-Decree No. 217 on the Organization, Management, and Distribution of Radio Frequencies in Cambodia establishes the regulatory framework for the efficient

allocation and oversight of the country's radio spectrum. The sub-decree outlines the responsibilities of the MPTC as the competent institution responsible for managing the resources of the radio frequency spectrum, satellite radio frequency band and the satellite orbit in Cambodia.⁴⁰

Article 1 of the Sub-Decree determines the principles, rules and competencies for the management of the radio frequency spectrum and satellite radio frequency band, and the satellite orbit is made to organise, distribute and use radio frequencies efficiently and effectively.⁴¹

B.3 Indonesia

The new Ministry of Communication and Digital Affairs (in Bahasa Indonesia: *Kementerian Komunikasi dan Digital*) (Komdigi), replacing the former Ministry of Communication and Information, is responsible for telecommunications policy, including spectrum management. Inside Komdigi, Directorate General of Digital Infrastructure (in Bahasa Indonesia: *Direktorat Jenderal Infrastruktur Digital*) regulates frequency spectrum.

Law No. 36 of 1999 on Telecommunications (Telecommunications Law), is the core legislation governing the telecommunications sector in Indonesia. It was one of over 70 laws amended by the *Omnibus Law on Job Creation (Omnibus Law)*, passed by Indonesia's Parliament on 5 October 2020. The Omnibus Law first passed in 2020 entailed major legislative changes to liberalise Indonesia's telecommunications sector and support the acceleration of Indonesia's digital economy, especially by optimising spectrum use in the 5G era. While subject to constitutional challenges, it was finally ratified in 2023.

Subsequently, on 2 February 2021, the Indonesian Government enacted 49 implementing regulations to the Omnibus Law. These consisted of 45 Government Regulations and four Presidential Regulations including Government Regulation No. 46 of 2021 on Post, Telecommunication and Broadcasting.

With respect to spectrum management issues, importantly the Omnibus Law *inter alia*:

- Allows telecommunications operators to share and transfer spectrum subject to approval from the central government. Spectrum frequency

holders are permitted to have spectrum sharing for the implementation of new technologies (such as MVNOs, advance transportation/infrastructure communication system) and to assign the use of spectrum to other operators.

- The sharing of passive infrastructure has become mandatory for telecommunications operators. Prior to the Omnibus law, this was not a mandatory requirement. The law provides that the central and regional governments may develop new passive infrastructure for common use by operators. The sharing of infrastructure is permitted where mutual agreement has been sought between the parties.⁴²
- The Omnibus Law mandates the migration of terrestrial television broadcasting from analog technology to digital technology within two years from enactment. This in turn freed up the first digital divided in the 700 MHz band.⁴³
- Section 34 of the Law clarifies some previously unclear provisions in existing regulations, for example, as to who should pay the annual radio frequency spectrum fee to the state (i.e. the spectrum user or the licence holder).
- Article 71 of the Omnibus Law allows the holder of a radio frequency band (in Bahasa Indonesia *Izin Pita Frekuensi Radio (IPFR)*) licence for telecommunications networks to transfer the rights to use radio frequency spectrum to other network operators.

Some features of earlier legislative regimes are left untouched by the new Omnibus Law. Pursuant to *Regulation 46 of 2021*, a Radio Frequency Spectrum

³⁹ Ibid., Article 47, Article 48.

⁴⁰ No publicly available source of Sub-Decree 217. It was mentioned in: https://cchrcambodia.org/storage/posts/16171/2023-Fundamental-Freedoms-Monitoring-Report-ENG_FINAL.pdf, p. 9.

⁴¹ Ibid. See also: <https://mptc.gov.kh/en/2020/06/discussion-on-draft-sub-decree-of-radio-frequency-spectrum-resource-management-and-allocation/>

⁴² Section 33 Omnibus Law; see also <https://www.globalcompliancenes.com/2020/11/19/indonesia-omnibus-law-chasing-efficiency-in-the-telecommunications-sector-19102020/>

⁴³ Section 60A Omnibus Law.

license shall comprise a bandwidth licence; apparatus licence and class licence.⁴⁴ Bandwidth licences are valid for up to 10 years⁴⁵ and apparatus licences are valid for up to five years.⁴⁶ It is possible for licence holders to transfer their spectrum rights to other operators, subject to approval from the Minister.⁴⁷

The Minister may “optimise” the use of radio spectrum that has already been licensed through spectrum migration, spectrum re-farming, revocation of the licence and other forms as determined by the Minister.⁴⁸ A spectrum license may also be terminated where there is non-optimal use of spectrum.⁴⁹ The determination of

non-optimal usage is based on a Minister’s evaluation of the deployment of the telecommunications network, the quality of services provided, radio station transmission and the payment of fees.⁵⁰

In January 2025, the Kominfo released Ministerial Regulation No. 2 of 2025, which aims to provide clearer guidelines regarding the use of radio frequency spectrum operating under class licences in Indonesia. The regulation clarifies that IMT can operate within a class licensing framework.⁵¹ Technical standard regulations were also issued under Ministerial Decree No.12.⁵²

B.4 Lao PDR

The Telecommunications Regulatory Authority (TRA) was established in the Ministry of Communications and Technology following Decree No 109/PM’s promulgation in 2017. The TRA is set up as an independent department within the Ministry.⁵³

The applicable regulatory regime in Lao PDR is as follows:

- *Law on Telecommunications (Amended) No.09/NA of December 2011*, which creates the key regulatory elements for licensing and the allocation of radio frequency. The law aims for the fairness, continuity of development and securitisation of the country’s telecommunications services and resources.
- *Law on Radio Frequency No. 17/NA dated 5 May 2017* provides for the allocation and use of radio spectrum. Article 1 requires its efficient and effective use, while also contributing to national defence and security.⁵⁴

Any individual or organisation wishing to use spectrum

must obtain authorisation from the state. Authorisation takes the form of a “frequency concession certificate”, the transfer or sharing of which must be approved by the government.⁵⁵ Spectrum sharing takes place through commercial agreements.⁵⁶

Telecommunications networks and services must obtain a licence in order to provide telecommunications services. Licences are valid for 15 years.⁵⁷ Providers and users are prohibited from using radio spectrum other than in accordance with their permits.⁵⁸ Licences are technology-neutral.⁵⁹

The *Law on Telecommunications (Amended)* imposes obligations on telecommunications service providers. These obligations include, inter alia, securing interconnection with other service providers, securing the availability of universal services, protecting against crises or disasters, complying with the law and accounting audits.⁶⁰

44 Article 45 Regulation 46 of 2021.

45 Article 46(1) Regulation 46 of 2021.

46 Article 47(1) Regulation 46 of 2021.

47 Articles 55, 56 and 57 Regulation 46 of 2021.

48 Article 48 Regulation 46 of 2021.

49 Article 64 Regulation 46 of 2021.

50 Article 65 Regulation 65 of 2021.

51 <https://typeapproval.id/index.php/2025/02/11/peraturan-menteri-komunikasi-dan-digital-nomor-2-tahun-2025-radio-frequency-spectrum-use-under-class-license/>

52 <https://icertifi.com/indonesia-opens-6-ghz-band-for-wi-fi-6e-wi-fi-7-new-regulations-announced-for-2025/>

53 World Bank. (2022). [Positioning the Lao PDR for a Digital Future](#).

54 [Law on Radio Frequency No. 17/NA](#).

55 Article 9 Law on Telecommunications (Amended) No.09/NA of December 2011.

56 ITU Datahub. (2022). [“Spectrum sharing – Lao PDR”](#).

57 Articles 22,23 Law on telecommunications 2011.

58 Article 9, Law on Radio Frequency No. 17/NA.

59 ITU Datahub. (2014). [“Spectrum licensing – Lao PDR”](#).

60 Article 27, Law on Radio Frequency No. 17/NA.

B.5 Malaysia

The primary regulator of the telecommunications sector in Malaysia is the Malaysian Communications and Multimedia Commission (MCMC). The MCMC manages spectrum allocation for telecommunications use and regulates spectrum. The Minister can give the MCMC general directions relating to performance of the MCMC's functions with which the MCMC must comply. Certain policy decisions affecting competition in the industry, such as licensing and the principles for spectrum use and rate regulation, are reserved for the Minister.

The relevant regulatory regime in relation to spectrum is:

- *Communications and Multimedia Act (1998) (the CMA)*
- *Communications and Multimedia (Spectrum) Regulations 2000*
- Spectrum Plan – developed by the Commission pursuant to section 172 of the CMA. It contains information on frequency allocations for the various wireless services in operation in Malaysia and follows ITU radio regulations.

The MCMC may develop a spectrum plan⁶¹ that defines the methods of assigning and reassigning spectrum.⁶² There are three types of spectrum assignments in Malaysia:⁶³

1. Spectrum assignment confers rights on a licensee the right to use one or more specified frequency(ies) for any purpose consistent with the assignment conditions. This type of assignment is subject to specified fees.
2. Apparatus assignment, which confers on a person the right to use one or more specified frequencies to operate an apparatus for a specified purpose. This is subject to specified fees.
3. Class assignment allows the MCMC to issue and impose conditions on the class assignment to allow any person to use the frequency for a list of devices.

Spectrum can be assigned by fixed price, auction and tender. Tender is used where there is competition for a particular band, involving either beauty contests or a comparative tender with price.⁶⁴

The Minister, upon recommendation from the MCMC, may make a determination that certain spectrum be reallocated for spectrum assignment.⁶⁵ The Minister may also direct the MCMC to develop procedures for the compulsory acquisition of spectrum. The MCMC may also make a recommendation to the Minister to make it compulsory to acquire spectrum in accordance with the spectrum plan. The MCMC has discretion to pay a reasonable amount of compensation to the holder of an assignment that has been acquired before its expiry.⁶⁶

Spectrum sharing is permitted via the use of commercial agreements.⁶⁷ Regulation 19(1) of the *CMA (Spectrum Regulations 2000)* provides the conditions in which a spectrum assignment holder may transfer or otherwise deal with it. The conditions of a spectrum assignment, eligibility requirements, the public or national interest, Ministerial rules and other conditions imposed by the MCMC may result in a transfer being absolutely prohibited.⁶⁸

In Malaysia, 5G technology will now be deployed through a dual wholesale network, namely Digital Nasional Berhad (DNB) and recently UMobile, with the aim of ensuring undifferentiated speed and quality for all users. While spectrum licensing is nominally technology-neutral,⁶⁹ currently there is no clear path for existing spectrum assignment for legacy IMT bands to refarm existing spectrum bands for 5G use in Malaysia given the current duopoly on 5G services.⁷⁰

61 Section 172 Communications and Multimedia Act 1998.

62 Section 173, *Ibid.*

63 ICLG. (2019). https://www.shearndelamore.com/wp-content/uploads/publication/International_Comparative_Legal_Guide_to_Telecoms_Media&Internet_2019.pdf

64 *Ibid.*

65 Section 176 Communications and Multimedia Act 1998.

66 Section 178 Communications and Multimedia Act 1998.

67 ITU Datahub. (2023). "Spectrum sharing – Malaysia".

68 ICLG. (2019). https://www.shearndelamore.com/wp-content/uploads/publication/International_Comparative_Legal_Guide_to_Telecoms_Media&Internet_2019.pdf

69 ITU Datahub. (2021). "Spectrum licensing – Malaysia".

70 Choudhury, A.R. (18 March 2025). "Scepticism remains despite Malaysia's shift to two operators of 5G wholesale network, says GSMA". GovInsider.

B.6 Myanmar

In Myanmar, the Posts and Telecommunications Department (PTD), under the Ministry of Transport and Communications (MOTC), currently oversees telecommunications regulation and spectrum management. The PTD is responsible for issuing service provider licences, managing frequency spectrum, numbering plans and ensuring consumer protection.⁷¹

Plans to establish an independent regulatory body, the Myanmar Communications Regulatory Commission (MCRC), were outlined in the article 86 of the *Telecommunications Law of 2013*, which mandated its formation within two years of the law being enacted.

Myanmar first published its Spectrum Roadmap (2016–2021) and assigned IMT spectrum accordingly in the 2600 MHz (in 2016) and 1800 MHz bands (in 2017). The Spectrum Roadmap (2022–2026) was then published, outlining a national strategy plan to improve telecommunications infrastructure through the release of additional IMT spectrum, supporting the growth of mobile broadband and deployment of 5G services. Assignments were accordingly made in the 2300 MHz band.

In Myanmar, all radio spectrum is regulated in accordance with the *Telecommunications Law of 2013* and Spectrum Rules (2016).

According to Sections 19 and 20 of the *Telecommunications Law of 2013*, the MOTC is responsible for managing and supervising Myanmar's national frequency spectrum and satellite orbital positions in accordance with international telecommunications agreements. PTD has the authority to allocate specific frequency bands from the National Frequency Allocation Plan to individuals, departments and organisations, setting terms and conditions for their use.⁷² Section 81 also specifies that the Ministry shall determine the licence fees, licence renewal fees, spectrum usage fees and fees for the allocation of number and electronic address and overdue payment.⁷³

Myanmar's Spectrum Rules provide a comprehensive framework for managing the country's radio frequency spectrum regarding spectrum allocation, licensing and compliance, ensuring efficient and effective utilisation of this vital resource. In Part III, it lists the licensing regime

for spectrum, including the requirement of the licence, the licence mechanisms, the conditions of the licence, licence renewal and spectrum fees. It also addresses the competition conditions in Part VI.⁷⁴

Other rules and regulations include:

- Licensing rules⁷⁵
- Interconnection rules⁷⁶
- Competition rules⁷⁷
- Numbering rules⁷⁸

Under Section 16 of the Licensing Rules of the Republic of the Union of Myanmar, issued on 14 October 2014, all telecommunications service licences are granted for a minimum of five years to a maximum of 20 years.⁷⁹

According to the licensing rules, the country adopts a technology-neutral policy in its licensing process. The PTD will not specify or require prior approval for the types of technologies that licensees choose to deploy or the specific services they offer using their assigned spectrum.⁸⁰

Myanmar's spectrum sharing policy is outlined in Section 91 of *Myanmar's Spectrum Rules*. A licensee may enter into agreements with other licensees to share radio spectrum. These agreements must be based on terms that are fair, reasonable and transparent. However, according to Section 33 of the *Telecommunications Law of 2013*, such agreements do not become effective until they receive written approval from the PTD.⁸¹

Section 15 of *Myanmar's Spectrum Rules* allows licensees to transfer their right to use radio spectrum to a third party, with prior written approval from the PTD.⁸²

Under Section 89 of the spectrum rules, licensees are legally required to support the PTD in the coordination and management of radio spectrum and to ensure the efficient use of their assigned frequencies. If a licensee no longer requires the use of any or all of its assigned spectrum, it must promptly notify the Department. In such instances, the Department is authorised to reclaim the unused spectrum and may reassign it to another person or licensee. This provision establishes both a legislative obligation for spectrum efficiency and a clear mechanism for the regulator to recover and reallocate underutilised spectrum resources.⁸³

71 Ministry of Transport and Communications, Posts and Telecommunications Department. (n.d.). "[Vision and Mission](#)".

72 [Telecommunications Law of 2013](#), section 19–20.

73 *Ibid.*, section 81.

74 No available English version for [2016 document](#). A [2013 version](#) is available.

75 [MCIT Licensing Rules](#).

76 [MCIT Interconnection Rules](#).

77 [MCIT Competition Rules](#).

78 [MCIT Proposed Numbering Rules](#).

79 [MCIT Licensing Rules](#).

80 No available English version for [2016 document](#). A [2013 version](#) is available.

81 *Ibid.*

82 *Ibid.*

83 *Ibid.*

B.7 Philippines

The Department of Information and Communications Technology (DICT) is a statutory body created under *Republic Act No.10844* responsible for broader telecommunications policy, including radio frequency spectrum management.

The National Telecommunications Commission (NTC) is a government agency created under Executive Order No. 546 (promulgated on July 23, 1979) conferred with regulatory and quasi-judicial functions. The NTC is the body that exercises jurisdiction over the supervision, adjudication and control over all telecommunications services throughout the Philippines.

The *Republic Act No.3846*, known as the Radio Control Law, is a colonial piece of legislation enacted in 1931 to govern radio communications in Philippines.⁸⁴

- Section 1 of RA No. 3846 mandates that entities must obtain a legislative franchise, passed by Congress, to construct, install, establish or operate a radio station. Note that Section 16 of RA no. 7925 reaffirmed the requirement of legislative franchise.⁸⁵
- Section 2 requires entities to also get a permit from the NTC before starting operations.
- Section 3 grants the executive authority the ability to (1) classify radio stations (equipment) and prescribe the nature of services those tools render; (2) assign frequencies and licence radio stations (equipment); and (3) make rules and regulations regarding spectrum to prevent interference between stations (spectrum users). These powers were eventually transferred to the NTC.

The *Public Telecommunications Policy Act (Republic Act no. 7925)* was passed in 1995 to promote and govern the development of the telecommunications industry. It lays the foundation for the administration, conduct and direction of the telecommunications industry. Key provisions include:

- Article III, Section 5 establishes the responsibilities of the NTC as the principal administrator of the Act. Some of these responsibilities include a mandate to set up the fair and reasonable interconnection of facilities and interconnection charges, foster fair and efficient market conduct and protect consumer welfare.
- Article IV categorises the various telecommunications entities that can be authorised to operate in the country.
- Section 16 establishes the licensing or “franchise” framework for public telecommunications entities.

84 [Republic Act No. 3846](#).

85 [Republic Act No. 7925](#).

- Section 4C and 15 on spectrum allocation: Section 4C declares that radio spectrum is to be managed by the government following principles of efficiency and effectiveness. The public interest and international agreements and conventions to which the Philippines is a party are also relevant considerations. Section 15 provides that radio frequency spectrum allocation and assignment be subject to periodic review and reasonable user fees.

Memorandum Circular No. 3-3-96 contains the procedure for the review, allocation and assignment of spectrum by the NTC. The Implementing Rules and Regulations of R.A. 7925 provide guidelines on spectrum management.

It should also be noted that in 2018, *Bangsamoro Basic Law (BBL)*, officially designated as Republic Act No. 11054, provided for the establishment of the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM). Bangsamoro has its own Bangsamoro Telecommunications Commission. While spectrum allocations and assignments are determined nationally, the BTC is able to request (or conduct) an audit of spectrum utilisation in BARMM and if they find that MNOs are not using the spectrum in the region, they are able to request that the NTC allow BTC to manage and re-assign that spectrum just for BARMM.

New legislation affecting spectrum management

The Philippines’ spectrum management legal framework was updated on 24 August 2025 with the lapsing into law of the *Konektadong Pinoy Act* (Act No. 2699 as amended by the bicameral process).

The *Konektadong Pinoy Act* obligates the DICT to develop a Spectrum Management Policy Framework (SMPF) in coordination with the NTC and Philippine Competition Commission (PCC) to ensure effective spectrum management. The SMPF must foster fair competition, adaptability to technological advancements and the ability to maximise efficient use of spectrum.

The SMPF contains the national policies and guiding principles to govern the management of spectrum, including spectrum valuation and pricing, spectrum allocation and spectrum assignment. The NTC shall periodically review existing spectrum allocation, use and assignment and ensure fair competition. The *Konektadong Pinoy Act* also regulates that all spectrum assignments validly subsisting remain effective if they are subject to the SMPF and under the provisions of this Act.

Section 10 of the *Konektadong Pinoy Act* details the SMPF to include:

- A requirement for the DICT and the NTC to ensure the technological neutrality of the law’s application.⁸⁶
- Methodologies for spectrum valuation and pricing.
- Procedures for spectrum assignment.
- Processes for joint use or co-use application.
- Rules and procedures for spectrum recall.
- The determination of unutilised or underutilised spectrum.
- The NTC’s mandate, which is to publish decisions related to spectrum assignment, joint use and co-use applications, and to act promptly on applications of data transmission industry participants (DTIPs) for permits to import equipment.
- Reserved frequencies for government use, including the NTC’s authority to recall spectrum assignments.
- The notice requirement for the entities requesting spectrum assignments or joint use.
- The DITC requirement to ensure the adoption of technology-neutral policies that allow the use of any available technology to provide telecommunications services.⁸⁷

B.8 Singapore

The Info-communications Media Development Authority (IMDA) oversees and regulates Singapore’s telecoms and media sectors. The IMDA operates independently under the Ministry of Digital Development and Information (MDDI) as a statutory board, promoting and managing both telecommunications and ICT industries.⁹³

The telecoms sector is governed by the IMDA under the *Telecommunications Act 1999* and the *IMDA Act 2016*. IMDA plays a key role in spectrum management in Singapore, including spectrum planning, allocation and assignment to ensure efficient use of this limited resource. It oversees services like mobile, fixed, satellite, short-range devices and broadcasting.⁹⁴

In 2022, the IMDA updated the *Spectrum Management Handbook*. The handbook provides a comprehensive overview of IMDA’s spectrum management activities, focusing on achieving efficient and effective spectrum

Certain features are particularly relevant to spectrum harmonisation. The Act empowers the NTC to reclaim spectrum assignments previously granted to an entity if it finds after due process that the DTIP has unutilised or underutilised spectrum.⁸⁸ The DICT is similarly empowered as part of its spectrum planning mandate to undertake spectrum recall and restacking to ensure the most efficient and optimal use of spectrum in accordance with the plan.⁸⁹

There is a legislative requirement for the SMPF to include rules and procedures for spectrum recall that are the product of consultations with stakeholders and affected licensees, and which address the existence of unutilised or underutilised spectrum.⁹⁰

The *Konektadong Pinoy Act* furthermore creates issuances regarding the development of the SMPF. First, within three months from the Act being effective, the NTC, in collaboration with the DICT, must undertake a review of existing spectrum allocations and assignments.⁹¹ Then, the DICT, in collaboration with the NTC, Philippines Competition Commission (PCC) and relevant stakeholders, must develop the SMPF to include the aspects in the aforementioned list, per section 10 of the Act.

The Implementing Rules and Regulations (IRR) of the Act were approved on 5 November 2025.⁹²

allocation and utilisation. Key areas covered include:⁹⁵

- Spectrum allocations and band plan
- Frequency assignment criteria and application procedures
- Licensing and application
- Temporary use of radio frequencies
- Spectrum fees

While IMDA has not published a specific spectrum roadmap, several key documents and initiatives outline the nation’s approach to spectrum allocation and future plans, including the 2020 Call for Proposal (CFP) and the 2022 Auction of 2.1 GHz Spectrum Rights.⁹⁶ After 2022, IMDA issued spectrum rights for the 2.1 GHz band to Singtel, TPG Telecom (now Simba Telecom) and a joint bid by M1 and StarHub. IMDA has further granted 700 MHz spectrum rights to Singtel in 2024 and M1 and Starhub in 2025.⁹⁷

86 Section 19, *Konektadong Pinoy Act*.

87 Section 6, *Konektadong Pinoy Act*.

88 Section 10(f), *Konektadong Pinoy Act*.

89 Section 7(j), *Konektadong Pinoy Act*.

90 Section 10(d), *Konektadong Pinoy Act*.

91 Section 10, *Konekatdong Pinoy Act*.

92 See: <https://www.dict.gov.ph/news-and-updates/24055> and https://cms-cdn.e.gov.ph/DICT/pdf/Konektadong_Pinoy_Act.pdf.

93 IMDA, “Who we are”.

94 IMDA, “Spectrum Management and Coordination”.

95 IMDA. (2022). *Spectrum Management Handbook*.

96 IMDA. (24 June 2020). “5G Call for Proposal (“5G CFP 2020”) – 3.5 GHz Spectrum Rights, mmWave Spectrum Rights”. See also: IMDA. (21 December 2021). “Auction of 2.1 GHz Spectrum Rights (2022) for 5G”.

97 IMDA, “Spectrum Right Issued”.

The applicable legal regime

The *Telecommunications Act 1999* serves as the fundamental legal framework governing Singapore's telecommunications sector.⁹⁸ It outlines the overarching structure for licensing and regulation within the industry. Specific regulatory matters are addressed through regulations, licences, codes of practice, performance standards, directives and advisory guidelines issued by the IMDA, which exercises these powers under the authority of the Act.

Singapore's *Telecommunications Act 1999* adopts a technology-neutral stance, not differentiating between fixed, mobile and satellite services. Certain services are subject to specific licensing and regulatory requirements.⁹⁹

Telecommunications (Radio-communication) Regulations provide a comprehensive framework for managing radio frequency spectrum usage, licensing and the operation of radio stations and networks. Part II allows the IMDA to prepare and publish a radio spectrum plan and radio frequency band plans.¹⁰⁰ The IMDA has the power to grant spectrum rights with conditions.¹⁰¹

Under section 6 of the *Telecommunications Act*, the IMDA has the authority to grant spectrum rights for radio frequency allocation and usage. IMDA has the authority to grant, regulate and revoke spectrum rights for radio frequency use. Spectrum can be assigned via auction, tender or allocation, with fees payable upfront and periodically. IMDA sets eligibility, conditions and compliance rules, while the Minister can direct in special cases. Licensees must follow IMDA's directives, and non-compliance can lead to suspension, cancellation or financial penalties of up to 10% of revenue or SGD 1 million.¹⁰²

Under Regulation 12 of the *Telecommunications (Radio-communication) Regulations*, Singapore allows spectrum sharing, where a spectrum right holder may authorise another party to use the assigned radio frequency spectrum. This is subject to conditions imposed by the IMDA and the authorised party must obtain the appropriate station or network spectrum licence.¹⁰³

Under Regulation 13 of the *Telecommunications (Radio-communication) Regulations*, spectrum trading is permitted, allowing a spectrum rights holder to assign or otherwise deal with all or part of their rights. However, such transfers or dealings require the prior written approval of the IMDA. The parties involved must also provide any information requested by the Authority to facilitate the approval process. This ensures that spectrum trading is regulated and aligns with national policy objectives.¹⁰⁴

Regulation 16 of the *Telecommunications (Radio-communication) Regulations* outlines the conditions under which IMDA may suspend or cancel a spectrum right, including instances where the spectrum is not utilised in accordance with the terms of the grant. Additionally, Regulations 17 and 18 provide IMDA with the power to resume spectrum rights, either in whole or in part, to ensure efficient spectrum management and prevent wastage of this finite resource.¹⁰⁵ Yet, there is no regulation regarding the compulsory acquisition of spectrum by regulators.

The *Telecommunications Act* and the *Telecommunications (Radio-communication) Regulations* grant the IMDA the authority to reallocate, revoke or reassign spectrum rights to ensure efficient use of radio frequencies. Spectrum refarming is practiced in Singapore. For example, the 2.1 GHz band, originally allocated for 3G services, has been officially refarmed and reallocated for 5G Standalone (SA) networks. This shift was formalised through an IMDA policy decision in 2021.¹⁰⁶

Under Section 5 of the *Telecommunications Act*, all entities operating or providing telecommunications systems and services in Singapore must obtain a licence.¹⁰⁷ The IMDA classifies these licences into Facilities-Based Operation (FBO) licences for those deploying infrastructure and Services-Based Operation (SBO) licenses for those leasing network elements. Additionally, if radio spectrum is needed for wireless services, operators must obtain an extra licence under the *Telecommunications (Radio-Communications) Regulations*. The IMDA typically grants FBO licences for a duration of 15 years.¹⁰⁸

⁹⁸ *Telecommunications Act 1999*.

⁹⁹ Drew and Napier LLC. (13 June 2023). "In brief: telecoms regulation in Singapore". Lexology.

¹⁰⁰ *Telecommunications (Radio-Communications) Regulations (Radio-Communications Regulations)*, section 3 and section 4.

¹⁰¹ *Ibid.*, section 6, section 10.

¹⁰² *Telecommunications Act 1999*, section 6.

¹⁰³ *Telecommunications (Radio-Communications) Regulations (Radio-Communications Regulations)*, Regulation 12.

¹⁰⁴ *Telecommunications (Radio-Communications) Regulations (Radio-Communications Regulations)*, Regulation 13.

¹⁰⁵ *Telecommunications (Radio-Communications) Regulations (Radio-Communications Regulations)*, Regulation 16-18.

¹⁰⁶ IMDA, "Next Wave of 5G Growth and Deployment in Singapore: Policy Issues and Proposed Regulatory Design for 2.1 GHz Band", 2-3. See also: Wyrzykowski, R. (1 October 2024). "Legacy spectrum and 5G in APAC: navigating the transition". Opensignal.

¹⁰⁷ *Telecommunications Act 1999*, section 5.

¹⁰⁸ IMDA, "About Facilities-Based Operations Licence".

The Part IV of the *Telecommunications (Radio-communication) Regulations* listed the licensing requirement and explained the restrictions on grant of licence.¹⁰⁹

Regulation 23 of the Part V of *Telecommunications (Radio-communication) Regulations Cap. 323, RG 5* outlines the conditions for granting station (spectrum) licences and network (spectrum) licences in Singapore. Licences specify conditions of use, duration and other necessary terms. All fees must be paid in advance and late payments incur penalties ranging from SGD 10 to 50, depending on the delay. Certain radiocommunication stations, as listed in the Fourth Schedule, are excluded from this regulation. The licence fees requirement is listed in Regulation 26.¹¹⁰

Other regulations address specific requirements for fixed, mobile and satellite services, including *Telecommunications (Class Licence) Regulations* and the *Telecommunications (Dealers) Regulations*.¹¹¹

B.9 Thailand

The relevant regulatory regime in Thailand is:

- The *Act on the Organization to Assign Radio Frequency and to Regulate Broadcasting and Telecommunications Services (2010) (as amended)*
- The *Radio Broadcasting, Television and Telecommunications Businesses Act 2010*

In accordance with the *Act on the Organization to Assign Radio Frequency and to Regulate Broadcasting and Telecommunications Services (2010) (as amended)*, the National Broadcasting and Telecommunications Commission (NBTC) regulates frequency spectrum and licensing in Thailand. The NBTC is bound to act in accordance with parliamentary and national policies announced by the Thai Government.¹¹⁷

There is a legislative requirement to prepare a master plan for the management of spectrum.¹¹⁸ The NBTC must monitor the performance of the plan and revise to

While efficiency is a core objective of IMDA's spectrum planning and assignment processes, it is not codified as a legal obligation. While spectrum is usually obtained voluntarily through auctions, IMDA retains legal authority to suspend, cancel or reassign spectrum rights in the public interest or for efficiency, particularly under Regulations 16–18 of the *Telecommunications (Radio-communication) Regulations*.¹¹²

In April 2017, all MNOs in Singapore, including M1, Singtel and StarHub, ceased their 2G services.¹¹³ In July 2023, the IMDA announced that all three MNOs providing 3G services in Singapore – Singtel, StarHub and M1 – originally planned to sunset their 3G services by 31 July 2024.¹¹⁴ However, M1 ceased its 3G network on 1 August 2024.¹¹⁵ Singtel and StarHub retired their respective legacy 3G networks from 1 November 2024.¹¹⁶

account for efficiency and technology considerations. Consultation requirements apply.¹¹⁹ The plan is binding on the NBTC and relevant government agencies.¹²⁰ The NBTC's powers also include preparing a national frequency schedule table and managing satellite orbit access rights.¹²¹ The NBTC is empowered to grant and oversee the licensing of radio frequency usage for broadcasting, television and telecommunications businesses, using criteria and methods for granting permission that are up to its discretion.¹²² Spectrum may be auctioned off.¹²³

The Act contains a legislative requirement for the regulation of spectrum to be efficient.¹²⁴ The public interest is also a paramount consideration when making decisions about network connections, fees and methods.¹²⁵

¹⁰⁹ Ibid., section 20.

¹¹⁰ Ibid., section 23, section 26.

¹¹¹ *Telecommunications Act*, chapter 323, section 74.

¹¹² *Telecommunications (Radio-Communications) Regulations (Radio-Communications Regulations)*, Regulation 16–18.

¹¹³ Today Online. (27 March 2017). "[Singapore's 2G network to cease completely on April 18](#)".

¹¹⁴ IMDA. (24 July 2024). "[3G services to retire in phases, starting with M1's network in Aug 2024](#)". Press release.

¹¹⁵ Ang, R. (26 July 2023). "[Singtel, Starhub, M1 to retire 3G services by July 2024](#)". The Straits Times.

¹¹⁶ See: <https://www.singtel.com/personal/products-services/mobile/goodbye3g>; see also StarHub. (1 November 2024). "[StarHub to Retire 3G services from 1 November 2024](#)".

¹¹⁷ Section 74 Act on the Organization to Assign Radio Frequency and to Regulate Broadcasting and Telecommunications Services (2010) (as amended).

¹¹⁸ Section 48 Act on the Organization to Assign Radio Frequency and to Regulate Broadcasting and Telecommunications Services (2010) (as amended); Section 27 The Radio Broadcasting, Television and Telecommunications Businesses Act 2010.

¹¹⁹ Section 48 Act on the Organization to Assign Radio Frequency and to Regulate Broadcasting and Telecommunications Services (2010) (as amended).

¹²⁰ Ibid.

¹²¹ Section 26(1) Act on the Organization to Assign Radio Frequency and to Regulate Broadcasting and Telecommunications Services (2010) (as amended).

¹²² Section 26(4) Act on the Organization to Assign Radio Frequency and to Regulate Broadcasting and Telecommunications Services (2010) (as amended).

¹²³ Section 41 The Radio Broadcasting, Television and Telecommunications Businesses Act 2010.

¹²⁴ Section 5 Act on the Organization to Assign Radio Frequency and to Regulate Broadcasting and Telecommunications Services (2010) (as amended).

¹²⁵ Section 8 Act on the Organization to Assign Radio Frequency and to Regulate Broadcasting and Telecommunications Services (2010) (as amended).

The NBTC is empowered by the Act to reclaim unused or unutilised frequencies or reclaim part of them, as specified in a frequency spectrum band plan prepared by the NBTC and in accordance with criteria, methods and conditions set by the body. These conditions must specify the methods for replacing, compensating or paying compensation to those whose frequencies have been revoked, taking into account the rights of those affected by the revocations.¹²⁶

B.10 Vietnam

The Ministry of Science and Technology (MOST) (in Vietnamese Bộ Khoa học và Công nghệ) is responsible for broader telecommunications policy in Vietnam, including frequency spectrum management. On 18 February 2025, the previous Ministry of Information and Communications (MIC) ceased operations and merged with MOST.

MOST has several important specialist authorities, especially the Vietnam Telecommunications Authority (VNTA) and Authority of Radio Frequency Management (ARFM). Both operate under its auspices.

The applicable legislative regime is:

- *Law on Telecommunications* No. 24/2023/QH15 adopted by the National Assembly of Vietnam on 24 November 2023 ("*Law on Telecommunications*")
- *Law on Radio Frequency* No. 42/2009/QH12 adopted by the National Assembly of Vietnam on 23 November 2009 ("*Law on Radio Frequency*") and Law No. 09/2022/QH15 promulgated on 9 November 2022 ("*Radio Frequency Amendments*")

The Radio Frequency Amendments provides amendments to 23 of 49 articles of the 2009 Law on Radio Frequency. It aims to strictly manage as well as rationally and effectively allocate the radio frequency use right to create a healthy competitive environment in the telecommunications field. The Revised Law amends 23 of 49 articles of the 2009 Law and adds three articles, focusing on the following major groups of issues: master plans on frequency bands, the granting of radio frequency use licenses, revenues from use of radio frequencies, training of radio operators, granting of radio operator certificates, handling of harmful interferences and the registration of and international cooperation on radio frequencies and satellite orbits.

A person must obtain a licence to lawfully use radio frequencies for the purpose of providing broadcasting services.¹²⁷ The authorisation of frequency usage can take place by way of auction or according to the methods and conditions announced by the NBTC. Spectrum sharing is permitted where there are multiple licensees for a particular band.¹²⁸

A licensee authorising the use of radio frequencies is a personal right and cannot be transferred unless permission is sought and received from the NBTC. The NBTC sets the criteria, methods, conditions and rates of fees for transferring licences.¹²⁹

To operationalise the amendments, on 18 August 2023, the Government of Vietnam promulgated Decree No. 63/2023/ND-CP guiding the *Law on Radio Frequencies 2009*, amended by the *Law on Radio Frequencies 2022*. It replaced the earlier Decree No. 88/2021/ND-CP. According to the Decree, the MIC (via the ARFM) shall issue, re-issue, replace, renew, revise, amend and revoke licences to use radio frequencies, prescribed by the *Law on Radio Frequencies*, except for cases prescribed in Clause 2 Article 5 of Decree (i.e. defence/security). Importantly, Section 6 promulgates the rules in relation to frequency auctions.

Decision 36/QD-TTg on 11 January 2024 titled On approving the information and communications infrastructure master plan for the period of 2021--2030, with a vision toward 2050 from the Prime Minister states, among other things, that:

- "*The development requirements up to 2025 are: ... that Mobile bandwidth network meets national standards .. for service quality, with a minimum average download speed of 40 Mb/s for 4G networks and 100 Mb/s for 5G networks; 100% of the adult population has a smartphone*"
- "*The development requirements up to 2030 are: .. for 5G mobile broadband network to cover 99% of the population, aiming to develop the next generation of advanced mobile networks.*"

¹²⁶ Section 12/1 Act on the Organization to Assign Radio Frequency and to Regulate Broadcasting and Telecommunications Services (2010) (as amended).

¹²⁷ Section 41 Act on the Organization to Assign Radio Frequency and to Regulate Broadcasting and Telecommunications Services (2010) (as amended).

¹²⁸ Section 42 Act on the Organization to Assign Radio Frequency and to Regulate Broadcasting and Telecommunications Services (2010) (as amended).

¹²⁹ Section 44/263 Act on the Organization to Assign Radio Frequency and to Regulate Broadcasting and Telecommunications Services (2010) (as amended).

The master plan on frequency bands is defined under the Revised Law as a master plan on the division of frequency bands into one or more than one frequency band block for each type of radiocommunication system, and on the allocation of such frequency bands to one or more than one organisation for use under specific conditions. For frequency bands planned for public land mobile telecommunications systems, the allocation thereof must consider the maximum limit of the total frequency bandwidth an organisation is licensed to use within the planned frequency bands or in a given frequency band group.

The Revised Law provides that the manufacturing and import of radio equipment and radio wave appliances for

use in Vietnam and the management and use of radio frequencies must comply with radio frequency master plans, except special cases in which radio frequencies are permitted for use not under radio frequency master plans.

Radio frequency use licences will now be granted via three methods:

1. Auction of the right to use radio frequencies
2. Examination for selection of entities eligible for the radio frequency use right
3. Direct licensing of the radio frequency use right

Appendix C.

Opensignal analysis of ASEAN markets

Table 3:

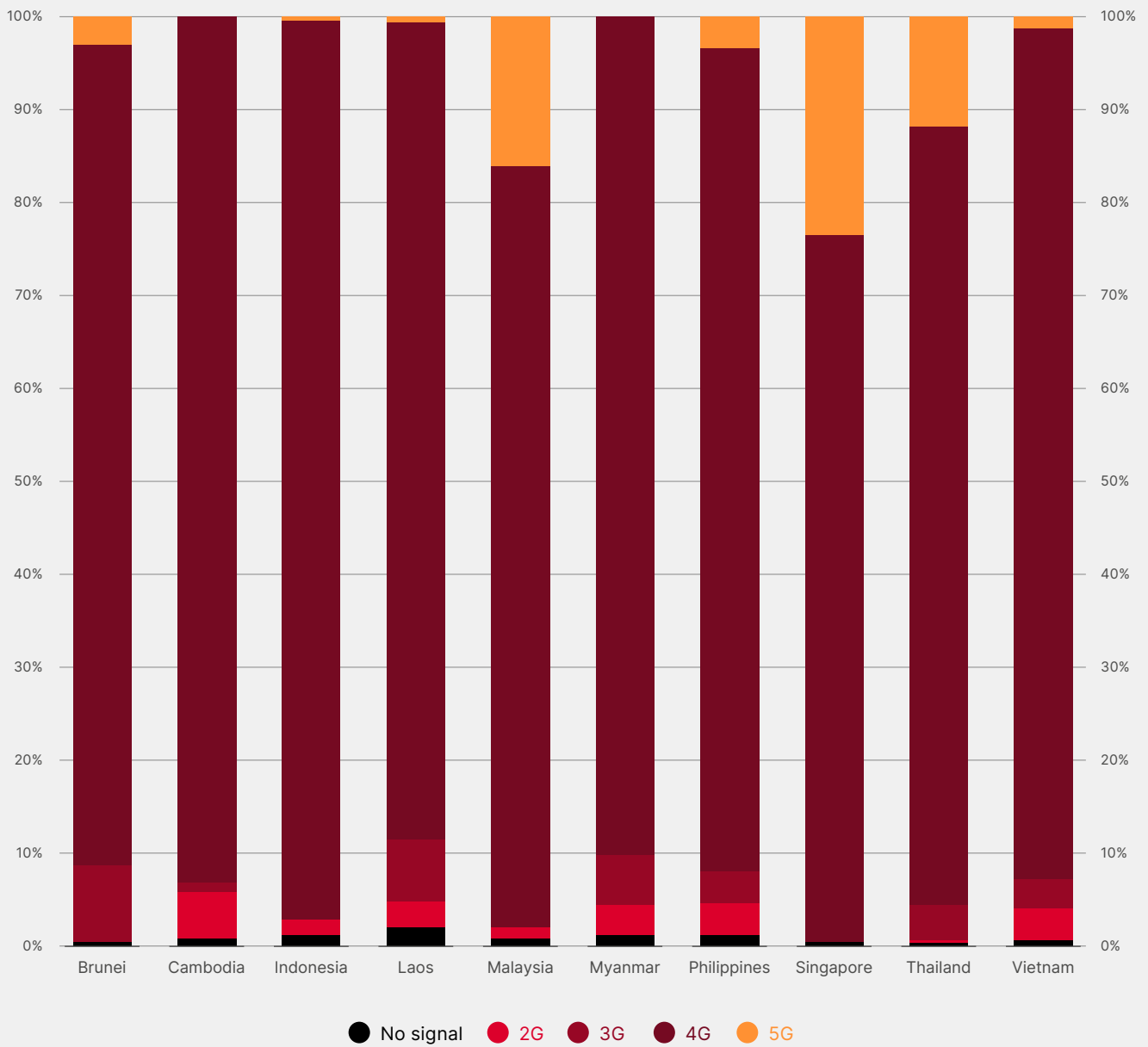
Download speed by technology

AMS	4G download speed (Mbps)	5G download speed (Mbps)	4G to 5G uplift
Brunei	56.5	181.4	x3.2
Cambodia	23.8	-	-
Indonesia	27.8	64.8	x2.3
Lao PDR	20.7	82.2	x4.0
Malaysia	35.1	220.2	x6.3
Myanmar	25.7	-	-
Philippines	25.4	144.7	x5.7
Singapore	45.8	265.3	x5.8
Thailand	24.6	96.3	x3.9
Vietnam	47.5	270.8	x5.7

Source: Opensignal (data collection period: 1 May–29 July 2025)

Figure 2

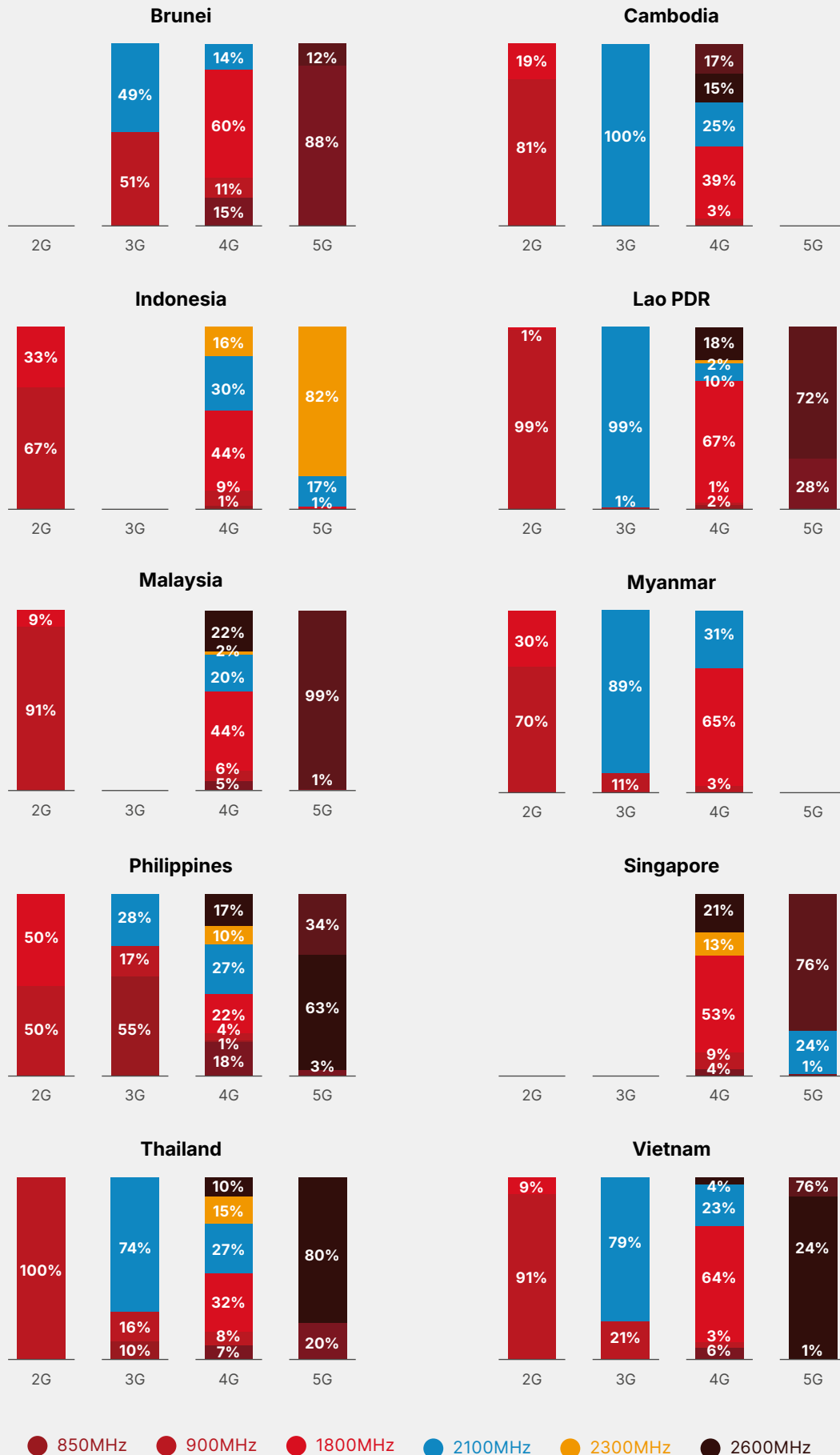
Proportion of time spent across network technologies



Source: Opensignal (data collection period: 1 May–29 July 2025)

Figure 3

Proportion of readings by technology and spectrum band



Source: Opensignal (data collection period: 1 May–29 July 2025)

Appendix D.

IMT trials in upper 6 GHz

Trials on upper 6 GHz IMT have been carried out since 2022. Some recent trials in 2025 include:

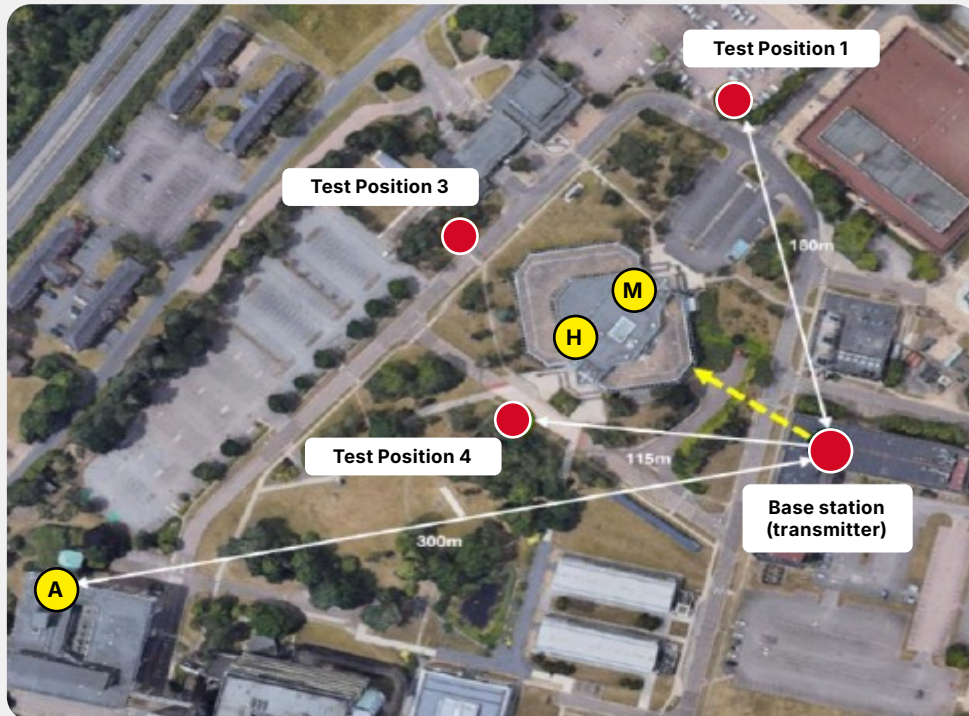
- **Finland:** The potential of upper 6 GHz for 6G: Field insights and comparison with 3.6 GHz by Nokia-Telia
- **Austria:** First pre-6G video stream in Austria by A1-Nokia
- **UK:** Upper 6 GHz Band for Mobile – Coverage and IMT/Wi-Fi Interference Field Trial by BT-Nokia
- **France:** Tests Confirm 6 GHz Band for Mobile Network - Orange Hello Future by Orange-Nokia
- **Thailand:** 10 Gbps throughput in U6G trial in Chulalongkorn University
- **Malaysia:** Maxis conducts 6 GHz field trial with Universiti Malaya
- **Australia:** Telstra and Ericsson conducted a U6G coverage trial

- **Germany:** Vodafone successfully completed the world's first network test of 6GHz spectrum using a commercially available chipset – the MediaTek M90 Modem – within a standard smartphone operating with 200 MHz bandwidth
- **China:** China Mobile conducted a trial in U6 GHz. 10 Gbps peak rate was achieved using a 256 TRX base station

In the BT and Nokia trial in May 2025, apart from verification of the coverage and performance of upper 6 GHz IMT, the trial also observed that when operating Wi-Fi equipment using the same frequencies as mobile in the U6 GHz band, there was a high risk of substantial impact on the performance of both mobile and Wi-Fi due to mutual interference. The exact interference mechanisms and impact on one application or the other depended on the particular deployment scenario.

Figure 4

Interference test locations at BT



- UE Test Positions
- Wi-Fi Access Point Test Positions
 - Hubble
 - Mezzanine
 - Antares

Source: Nokia

In the indoor-to-indoor scenario, there were severe reductions in performance for both networks.

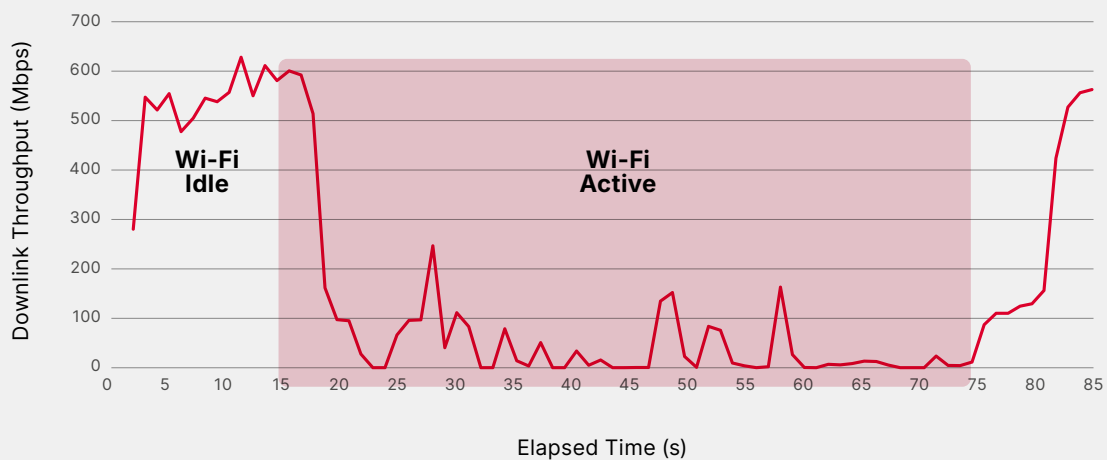
- **Impact on Wi-Fi:** the impact of the mobile network on Wi-Fi performance depends on the mobile network state, the Wi-Fi channel configuration and the access point location relative to the mobile base station. If the Wi-Fi primary channel was within the mobile channel, Wi-Fi throughput was significantly impacted, reducing to zero for significant periods of time when the UE was active, with mean throughput

reduced by more than 99% to 62 Mbps in the worst-case test.

- **Impact on IMT:** when the Wi-Fi network was idle, the indoor mobile UE achieved more than 500 Mbps, however, once the Wi-Fi throughput test began, mobile throughput was severely impacted, dropping to zero for several seconds on multiple occasions and overall mean throughput of less than 100 Mbps (a more than 80% reduction), see Figure 5.

Figure 5

Impact of Wi-Fi on indoor mobile UE performance



Source: BT-Nokia

In the outdoor-to-indoor scenario,

- **Impact on Wi-Fi:** Wi-Fi network performance was severely affected by mobile network traffic from an outdoor mobile UE regardless of the mobile UE position. Mean Wi-Fi throughput was reduced by between 40% and 90% (compared to the No UE case) depending on the relative AP and mobile UE location. In the worst cases, Wi-Fi throughput was often reduced to zero for many seconds.

- **Impact on IMT:** mobile UE downlink throughput could reduce to zero when the Wi-Fi AP was active and its location was in line-of-sight to the base station.

The trial provides further evidence that potential shared use of U6 GHz mobile with Wi-Fi in the same areas will be highly problematic for consumers in terms of the impact of mutual interference.

Appendix E.

Public safety broadband use and future spectrum demand

As noted by the International Telecommunication Union (ITU), there will be an increase in demand for IMT spectrum driven by demand for, and the deployment of, future Public Protection and Disaster Relief (PPDR) broadband services globally, including in ASEAN. This makes it an important consideration in future IMT spectrum planning in ASEAN and therefore needs to be noted in this report.¹³⁰ Existing systems for PPDR applications in ASEAN mainly support narrowband/wideband voice and data applications. This is also reflected in the current APT recommendations (which are limited to the 694–894 MHz band).¹³¹

However, there is growing consensus that the range of capabilities of connected devices for emergency responders, when added to new technologies such as drones, robots and AI systems, will substantially increase demand for wireless broadband network capacity and, therefore, IMT spectrum.¹³² Additional future requirements may be as material as 100 MHz or more of IMT spectrum and might involve the use of new IMT bands, such as the 4.9 GHz band (for example, as in the United States).¹³³ Importantly, the greatest demand for PPDR broadband is in large urban areas – of which there are a number in AMS.¹³⁴

Ensuring harmonised conditions for spectrum and technology for PPDR broadband across ASEAN promises substantial advances in scale, portability and interoperability.¹³⁵ Interoperability is likely to be important for AMS, where national agencies may require national and cross-border cooperation¹³⁶ with other AMS, either on a local level such as Singapore and Malaysia or for large-scale disasters.

Public safety and emergency response communication capabilities must therefore be improved to provide mission-critical voice services and data and video features.¹³⁷ Improved public emergency response capacity is not only economically rational, but also enhances the safety of first responders and assists

them in keeping ASEAN communities safe and resilient.¹³⁸ Malaysia, for instance, recently upgraded its narrowband TETRA public safety network using the latest standards in technology to improve coverage and services.¹³⁹

There are different kinds of PPDR networks:

- **Dedicated networks** entirely capable of handling requirements for PPDR broadband applications, which best guarantee greater network resilience and security.
- Networks with **allocated spectrum for shared use** between PPDR and commercial operators, with PPDR retaining primary use of a sufficient quantity of the spectrum.
- **Full reliance on commercial mobile networks**, including broadband, which may boost auction revenues but risk failing to meet PPDR broadband requirements.¹⁴⁰

There is a significant scarcity of IMT spectrum, especially in ASEAN given the ongoing challenges of releasing low-band spectrum and mid-band spectrum (especially the 3.5 GHz band). This creates a great opportunity loss if core IMT spectrum bands are directly assigned to first responder agencies that do not deploy networks and/or ensure its optimal or efficient use (see discussion in Section 5.4).

The United States has opted for AT&T FirstNet, a national dedicated public safety communications network.¹⁴¹ The network was created following 9/11, when first responders across various agencies experienced challenges communicating with each other due to overwhelming volumes across both fixed and mobile phone lines.¹⁴² FirstNet plans to connect more than 10,000 public safety agency radio networks, from single agency small towns to large, multi-agency, statewide public safety networks.¹⁴³

130 ITU. (2023). ITU Report ITU-R M.2377-2 (09/2023), Radiocommunication objectives and requirements for public protection and disaster relief, p. 18.

131 APT. (2019). Recommendation on Frequency Arrangements in the Range 684–894 MHz for Broadband Public Protection and Disaster Relief (PPDR) 2019, MC-42/OUT-03.

132 ITU. (2023). ITU Report ITU-R M.2415-1 (09/2023), Spectrum aspects for public protection and disaster relief; and developments in Australia.

133 Radiocommunications (Public Safety and Emergency Response) Class Licence 2023 (see: <https://www.legislation.gov.au/F2023L01243/latest/text> and <https://www.fcc.gov/document/fcc-adopts-new-rules-public-safety-49-ghz-band>).

134 ITU. (2017). ITU Report ITU-R M.2415-0 (11/2017), Spectrum needs for public protection and disaster relief, p. 8.

135 Wik Consult. (2013). The need for PPDR broadband spectrum in the bands below 1GHz, p. 30.

136 ITU Report ITU-R M.2377-2, p. 14.

137 National Emergency Management Agency, Australian Government. (June 2025). Public Safety Mobile Broadband.

138 Ibid.

139 Asian Wireless Comms. (January 2024). Malaysia sees enhanced public safety with TETRA upgrade.

140 Wik Consult. (2013). The need for PPDR broadband spectrum in the bands below 1GHz, p. 25.

141 See: <https://www.firstnet.com/>

142 Telstra. (11 July 2025). "Telstra's Vision for Public Safety Mobile Broadband (PSMB) in Australia".

143 Etherstack. AT&T FirstNet LMR-LTE Interworking Function; see also Etherstack. (11 August 2025). "Etherstack selected by AT&T for MCX IWF Technology".

An alternative approach for ASEAN is for MNOs to partner with first responder agencies to deliver PPDR broadband services in their respective markets. Sharing arrangements are a practical solution to the fair and sustainable use of spectrum given the different vested interests of governments and MNOs. In Australia, PPDR broadband (known as Public Safety Mobile Broadband or PSMB) capability is intended to be able to prioritise between different public safety agency users and, where the use case requires it, provide priority access to such users when service resources are shared with non-public safety agency users.¹⁴⁴ There is a strong need for prioritisation mechanisms since MNOs are also subject to heavy overload during a disaster or crisis.¹⁴⁵

With 5G SA network slicing, a single physical network can be “sliced” into many different virtual private networks with different service characteristics, including one assigned to public safety users of

a shared network.¹⁴⁶ This means that police or ambulance services can be prioritised over other users in the event of a disaster, guaranteeing a swift response independent of network traffic and free from congestion.

Looking ahead to the arrival of 6G around 2030, in the United States, a FirstNet working group is evaluating basic use case scenarios, as well as investigating the use of the technology in a public safety context when interworking with 5G, non-3GPP systems and potentially 4G. The findings from these studies aim to increase communications coverage and throughput in weak and off-network areas, as well as accommodate new advanced public safety features, such as discreet listening in hostage situations.¹⁴⁷ The working group has also advocated for the inclusion of public safety-relevant functionality in future 3GPP standards.¹⁴⁸

Appendix F.

Spectrum issues associated with rail communications

Radiocommunication systems and technologies have been used for many years for the purpose of railway operational applications, providing improved railway traffic control, passenger safety and security for train operations. These systems enable train control, voice dispatching, command and operational information, as well as the monitoring of data between onboard radio equipment and related radio infrastructure located along the trackside.¹⁴⁹ They are essential for railways to operate safely and effectively and must be properly managed.¹⁵⁰

Railway communications have typically relied on GSM-R frequencies, a derivation of 2G GSM technology dating back to the late 1990s. GSM-R was selected as the interoperable radio system for railways and was mandated by a European Commission Decision in 1997.¹⁵¹ However, it has increasingly become obsolete due to the technological advancements of mobile communications systems, the widespread use of broadband services and the increasing deployment of 5G cellular networks.¹⁵²

In the past, countries used different technologies and railway communication systems, which meant that one country’s railway systems could not easily operate in conjunction with another’s. As a region seeking greater integration, ASEAN Member States (AMS) are now faced with the challenge of establishing interoperable systems that allow railway systems to optimise their operations and use the same standards. Incompatible railway systems ultimately amount to a waste of resources both within an AMS and from one AMS to the next – an issue that extends to spectrum management.

Future Railway Mobile Communication Systems (FRMCS) is the next-generation standard for railway communications, designed at least in Europe to replace the legacy GSM-R system in use for the past few decades. FRMCS is based on 3GPP standards and is intended to support a wide range of railway applications, including train control, signalling, operations, passenger information and future digital services.¹⁵³ The transition to FRMCS is a major regulatory and technical undertaking, requiring careful planning of spectrum

144 Australian Government. (October 2022). [Public Safety Mobile Broadband Strategic Review – Final Report](#), p. 31.

145 Wik Consult. (2013). [The need for PPDR broadband spectrum in the bands below 1GHz](#), p. 26

146 Australian Government. (October 2022). [Public Safety Mobile Broadband Strategic Review – Final Report](#), p. 35

147 Urgent Communications. (18 August 2025). [“3GPP focuses on Release 20 6G and 5G-Advanced, including key public-safety needs”](#).

148 Ibid.

149 ITU-R. (2017). ITU-4 M.2418-0, [Description of Railway Radiocommunication Systems between Train and Trackside \(RSTT\)](#).

150 ITU. (24 March 2020). [“A revolution in railway communication”](#).

151 Sultan, A. (8 July 2024). [“Use of 3GPP technologies by railways”](#). 3GPP.

152 APT/AWG/REP-149.

153 APT/AWG/REP-149.

allocation, licensing and coexistence with other services.

In anticipation of this transition to FRMCS, AMS can consider the European regulatory approach¹⁵⁴ involving

European approach

Various European agencies have played a leading role in ensuring the interoperability of railway systems across Europe. For the use of GSM-R, the European Commission Decision 1999/569/EC and ECC Decision (02)05 harmonised the frequency bands 876–880 MHz (train-to-ground) and 921–925 MHz (ground-to-train). The allocation of a dedicated, harmonised frequency band enabled the creation of pan-European radiocommunication network for both passenger and freight trains to travel across EU borders without the need to install any other national radiocommunication systems. This fulfilled the requirement of the Interoperability Directive 2016/797/EU.

Rail communications are also evolving, with the transition from GSM-R to FRMCS requiring new spectrum allocations. More recently, CEPT ECC Decision (20)02 designated two frequency bands for FRMCS:

- 874.4–880 MHz paired with 919.4–925 MHz (band n100): this band is currently used for GSM-R and will be refarmed for FRMCS.
- 1900–1910 MHz (band n101): this unpaired band

Considerations for ASEAN members

ASEAN policymakers are thus faced with the same challenge of having to design the transition to FRMCS. The European approach is suitable for multiple reasons:

- The **700 MHz band** is unavailable in ASEAN as it has already been assigned or auctioned for IMT use. Spectrum is a limited resource, meaning competition from MNOs and other commercial actors can make it difficult for railway operators to obtain dedicated frequencies.¹⁵⁶ Furthermore, railway operators cannot simply refarm spectrum for their own purposes.
- The **900 MHz band** used by FRMCS is available.
- The **1900 MHz band** is not a commonly used band for mobile communications in Asia, making it a possible candidate for railway communications.

the 874.4–880 MHz band paired with 919.4–925 MHz (band n100) and the unpaired 1900–1910 MHz (band n101).

is designated specifically for FRMCS, providing additional capacity and supporting advanced applications. The CST is making the 1900–1910 MHz band available for FRMCS in alignment with CEPT recommendations and European practice.

Many European countries are now planning the migration from GSM-R to FRMCS, with regulators developing transition roadmaps, refarming strategies and technical coexistence rules. The European Union Agency for Railways (ERA) is coordinating technical and operational requirements to ensure interoperability across borders. The European Commission has mandated that all new railway radio systems be based on FRMCS standards.

China is another country with notable developments in railway communication systems and deploying a number of high-speed railways in ASEAN. China has also signalled a desire to replace the current 2G-based technology given impending 2G switch-offs with the next generation of railway-dedicated communication systems.¹⁵⁵

It is important that spectrum be harmonised to ensure the standardisation of railway telecommunications.¹⁵⁷ Standardising railway telecommunications improves interoperability, safety, reliability and efficiency, and reduces the risk of communication failures. Standardisation also makes it easier for railways to work together, which is particularly important for linking rail systems across international borders. Harmonised spectrum also facilitates the general deployment of radiocommunication systems.

Alongside these developments, the effective management of spectrum should remain a priority for AMS. In particular, ASEAN regulators should continue to coordinate and manage all radio spectrum nationally and with their regional counterparts. The allocation of spectrum, when managed improperly, can lead to issues around fragmentation, hindering cross-border interoperability in international rail systems.

¹⁵⁴ See CEPT ECC Decision (20)02.

¹⁵⁵ Ruisi He et al. (2022). [5G for Railways: the Next Generation Railway Dedicated Communications](#).

¹⁵⁶ APT/AWG/REP-149.

¹⁵⁷ See: ECC/DEC/(20)02 – [Resolution 236 \(WRC-15\)](#), p. 3.

As a densely populated and fast-growing region, the ASEAN region is undertaking a multitude of major railway projects that are relevant to future spectrum planning for railway communications. A summary of the various railway projects in the region can be found in

Table 4, all of which indicate the impending rise of high-speed train networks. High-speed rail (HSR) networks are likely to operate under newer and more advanced systems, which will be optimised in their performance where there is interoperability.

Table 4:

ASEAN rail projects

Name	Status / additional information	System	AMS	Expected date in service
Ho Chi Minh City – Bavet – Phnom Penh Railway*	In discussions, with an agreement reached for French investment. ¹⁵⁸	HSR (160 kph)	Cambodia, Vietnam	Exact date not set
Phnom Penh – Poipet Railway	In discussions. As of April 2025, the project is set to move forward with feasibility studies being conducted. The project is part of the Comprehensive Masterplan on the Cambodian Intermodal Transport and Logistics System 2023–2033. ¹⁵⁹	HSR (160 kph)	Cambodia, Thailand	2028–2033 as part of the CITLS (exact date not set)
Jakarta-Surabaya High Speed Rail	In discussions. As of May 2025, the project is set to move forward with studies on routes and feasibility is being conducted ¹⁶⁰ The project is an extension of Jakarta-Bandung HSR.	HSR (350 kph)	Indonesia	Exact date not set
Laos-China Railway*	In deployment since 2021	HSR (160 kph)	Lao PDR	In use
East Coast Rail Link	Under construction ¹⁶¹	Electrified intercity rail line (160 kph)	Malaysia	January 2027
Johor Baru-Singapore Rapid Transit System (RTS Link)	Under construction, set to be in operation by the end of 2026. ¹⁶²	Light rail transit (LRT)	Malaysia, Singapore	December 2026
North-South Commuter Railway (Clark Calamba Railway)	Under construction ¹⁶³	Commuter rail line (120–160 kph)	Philippines	2028
China-Thailand High Speed Rail*	Under construction. Phase 1 set to be completed by 2028 and Phase 2 by 2030. ¹⁶⁴	HSR (250 kph)	Thailand	2030
Lao-Cai – Hanoi – Haiphong*	Committed. Approved in February 2025 with construction set to begin in December 2025. ¹⁶⁵	HSR (160 kph)	Vietnam	2030
North-South Express Railway (Hanoi-Ho Chi Minh City)	Committed. Approved in November 2021 ¹⁶⁶ with construction set to begin in 2027. ¹⁶⁷	HSR (350 kph)	Vietnam	2035

*These railways are/would be part of the broader Kunming-Singapore Railway (Pan-Asian Railway).

158 Khmer Times. (26 January 2023). "Cambodia to allow 100 percent private investment in Phnom Penh-Ho Chi Minh high-speed railway".

159 Sinorn, T. (20 April 2025). "Cambodia's Railway Network to Expand to China". Kiripost; <https://mpwt.gov.kh/kh/press/41960>.

160 The Jakarta Post. (26 May 2025). "Luhut confirms Jakarta-Surabaya high-speed rail project will continue".

161 Sarmiento, P. (5 July 2024). "Malaysia's East Coast Rail Link hailed". China Daily – Hong Kong.

162 Land Transportation Authority, "Johor Bahru – Singapore Rapid Transit System Link".

163 Mangaluz, J. (16 July 2025). "Marcos OKs private sector help to run North-South commuter railway". Philstar; ADB. (8 November 2021). "Philippines: Commuter Corridor Leads Rail Revival".

164 Global Times. (5 February 2025). "China-Thailand High-Speed Railway Phase-2 approved by Thai Cabinet; project scheduled to be completed by 2030"; Strangio, S. (30 January 2025). "Thai High-Speed Rail Project Set for Completion in 2030, Government Says". The Diplomat.

165 Strangio, S. (21 February 2025). "Vietnam's National Assembly Approves \$8B Rail Link to China". The Diplomat; Reuters. (13 February 2025). "Vietnam to use Chinese loans for \$8.3 billion railway linking both countries".

166 Reuters. (30 November 2024). "Vietnam approves data, electricity laws, \$67 bln rail plan".

167 Bowerman, G. (26 March 2025). "Viet Nam Fast-Tracks High-Speed Rail". Asia Media Centre.

In the case of Indonesia's high-speed rail network Woosh, connecting Jakarta to Bandung, the final decision was to make GSM-R allocation in the 900 MHz band, which has caused some interference issues. The high-speed rail might in future extend the network to connect to Surabaya, but this decision remains subject to cost.¹⁶⁸ High-speed train networks are clearly a key development for policymakers to consider when managing spectrum for railway communications.

Looking ahead, it is possible that railway communications form part of a smart grid and smart city spectrum management. Still, rail networks and the

need for rail communications in ASEAN will continue to grow. This development also has an international dimension as seen, for instance, in the connection between China and Vietnam. Across ASEAN there are increasing rail deployments. In anticipation of these future developments, standardisation systems like FRMCS are optimal because they mean that all train suppliers can standardise their communications systems going forward. Standardisation and interoperability are therefore issues relevant to both present and future plans for ASEAN's spectrum management for railway communications.

APPENDIX G.

Network sunsets in ASEAN

Table 5:

Announcements of switch-off of legacy 2G and 3G networks in AMS

Markets	MNO	2G status/sunset date	3G status/sunset date
Brunei	Datastream Digital (DST)	June 2021 ⁱ	No plan yet
	Imagine (TelBru)		
	Progresif		
Cambodia	Metfone	No plan yet	No plan yet
	Cellcard		No plan yet
	Smart Axiata		3G shutdown in 2024 ⁱⁱ
Indonesia	XL Axiata	Shutdown in stages. ⁱⁱⁱ No set date, suggestions it could be completed by 2030. ^{iv}	Shutdown completed in stages ^{v vi}
	Indosat	No plan to switch off, citing dependence in rural areas. ^{vii}	December 2022 ^{viii}
	Telkomsel	No plan to switch off, citing continued dependence on 2G. ^{ix}	June 2023 ^x
Lao PDR	Lao Telecom	Planned for 2030 ^{xi}	Planned for 2035 ^{xii}
	Unitel		
	TPlus		
	ETL		
Malaysia	Maxis	No plan yet ^{xiii}	December 2021. MCMC-led as part of JENDELA (National Digital Network Program). ^{xiv} Although the deadline was later extended to March 2022. ^{xv}
	Celcom Digi	No plan yet	
	U Mobile	Service not provided	

¹⁶⁸ Clark, J. (15 November 2024). "Jakarta-Surabaya high-speed railway". Future Southeast Asia.

Markets	MNO	2G status/sunset date	3G status/sunset date
Myanmar	ATOM (formerly Telenor)	Telenor had planned to shut down its 2G and 3G networks in 2024 and 2025, respectively. ^{xvi} However, its sale and rebranding as ATOM likely affected these plans. Its website indicates it still offers 2G and 3G. ^{xvii}	
	MPT	No plan yet	No plan yet
	Mytel	No plan yet	No plan yet
Philippines	Globe Telecom	No set date	NTC issued MC on 28 August 2025 mandating 3G switch-off by 31 December 2026
	Smart Communications	No set date	
	DITO Telecommunity	Service not provided	Service not provided
Singapore ^{xviii}	Singtel	Country-wide shut down in April 2017 coordinated by the IMDA.	November 2024
	M1		August 2024
	StarHub		November 2024
Thailand	AIS	NBTC set a deadline for MNOs to submit shutdown plans for 2G and 3G by Q3 2026. ^{xix}	
	True Corporation		
Vietnam	Viettel	Country-wide shut down began in October 2024. ^{xx} MIC set a target for a complete shutdown by September 2026 for all MNOs. ^{xxi}	MIC set a target of September 2028 for all MNOs. ^{xxii}
	Vinaphone		
	Mobifone		
	Gtel		

Source: AMS Questionnaire responses and WPC from industry sources, December 2025.

Endnotes

- i UNN, "Cessation of 2G Services".
- ii Update from TRC, December 2025.
- iii See: <https://www.cnnindonesia.com/teknologi/20230731182057-213-980110/usai-3g-xl-matikan-jaringan-2g-bertahap>.
- iv See: https://teknologi.bisnis.com/read/20230731/101/1679873/xl-axiata-excl-ramal-jaringan-2g-bertahan-hingga-2030-goog_rewarded.
- v See: <https://www.cnnindonesia.com/teknologi/20230731182057-213-980110/usai-3g-xl-matikan-jaringan-2g-bertahap>.
- vi According to questionnaire response by Komdigi, Indonesia.
- vii See: <https://www.liputan6.com/teknologi/read/5602350/indosat-beberkan-alasan-masih-pertahankan-jaringan-2g?page=2>.
- viii See: <https://kumparan.com/kumparantech/indosat-sudah-bunuh-semua-jaringan-3g-im3-dan-tri-di-indonesia-1zPF4GoXaIK/2>.
- ix See: <https://www.cnbcindonesia.com/tech/20250221200535-37-612699/telkomsel-belum-suntik-mati-layanan-teknologi-2g-kenapa>.
- x See: <https://www.cnnindonesia.com/teknologi/20230621163011-213-964871/jaringan-3g-telkomsel-resmi-hilang-di-seluruh-indonesia>.
- xi According to questionnaire response by MPT, Lao PDR.
- xii According to questionnaire response by MPT, Lao PDR.
- xiii In 2023, [Maxis announced plans to share its 2G \(and 4G\) infrastructure with Telekom Malaysia](#).
- xiv Ministry of Communications, "3G Network to be Shut Down by the End of the Year".
- xv Malay Mail. (25 February 2022). "Retirement of 3G network extended to March 2022".
- xvi Worth, A. (29 August 2019). "A Complete Overview of 2G & 3G Sunsets". [1ot.com](#)
- xvii ATOM: <https://www.atom.com.mm/en/business>.
- xviii For 3G shutdown dates, see: <https://www.imda.gov.sg/resources/press-releases-factsheets-and-speeches/press-releases/2024/3g-services-to-retire>.
- xix Tortermvasana, K. (29 July 2025). "NBTC seeks AIS, True plans to end 2G, 3G". Bangkok Post.
- xx Vietnam Law & Legal Forum. (15 October 2024). "Vietnam to shut down 2G mobile network from Oct. 16".
- xxi Quy, L. (22 April 2025). "Vietnam to switch fully to 4G, 5G by 2028". [VN Express](#); Ministry of Science and Technology. (29 July 2024). "3G networks to be decommissioned in Vietnam by 2028".
- xxii Ibid.

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