GSMA

Accelerating 5G in Indonesia: A spectrum roadmap for success

GSMA

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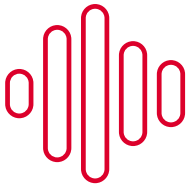
Summary

Communications, connectivity and digitisation are central to achieving higher productivity and broader socio-economic inclusion of Indonesia's broadly distributed and diverse population. Devising effective pro-growth, pro-inclusion communications and digitisation policies will be key to Indonesia's success in the new global economic environment.

Broadband connectivity and digital services that use spectrum play a vital role in how people live and businesses operate. Digital transformation is rapidly occurring in many sectors of the Indonesian economy. The 5G era will help to accelerate this process and boost economic growth in the country in the years ahead.

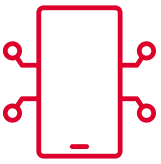
In Indonesia, mobile data traffic per connection has grown strongly in recent years, reaching over 16 GB per connection in 2024. 5G is being implemented with limited launches by operators using mainly their existing legacy spectrum holdings. As of the end of 2024, 5G network coverage is around 26% of the population (see below).[1]

Figure 1
Indonesia mobile market – key indicators



Total spectrum assigned: 452 MHz; Mid-band: 360 MHz

4G population coverage: 98%; 5G population coverage: 26.3%



Mobile data per connection per month: 14.9 GB (2024) vs 41.5 GB (2030)

Much work must be done to ensure adequate spectrum resources to support 5G development in Indonesia, especially in the crucial mid-band range (1–7 GHz). The GSMA estimates that mid-band 5G spectrum will drive an increase of more than $610 billion in global GDP in 2030, almost 65% of the overall socio-economic value generated by 5G. In Southeast Asia, 5G mid-bands will boost annual GDP by $35 billion by 2030, heavily driven by the large Indonesian market, which will account for 41% of this increment.

To secure these benefits, markets will need an average of 2 GHz of mid-band spectrum during this decade. In Indonesia, just 360 MHz of mid-band spectrum is currently assigned for mobile services. A clear spectrum roadmap setting out the strategy and actions to make spectrum available over the next few years will support the long-term growth of 5G and its full socio-economic benefits for citizens and enterprises across all sectors of the economy.

The 5G era promises to unlock many new use cases across different industries and accelerate economic growth. To realise this, it is essential to build on current plans by prioritising the following actions for 5G development:

- Refarm and auction the 2.6 GHz band for IMT/5G in early 2025 following the expiry of current satellite broadcasting licences on 1 January 2025. The 2.6 GHz band should be auctioned together with the 700 MHz spectrum. Reserve prices should be set conservatively to allow mobile operators to acquire sufficient spectrum for high-speed 5G broadband services.

1. Refer to https://indonesiabusinesspost.com/risks-opportunities/gsma-warns-indonesia-of-potential-losses-urging-for-5g-spectrum-price-review/

— Accelerate the initial release of 200 to 300 MHz of the 3.5 GHz band (from 3.4 GHz to 3.7 GHz), especially in urban areas, including greater Jakarta, Surabaya, Bandung and Medan, where demand is currently highest.

  - For 3.5 GHz, an unnecessarily large guard band between mobile and fixed satellite services (FSS) should be avoided. Instead, appropriate coexistence measures, such as site shielding, LNB replacement and upgrading FSS receiver filters, can be implemented to allow sufficient spectrum for 5G services.

  - In December 2024, the government proposed the 3.5 GHz band as essential for mobile broadband in the 2025–2029 Strategic Plan. The plan emphasised that each operator would need at least 100 MHz of mid-band spectrum to meet the 100 Mbps speed quality target.[2] At least 80 MHz in the 3.3–3.4 GHz band is cleared and should be auctioned earlier if possible.

— Work towards making at least 2 GHz[3] of mid-band spectrum available for IMT/5G by developing a spectrum roadmap for 2025–2030, considering future IMT spectrum supply, including the 4.8 GHz and upper 6 GHz bands.

— For upcoming auctions of new spectrum bands, reserve prices should be set conservatively below estimates of market value. This will allow room for price discovery and reduce the risk of unsold spectrum. Incentives in the form of reduced spectrum payments in exchange for investment and network commitments by operators should also be considered.

— Review the current formula for annual spectrum fees to provide the right incentives for efficient spectrum use. Avoid disproportionate increases in costs that are not aligned with evolving market conditions.

2. Refer to Adis Alifiawan, FGD-2, Rancangan Teknokratik Renstra Kominfo 2025-2029, Penyediaan Pita Frekuensi 3,5 GHz untuk Mobile Broadband, pages 4-5
3. Refer to www.gsma.com/spectrum/wp-content/uploads/2021/07/5G-Mid-Band-Spectrum-Needs-Vision-2030.pdf

1. Introduction

Communications, connectivity and digitisation are central to achieving higher productivity and broader social and economic inclusion of Indonesia's broadly distributed and diverse population. Devising effective pro-growth, pro-inclusion communications and digitisation policies will be key to Indonesia's success in the new global economic environment.

Digital services, underpinned by high-speed, high-performance networks, are set to become more integral to the Indonesian economy and society. Digital transformation is rapidly occurring in many sectors of the economy. The 5G era will help accelerate this process and boost economic growth in the country in the years ahead.

The International Telecommunication Union (ITU) World Radiocommunication Conference 2023 (WRC-23) completed the harmonisation of the 3.5 GHz band to deploy 5G services and identified additional mid-band spectrum in 6 GHz for future expansion towards 2030. Spectrum harmonisation is essential because it ensures stronger mobile connectivity while achieving economies of scale.

Increasing smartphone adoption and video usage have driven mobile data traffic growth over the last decade. This trend is set to continue in the 5G era with more immersive media-rich services, new online gaming technologies and extended reality (XR) applications. 5G has been the fastest mobile generation rollout, surpassing 2.1 connections by the end of 2024.[4] As of September 2024, 311 operators in 122 markets have launched commercial 5G services.[5]

This report looks closer at the 5G spectrum planning state in Indonesia. It discusses the key issues and challenges in securing sufficient spectrum resources for 5G, particularly in the mid-bands. It then provides some recommendations on the way forward.

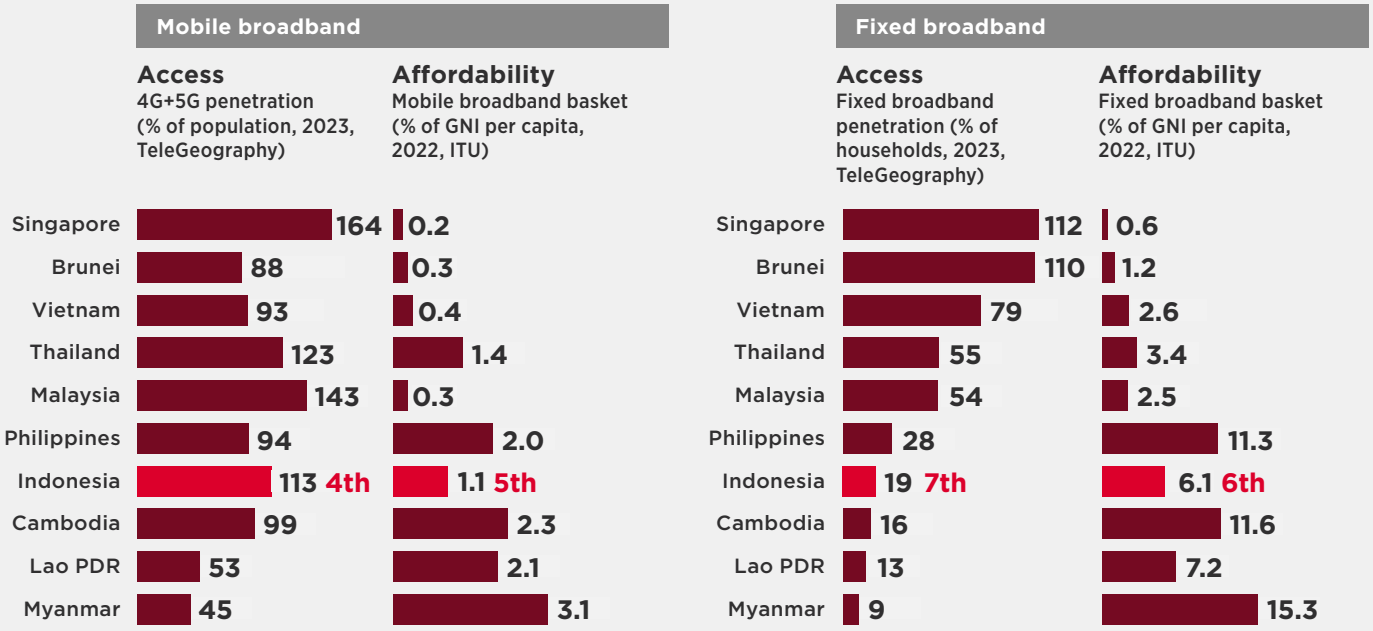
1.1 The Indonesia mobile market

High-bandwidth internet connectivity is increasingly important for enhancing productivity, social welfare, and well-being. It also supports Indonesia's leading entrepreneurial and technology scene.[6]

In many emerging markets, where fibre penetration is typically low, there tends to be a greater reliance on wireless technology – both mobile and fixed wireless – to meet the growing demand for affordable and expandable connectivity. As of the end of 2024, mobile broadband penetration in Indonesia stood at 121 per 100 inhabitants, compared to fixed broadband penetration of 5.3 per 100 inhabitants (or 20.5 per 100 households).[7] 4G network coverage was 98% of the national population. However, it is estimated that 11% of populated areas remain unserved as of 2023, with 12,548 villages not covered by 4G.[8]

4. Source: GSMA Intelligence
5. Source: GSMA Intelligence. 5G in Context, Q3 2024.
6. Source: Bain & Co, *Navigating High Winds: Southeast Asia Outlook 2024:2034*, 1 August 2024. Available at www.bain.com/globalassets/noindex/2024/bain_report_navigating_high_winds_southeast_asia_outlook_2024_34.pdf page 16
7. Source: GSMA Intelligence.
8. Refer to Dr Denny Setiawan, MCI, *Country Case Study: Spectrum Pricing Methodology and Mechanisms in Indonesia*, 10th APAC Spectrum Management Conference, Jakarta, 23-24 April 2024, page 2

Figure 2
Competitiveness of access penetration and affordability of Indonesia's mobile and fixed broadband services



Source: World Bank Group Study (Aug 2024), ITU Datahub

Indonesia's broadband infrastructure lags behind many Southeast Asia counterparts in terms of access and affordability. In ASEAN, Indonesia is ranked 4th for mobile broadband access compared to 7th for fixed broadband. Regarding affordability, mobile and fixed broadband services are mid-ranked among ASEAN countries.[9]

The Indonesian mobile market comprises the following main players as of 2024.

- Telkomsel, the largest mobile operator by subscriber base, has around 45% market share.
- Indosat Ooredoo Hutchison was formed in January 2022 following a merger between Indosat Ooredoo and 3 (Hutchison). The two entities have a combined market share of around 28%.
- XL Axiata has a market share of around 16%, while Smartfren has a market share of around 11%. On 11 December 2024, the two operators announced a proposed merger to create a stronger local player to drive investments in digital infrastructure, expand service coverage, and foster innovation.[10] The proposed merger has been conditionally approved by the Ministry of Communication and Digital Affairs.[11]

In Indonesia, 5G rollout is progressing, with commercial services launched by Telkomsel, Indosat Ooredoo and XL Axiata since 2021, utilising existing spectrum holdings in the 1800 MHz, 2.1 GHz and 2.3 GHz bands. As of the end of 2024, 5G networks covered 26.3% of Indonesia's population, or around 15.7 million 5G connections.

Currently, 452 MHz of mobile spectrum is assigned in Indonesia, as shown below. In the mid-band range, only 360 MHz across the 1800 MHz, 2.1 GHz and 2.3 GHz bands has been assigned, compared to an average of 850 MHz in the Asia-Pacific region today. Therefore, there is a clear need for more mid-band spectrum to be made available in the country as soon as possible to support the development of high-speed 5G services.

9. Refer to Adis Alifiawan, FGD-2, Rancangan Teknokratik Renstra Kominfo 2025-2029, Penyediaan Pita Frekuensi 3,5 GHz untuk Mobile Broadband, pages 9-10
10. Refer to www.xlaxiata.co.id/en/news/xl-axiata-and-smartfren-announce-idr-104-trillion
11. Refer to https://www.cnbcindonesia.com/tech/20250307150750-37-616648/meutya-hafidz-restui-merger-xl-dan-smartfren-tapi-ada-syaratnya

Table 1
Current IMT spectrum assigned in Indonesia

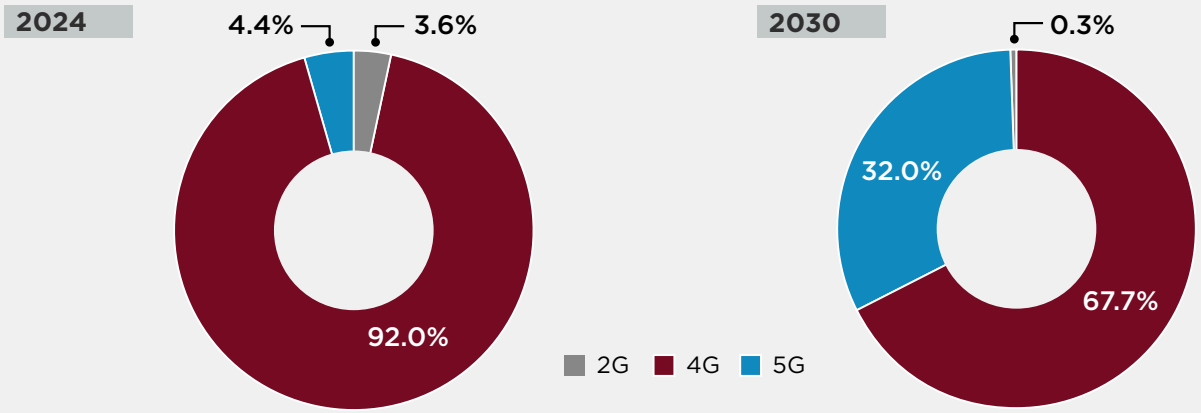
Type of spectrum	Bandwidth assigned	Bands
Low band (sub-1 GHz)	92 MHz	850 MHz, 900 MHz
Mid-band (1–7 GHz)	360 MHz	1800 MHz, 2.1 GHz, 2.3 GHz
High band (above 24 GHz)	—	—

Source: GSMA, APT

Given the lack of spectrum, Indonesian mobile operators have refarmed existing IMT spectrum holdings from 3G services to 4G and 5G. Such moves have already accelerated the switch-off of legacy 2G and 3G services, with XL Axiata switching off 3G services at the end of March 2022.[12] Indosat Ooredoo Hutchison (IOH) switched off 3G services at the end of 2022, as did Telkomsel in May 2023.

Subject to the release of adequate mobile spectrum, the pace of 5G deployment and adoption is forecast to grow over the next three years. By 2027, the number of 5G connections is forecast to reach 70 million, with 5G networks covering 59% of the population.[13] While 4G will continue to account for most mobile connections, the share of 4G connections will begin to decline from 2024 onward.

Figure 3
Connections by technology in Indonesia



Source: GSMA Intelligence

In Indonesia, total mobile data traffic has grown almost four-fold over 2019–2024, reaching 60.5 exabytes in 2024.[14] The average monthly mobile data per connection is forecast to increase from 14.9 GB in 2024 to 41.5 GB in 2030.[15]

At the same time, 5G enterprise use cases are also emerging across different industrial verticals, which will drive growth in cellular IoT connections.

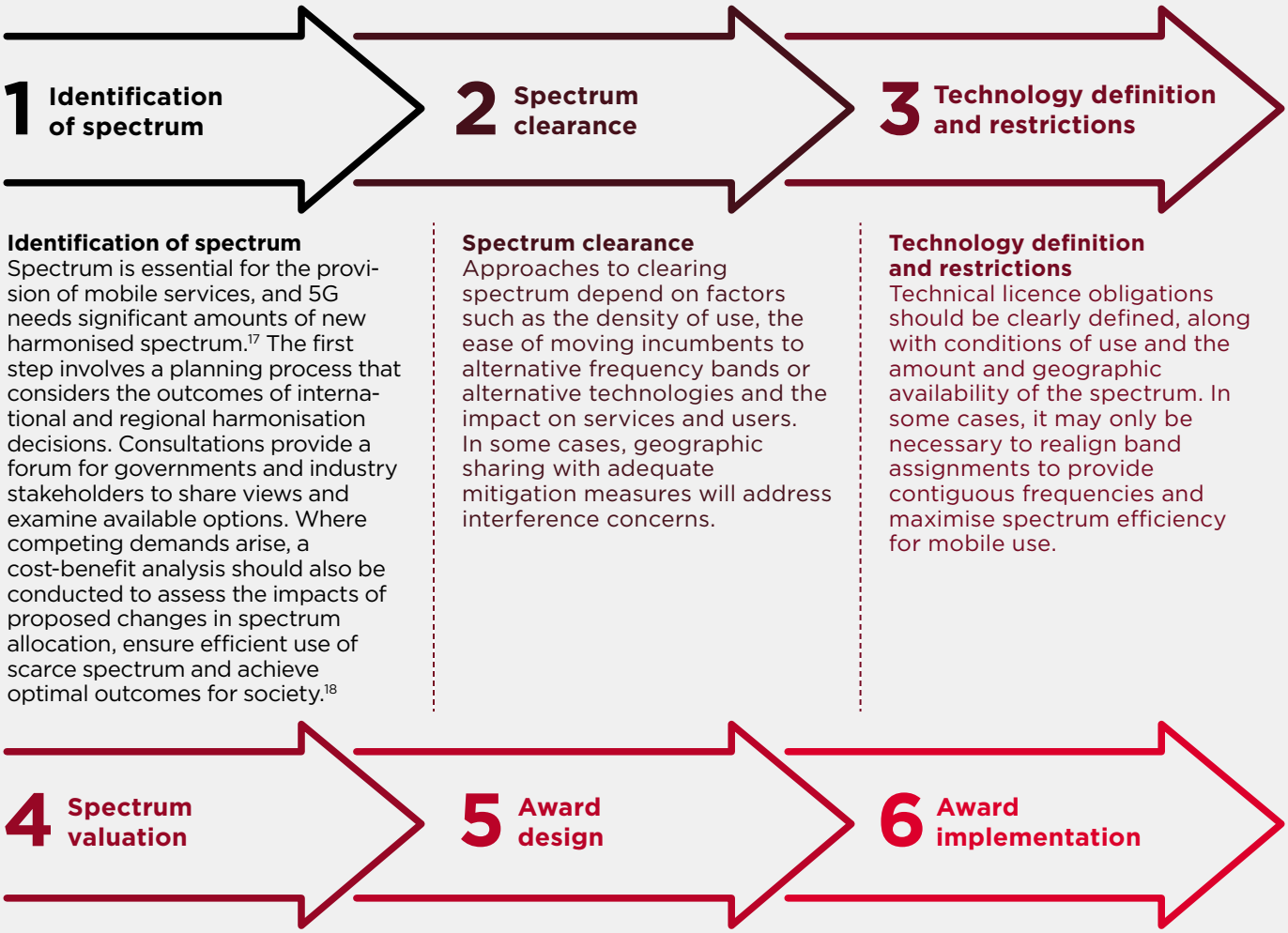
Across the Asia Pacific, operators use the scale and utility of mobile networks and services to facilitate innovative digital solutions for large and small enterprises in line with Industry 4.0 objectives. In particular, 5G and IoT will play key roles in implementing digital transformation projects across different industries, further driving demand for 5G connectivity and economic growth for the rest of the decade.

12. Refer to https://newsbeezer.com/indonesiaeng/xl-to-switch-off-all-3g-signals-at-the-end-of-march-2022-all/
13. Source: GSMA Intelligence.
14. Source: GSMA Intelligence.
15. Source: GSMA Intelligence.

1.2 A spectrum roadmap for 5G

As with all previous generations of mobile services, the road to 5G in each country starts with the release of spectrum to support the network rollout. A typical spectrum roadmap, as illustrated below, involves the following steps.[16]

Figure 4
Spectrum roadmap and steps



Identification of spectrum
Spectrum is essential for the provision of mobile services, and 5G needs significant amounts of new harmonised spectrum.[17] The first step involves a planning process that considers the outcomes of international and regional harmonisation decisions. Consultations provide a forum for governments and industry stakeholders to share views and examine available options. Where competing demands arise, a cost-benefit analysis should also be conducted to assess the impacts of proposed changes in spectrum allocation, ensure efficient use of scarce spectrum and achieve optimal outcomes for society.[18]

Spectrum clearance
Approaches to clearing spectrum depend on factors such as the density of use, the ease of moving incumbents to alternative frequency bands or alternative technologies and the impact on services and users. In some cases, geographic sharing with adequate mitigation measures will address interference concerns.

Technology definition and restrictions
Technical licence obligations should be clearly defined, along with conditions of use and the amount and geographic availability of the spectrum. In some cases, it may only be necessary to realign band assignments to provide contiguous frequencies and maximise spectrum efficiency for mobile use.

Spectrum valuation
This step involves assessing the value of spectrum guides upfront, as well as annual fees. There are different valuation approaches, including benchmarking and modelling analysis, and both methods should be used to improve accuracy and capture local market factors. Costs related to licensing obligations should be considered when setting prices for spectrum.

Award design
There are three main approaches to awarding spectrum: auctions, beauty contests and direct award.[19] The approach adopted, and associated licence obligations, must consider policy objectives, available spectrum and market specifics (for example, the number of MNOs or current spectrum holdings). Depending on the availability timeline of different frequency bands and award design, it may be appropriate to have a single multiband award or several separate ones.

Award implementation
The final step is the actual award. This will normally be underpinned by documentation that provides all the necessary details of the award process, spectrum on offer, licence obligations and other essential information for potential licensees.

16. Refer to GSMA. *Roadmaps for awarding 5G spectrum in the APAC region*. April 2022. www.gsma.com/spectrum/resources/5g-spectrum-in-the-apac-region-roadmaps-for-success/.
17. The key frequency bands to prioritise for 5G are outlined in section 1.3.
18. Refer to GSMA. *Maximising the socio-economic value of spectrum. A best practice guide for the cost-benefit analysis of 5G spectrum assignment*. January 2022. www.gsma.com/spectrum/wp-content/uploads/2022/01/mobile-spectrum-maximising-socio-economic-value.pdf.
19. Refer to GSMA auction best practice position www.gsma.com/spectrum/wp-content/uploads/2021/09/Auction-Best-Practice.pdf.

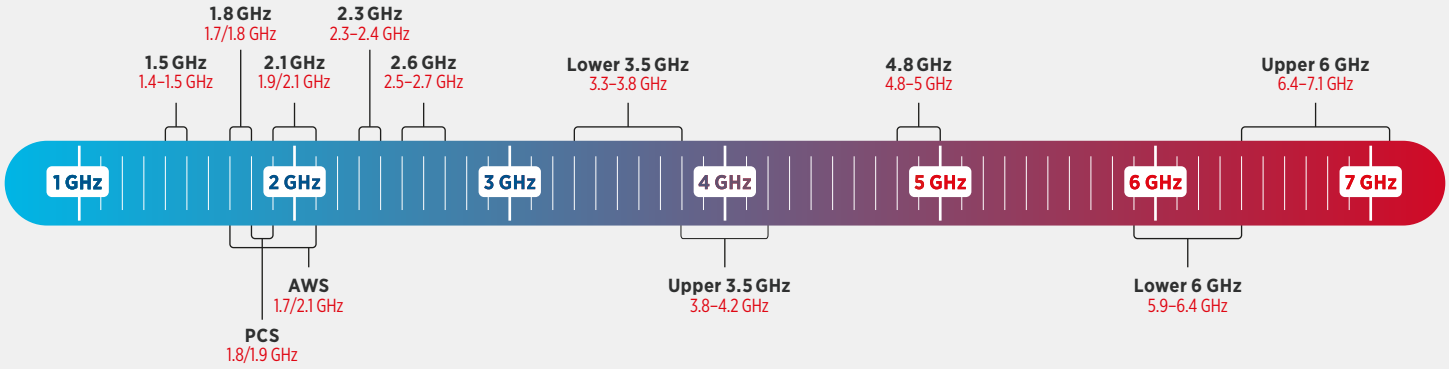
1.3 The key role of mid-band spectrum for 5G

To get the most out of 5G, spectrum is needed across low, mid- and high bands to deliver widespread coverage and support all use cases. Mid-band frequencies are especially crucial because they offer the balance of capacity and coverage that enables mobile networks to provide reliable performance that meets the ITU IMT-2020 requirements[20] across densely populated urban areas.

New 5G use cases from enhanced mobile broadband (eMBB), fixed wireless access (FWA), and enterprise and Industry 4.0 applications will enable digital transformation and drive economic growth in Indonesia. Over 2024–2030, 5G is forecast to contribute more than $41 bn (IDR 650 tn) in GDP to the Indonesian economy. By 2030, 5G will add 0.6% to Indonesia's GDP, representing over $11 bn (IDR 172 tn) annually.[21]

Mid-band spectrum resources include both lower mid-bands (i.e. 1500 MHz, 1800 MHz, 2.1 GHz, 2.3 GHz and 2.6 GHz) and upper mid-bands (i.e. 3.3–4.2 GHz, 4.5–5.0 GHz and 5.925–7.125 GHz). To launch 5G services that are consistent with the ITU's IMT-2020 requirements,[22] each operator needs access to at least 100 MHz of contiguous mid-band spectrum for initial service launch. As adoption grows, more mid-band spectrum will be required.

Figure 5
Mid-band spectrum



Source: GSMA Intelligence

It is estimated that MNOs will need an average of 2 GHz of mid-bands during this decade.[23] Research by GSMAi on the socio-economic benefits of mid-band 5G services indicates that mid-band 5G spectrum will drive an increase of more than $610 billion in global GDP in 2030, accounting for almost 65% of the overall socio-economic value generated by 5G.[24] In Southeast Asia, 5G mid-band services will generate an additional GDP contribution of $35 billion (which represents 0.64% of GDP), with Indonesia accounting for 41% of this increment.

20. Refer to ITU. Minimum requirements related to technical performance for IMT-2020 radio interface(s). Report ITU-R M.2410-0 , November 2017. https://www.itu.int/pub/R-REP-M.2410-2017
21. GSMA. Sustainable spectrum pricing to boost Indonesia's digital economy, November 2023. https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2023/11/GSMA_Sustainable-spectrum-pricing-to-boost-Indonesias-digital-economy.pdf
22. User experience of 100 Mbps DL, 50 Mbps UL rates.
23. GSMA. (8 July 2021). *5G Mid-Band Spectrum Needs: Vision 2030*.
24. GSMA. (February 2022). *The Socio-Economic Benefits of Mid-Band 5G Services*.

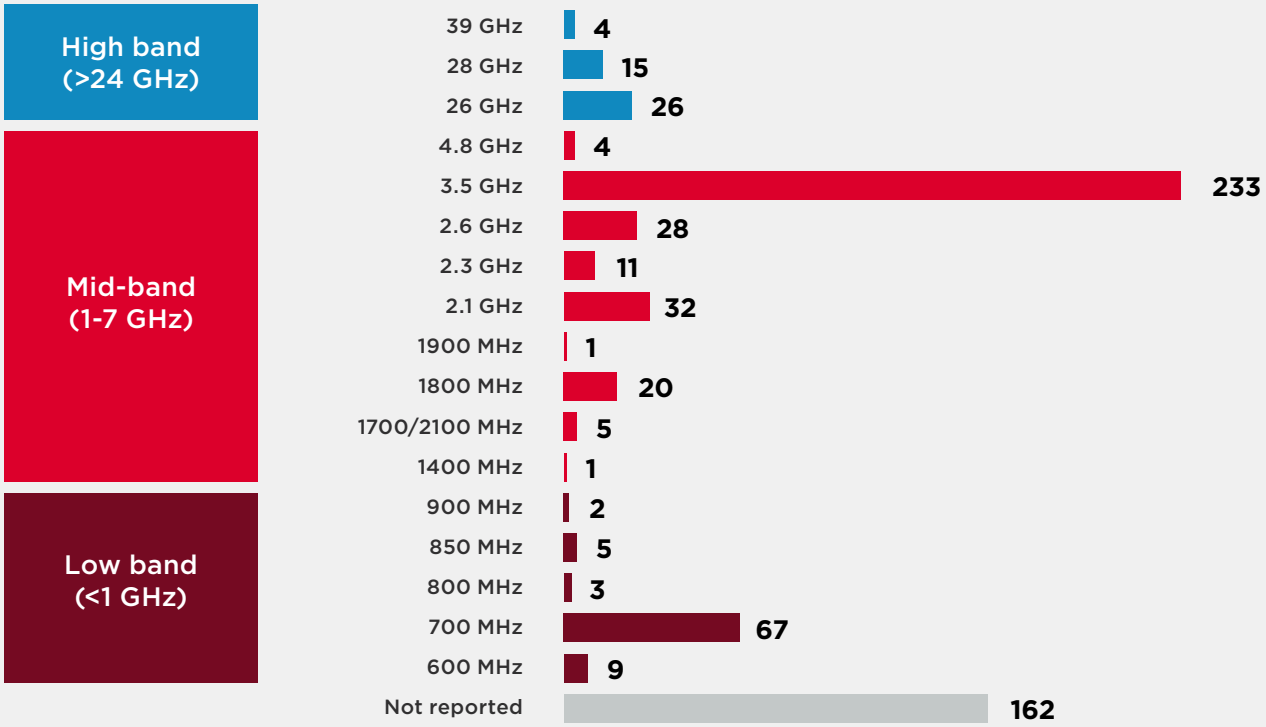
2.6 GHz and 3.5 GHz bands as the springboard for 5G

The 3.5 GHz band (3.3–4.2 GHz) n77/78, which is widely harmonised for 5G, has been the basis for the first phase of 5G rollouts in many markets. To date, 3.5 GHz accounts for most global 5G network launches,[25] driving the wider ecosystem[26], device diversity and competition. It has been deployed for eMBB, enabling faster data speeds and greater capacity required in urban, densely populated areas and for FWA in suburban and rural areas where fixed broadband availability tends to be limited.

The 2.6 GHz band, particularly the n41 Time Division Duplexing (TDD) version, has been widely deployed for 5G, including in China, the Philippines, Saudi Arabia, South Africa, Thailand, Vietnam and the United States. According to the GSA, 5G deployments in the 2.6 GHz band are the equal fourth most supported globally. Of the announced 5G device models supporting key 5G spectrum bands, 2.6 GHz (n41) had the second strongest ecosystem after 3.5 GHz with over 1,800 device models.[27]

According to GSMAi, 5G deployments in the 2.6 GHz band are the fourth most supported globally, and of the announced 5G device models supporting key 5G spectrum bands, 2.6 GHz (n41) had the second strongest ecosystem after 3.5 GHz with more than 1,800 device models.

Figure 6
5G network launches by spectrum frequency (up to Q3 2024)



Source: GSMA Intelligence.

Note: Figures refer to launches, not individual operators. A range of operators have launched their 5G networks on more than one frequency. If an operator has launched both mobile and fixed wireless 5G networks, it is counted twice. 3.5 GHz band = 3.3–3.8 GHz range. 2.6 GHz band = 2.5–2.6 GHz range.

25. Excluding frequencies not reported..
26. Of the announced 5G device models supporting key 5G spectrum bands (end March 2024), n78 (3.4-3.8 GHz) 5G devices had the strongest ecosystem with nearly 2,000 device models while n77 (3.3-4.2 GHz) had over 1,600 device models and was the fourth strongest. n41 (2.6 GHz) had the second strongest ecosystem with over 1,800 device models. Refer to GSA, *5G Market Snapshot*, May 2024, page 4.
27. Refer to GSA, *5G Market Snapshot*, May 2024, page 4

2. Progress on Indonesia's spectrum plan for 5G

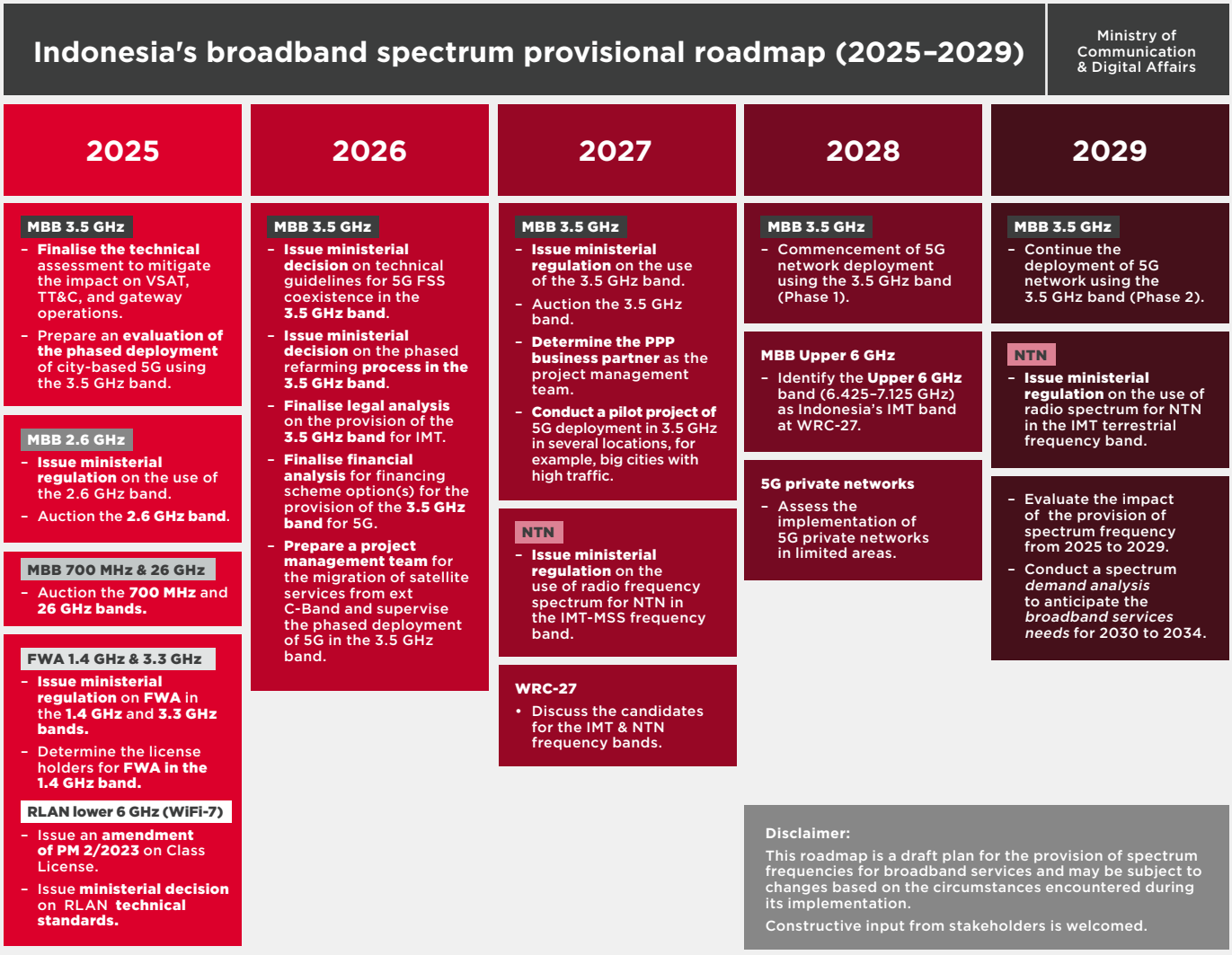
2.1 Indonesia's 5G spectrum planning

The new Ministry of Communication and Digital Affairs (Komdigi) is responsible for telecommunications policy, including spectrum management. Inside Komdigi, the Directorate General of Resources and Equipment for Post and Information Technology (SDPPI) regulates spectrum.

Current IMT spectrum roadmap for Indonesia

Indonesia's provisional spectrum roadmap is summarised below. The plan is for new spectrum to be made available to support 5G deployment in the near term in the priority bands of 700 MHz, 2.6 GHz, 3.5 GHz and 26 GHz.

Figure 7
Indonesia's current provisional IMT spectrum roadmap



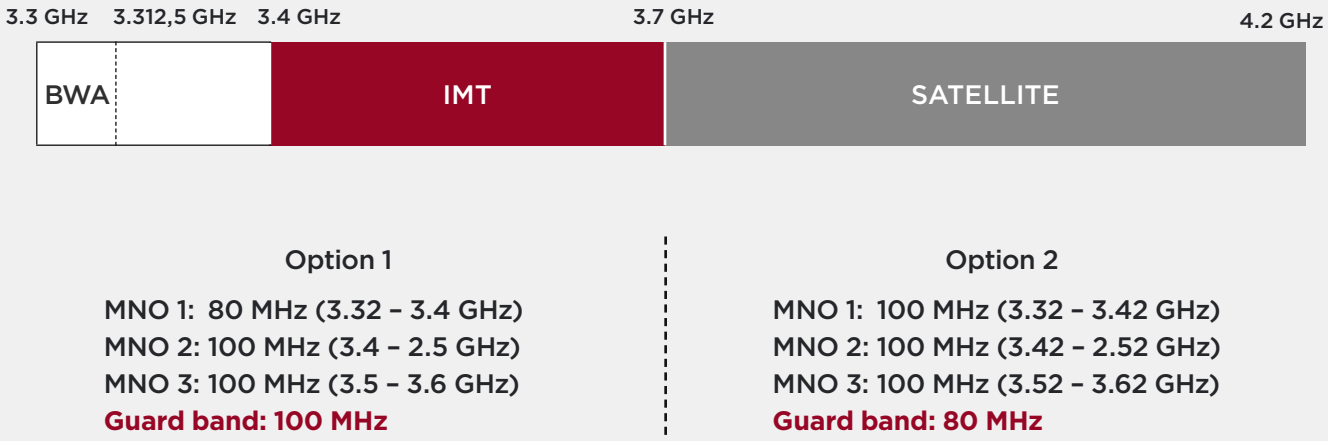
Source: SDPPI, Penataan Spektrum Frekuensi Radio Dinas Tetap & Bergerak Darat (DTBD) Capaian Tahun 2024 Untuk Dilanjutkan di Periode Tahun 2025-2029, 20 December 2024 page 47. Translation by Retno W. Damajanti.

The spectrum auction for the 700 MHz and 26 GHz bands planned for completion by July 2024 has been delayed to 2025 due to a lack of clarity on demand for these particular bands and the ongoing merger talks between XL Axiata and Smartfren.[28]

Komdigi is planning to include mid-band spectrum in the 2.6 GHz band to be auctioned in 2025 alongside the 700 MHz and 26 GHz bands. The 3.5 GHz band (3.4–3.7 GHz) is expected to be further delayed until 2027.[29] The remaining 80 MHz of the 3.3–3.4 GHz band is still under consideration and could be made available in 2025.

In September 2024, the government highlighted the importance of 3.5 GHz for mobile broadband in the 2025–2029 Strategic Plan and the need to ensure that each operator has at least 100 MHz of mid-band spectrum to meet the 100 Mbps wireless broadband speed target.[30] The 3.4–3.7 GHz band is prioritised for IMT implementation, and the use of this band for Fixed-Satellite Service (FSS) in the Extended C-band (downlink) is being phased out.[31] Two possible options are under consideration for future 5G networks: either with a 100 MHz or 80 MHz guard band, as shown below.[32]

Figure 8
The state of the 3.5 GHz band: in the future



Other spectrum bands which are the subject of longer term planning by the SDPPI are (i) L-Band (1427–1518 MHz) for supplementary download (SDL) or TDD, (ii) upper 6 GHz band (6.425–7.125 GHz recognising that 7.025–7.125 GHz was already identified for IMT at WRC-23) and (iii) 28 GHz band (still under study for 5G local network implementation in limited areas of the country).

28. Refer to www.thejakartapost.com/business/2024/07/29/govt-delays-5g-spectrum-auction-as-telcos-see-little-demand.html. See also Arah Kebijakan dan Strategi Pengembangan Pitalebar Indonesia Periode Tahun 2025-2029, November 2024.
29. SDPPI, Penataan Spektrum Frekuensi Radio Dinas Tetap & Bergerak Darat (DTBD) Capaian Tahun 2024 Untuk Dilanjutkan di Periode Tahun 2025-2029, 20 December 2024 page 47
30. Refer to Adis Alifiawan, FGD-2, Rancangan Teknokratik Renstra Kominfo 2025-2029, Penyediaan Pita Frekuensi 3,5 GHz untuk Mobile Broadband, pages 4-5 .
31. Ibid, page 16
32. Ibid, page 12

2.2 Digital dividend, 700 MHz and changes to the applicable spectrum management law

In Indonesia, there were delays in securing the release of the 700 MHz band (digital dividend) after the switchover from analogue to digital television. Following considerable internal debate, the switchover was legislated in late 2020 by the Indonesian Parliament, with the digital dividend spectrum in the 700 MHz band cleared for assignment by late 2023.

The *Omnibus Law*, first passed in 2020, entailed significant legislative changes to liberalise Indonesia's telecommunications sector and support accelerating its digital economy – especially by optimising spectrum use in the 5G era. While subject to constitutional challenges, it was finally ratified in 2023. Specifically, the Omnibus Law:

- Permits spectrum sharing and transfer among telecom operators.
- Mandates the completion of the digital TV migration within two years of the enactment of the Law, freeing up the 700 MHz band.
- Provides clarification on payment of annual spectrum fee.
- Allows spectrum licensees to transfer spectrum rights to other network operators.

While such changes are welcome, additional reforms can further improve the spectrum management framework in Indonesia. For example, these can include:

- Flexibility in the licence period term, which is currently fixed for 10 years. This should be amended to provide a licence period of up to 15 years. A non-fixed longer period would give flexibility in aligning spectrum band licence period end-dates, as well as providing more flexibility for future frequency band refarming.
- Komdigi's ability to terminate non-compliant frequency licences should also be strengthened as it remains challenging for spectrum to be returned to the government for reallocation on time.
- Creation of a spectrum relocation fund. Given the continuing challenges of the spectrum being returned to the government for prompt reallocation, one approach that can be considered is creating a fund to pay the costs of spectrum re-organisation and refarming. This could be modelled on France's 'Fond de Réaménagement de Spectre' (FRS)[33] or refarming fund, managed by Agence Nationale des Fréquences (ANFR) or the USA's Spectrum Relocation Fund.[34] The need for such mechanisms is obvious, given the proposed compensation to FSS users in the C-band from the spectrum auction proceeds with the refarming of the 3.5 GHz band to IMT/5G use.[35]

33. Refer to www.anfr.fr/planifier/le-fonds-de-reamenagement-du-spectre
34. Refer to https://uscode.house.gov/view.xhtml?req=(title:47%20section:928%20edition:prelim)
35. Refer to Adis Alifiawan, FGD-2, Rancangan Teknokratik Renstra Kominfo 2025-2029, Penyediaan Pita Frekuensi 3,5 GHz untuk Mobile Broadband, pages 16 and 21-24

3 Challenges and recommendations for Indonesia's spectrum roadmap

Timely access to IMT spectrum, particularly in the mid-band range, is essential for 5G and future 6G development in Indonesia. The key challenges to securing spectrum access for IMT are technical and financial. Below, we discuss the key issues and recommendations to secure sufficient spectrum for 5G services in Indonesia.

3.1 Spectrum roadmap towards 2030

Assignment of the 700 MHz band

Following the successful analogue-to-digital TV migration completed at the end of 2023, additional harmonised spectrum below 1 GHz should be made available via auction in 2025.

Low-band spectrum is a cornerstone of digital equality and a driver of broad and affordable connectivity. Ensuring the full availability of 2x45 MHz of the 700 MHz band is particularly beneficial as it will help in the provision of affordable mobile broadband coverage in 3T (foremost, remote and disadvantaged) and rural areas of the country, including Sumatra, Sulawesi, Papua and Kalimantan. It will also improve deep in-building coverage in urban areas. It will facilitate future voice services and migration to Voice over LTE (VoLTE) or Voice over 5G New Radio (VoNR).

Refarming of the 2.6 GHz band for IMT services

The 2.6 GHz band in Indonesia is currently under-utilised. Following the expiry of current satellite broadcasting licences on 1 January 2025, ensuring that the full band is refarmed for mobile is essential. It is understood that Indonesia has plans to migrate the DTH services operating in the 2.6 GHz band to the Ku-band.

The availability of the 2.6 GHz band in Indonesia, especially using the full TDD band n41 across 2.5–2.69 GHz, would expand capacity in urban centres, alleviate network congestion and improve the quality of services. For example, the extensive use of this band in Thailand, particularly in the greater Bangkok area, is a key reason behind Thailand's successful 5G deployment. The 2.6 GHz band was also successfully auctioned in Vietnam and is forming a key part of market leader Viettel's 5G national deployment.[36]

36. GSMA, *Accelerating 5G in Vietnam: A Spectrum Roadmap for Success*, November 2024

Securing the 3.5 GHz band for 5G services

Given the continued role of satellite in the Indonesian archipelago, it is crucial to optimise the use of the 3.5 GHz band for 5G, particularly in major cities and industrial complexes in Indonesia. Four satellites are currently utilising C-band, including extended C-band range in 3.4–3.7 GHz, which pose significant challenges to refarming for 5G. These are, namely:

- BRIsat (C-band and Ku-band, expected end date in 2031). This satellite is used by Bank Rakyat Indonesia (BRI) to connect its nationwide ATM network.[37]
- Telkom-3S (C-band and Ku-band, expected end date 2032).
- Telkom-4 (C-band and Ku-band, expected end date 2033).
- Nusantara Satu (C-band and Ku-band, expected end date 2034).

To free up 3.5 GHz for 5G before 2034 will likely require a service migration plan and low-noise block downconverter (LNB) replacement for existing C-band FSS receivers.

Even then, only an initial 200 to 300 MHz of spectrum in 3.4–3.7 GHz could be made available for IMT/5G services. Notably, the 3.3–3.4 GHz band, which was previously used for broadband wireless access, is now vacant.

The government's proposal to allocate the 3.4–3.7 GHz range for future 5G networks marks a positive step forward.[38] However, the proposed award in 2027 will place Indonesia behind its ASEAN counterparts in terms of mid-band spectrum supply and is likely to have negative implications on 5G development.

Post-2034, additional 3.5 GHz band spectrum should become available if current C-band satellite services are moved to higher satellite bands. While the C-band continues to be necessary, there is a global trend towards the use of higher bands for satellite. Satellite operators are rapidly expanding Ku- and Ka-bands capacity by developing advanced satellite modulation techniques. For example, the SATRIA-1 High-Throughput Satellite, which utilises the Ka-band and is designed to address the digital divide, was successfully launched in late 2023 and has been used commercially since early 2024.[39]

37. Refer to https://asia.nikkei.com/Business/BRI-pioneers-world-s-first-dedicated-satellite-to-regain-Indonesian-banking-lead and www.asiasat.com/system/files/2019-12/GSC%20-%20C-band%20is%20critical%20for%20satellite%20servcies.pdf
38. Refer to Adis Alifiawan, FGD-2, Rancangan Teknokratik Renstra Kominfo 2025-2029, Penyediaan Pita Frekuensi 3,5 GHz untuk Mobile Broadband, pages 12-13
39. Refer to www.bcsatellite.net/blog/indonesias-satria-1-satellite-is-connected-and-set-for-2024/

Recommendations for 3.5 GHz

1. **Supply:**
   Ensure at least 300 MHz of 3.5 GHz spectrum in the 3.3–3.7 GHz band should be made available by 2026. If this is not possible, then consistent with the phased approaches in other markets, at least 200 MHz should be released first. Additional 3.5 GHz spectrum should be released in the future, subject to clearance and/or the implementation of adequate mitigation measures. If a phased approach is taken, all the spectrum released during such a process should be subject to a condition that allows the band to reorganise to create larger contiguous blocks of spectrum. The aim is for all mobile operators to secure at least 100 MHz of contiguous spectrum in this band.

2. **Clearance and mitigation measures:**
   Indonesia should accelerate clearance or introduce adequate mitigation measures to ensure coexistence with incumbent users in the band. Firstly, where alternatives to C-band satellite (e.g. fibre, mobile) are available, these should be used instead. Secondly, in considering mitigation measures, the recommended actions are:

   — Adopt guard bands that maximise spectral efficiency. Studies and real-world regulatory examples of the necessary guard band between 5G and FSS exist. For example, studies have concluded that a guard band in the 18[40] to 25 MHz range is needed.[41] In Vietnam,[42] Canada[43] and the US,[44] a guard band of 20 MHz has been adopted. In Singapore, after initially proposing a guard band of 100 MHz, a guard band of 50 MHz was used instead.

   — Ensure improved filtering for FSS receivers by installing LNBs where required. Other possible measures to address coexistence issues, such as earth station shielding, restriction zones or detailed coordination, could also be considered.

3. **Phased introduction by geography:**
   Indonesia should consider whether to adopt geographical separation for VSAT in regional and rural areas while restricting the use of satellite direct-to-home (DTH) and TVRO in the 3.4–3.7 GHz in key urban areas, such as Java and the top 10 urban areas of the country.[45] This approach would allow 5G deployment of 3.5 GHz in urban areas where demand is highest while permitting continued access to the band for FSS services in more rural parts of Indonesia, where satellite connectivity still plays an important role.

mmWave band spectrum availability

While Indonesia has decided to allocate the 26 GHz bands for 5G, the spectrum auction in the 26 GHz band, which was planned for completion by July 2024, has now been delayed to 2025. Spectrum in high bands can be made available regionally if industry demand exists, especially for enterprise use.

As the mmWave ecosystem is relatively small and use cases are still emerging, it will be necessary for Komdigi to ensure licence conditions provide appropriate incentives, including longer validity, lower prices and flexible obligations.

Future IMT spectrum and planning towards 2030

Spectrum is central to mobile connectivity and will underpin Indonesia's digital transformation and economic growth. Indonesia will need an average of 2 GHz of mid-band spectrum by 2030 to ensure sufficient capacity as 5G expands and to prepare for future 6G services.[46] Policymakers must adopt a long-term strategy to manage spectrum demands, balancing various uses to maximise economic and societal benefits. This will allow businesses to prepare investment plans, secure financing and develop arrangements for deploying particular technologies.

40. Refer to the Transfinite study in 2019 which concluded that an 18 MHz guard band is sufficient to mitigate co-frequency interference. Available at www.transfinite.com/papers/Report_for_GSMA_on_3.4-3.8_GHz_Compatibility.pdf
41. In Brazil, a guard band of 25 MHz was assessed to be adequate, though this was not needed as the decision was made to migrate existing TVRO services to the Ku-band. Refer to https://www.gsma.com/connectivity-for-good/spectrum/brazil-multi-band-auction-one-of-the-largest-in-mobile-history/
42. Guard band from 3980 to 4000 MHz.
43. Refer to ISED. *Decision on the Technical and Policy Framework for the 3650-4200 MHz Band and Changes to the Frequency Allocation of the 3500-3650 MHz Band*. May 2021. Available at https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11699.html
44. Refer to FCC. *Expanding Flexible Use of the 3.7 to 4.2 GHz Band,* 3 March 2020. Available at https://docs.fcc.gov/public/attachments/FCC-20-22A1.pdf
45. Refer to Adis Alifiawan, FGD-2, Rancangan Teknokratik Renstra Kominfo 2025-2029, Penyediaan Pita Frekuensi 3,5 GHz untuk Mobile Broadband, pages 12-13.
46. Refer to Coleago Consulting. *Estimating the mid-band spectrum needs in the 2025-2030 time frame*, July 2021. Available at www.gsma.com/spectrum/wp-content/uploads/2021/07/Estimating-Mid-Band-Spectrum-Needs.pdf

Only around 360 MHz of mid-band spectrum has been assigned for IMT in Indonesia. Even with the inclusion of the 2.6 GHz and 3.5 GHz bands, the total supply of mid-band spectrum will still be significantly below the 2 GHz required for IMT by 2030. The following actions are recommended for Indonesia:

- Assess options for expanding spectrum supply for 5G in the 2025–2030 timeframe, particularly in the mid-bands. These can include the release of unassigned spectrum in existing mid-bands and the identification of new spectrum in potential future bands.
- Plan for the use of 4.8 GHz and the entire upper 6 GHz (6.425–7.125 GHz)[47] bands to support further development of 5G. The additional 700 MHz in the upper 6 GHz band will go a long way to addressing Indonesia's mid-band needs.
- Gather information on usage trends for FSS in the 3.7–4.2 GHz band and assess possible options for future 5G use in this range as satellite capacity in other bands, such as Ku and Ka, develops.
- Explore options for other IMT candidate bands, which can be used for 5G local networks in limited areas.

Komdigi's 2025–2029 Strategic Plan represents an excellent start on a long-term spectrum roadmap for Indonesia. This roadmap should be updated annually to incorporate SDPPI's work, which releases different frequency bands and information on evolving technology and spectrum trends, including harmonisation and standardisation activities.[48]

3.2 Long-term financial sustainability in Indonesia

Indonesian mobile operators face financial challenges despite significant mobile usage and data traffic growth. Spectrum costs for operators have risen substantially since 2010, with annualised spectrum costs reaching 12.2% of recurring revenue in 2023, above the APAC median of 8.7%.[49] Sustainable spectrum prices are needed to facilitate 5G network investment and accelerate digital transformation.

There are several risks to the long-term financial sustainability of the Indonesian mobile market, namely:

- **Spectrum auction prices have risen to unsustainable levels** due to scarcity of IMT spectrum and sub-optimal processes in previous auctions involving individual spectrum blocks in the 2.1 and 2.3 GHz bands being auctioned separately over several years rather than multiple blocks or a multi-band auction.
- **Indonesia has a relatively low total IMT spectrum allocation and high unit spectrum prices**[50] compared to other countries. This adversely affects mobile broadband quality of service and operational expenditures. These twin pressures can stifle the intensity of competition and crowd out investment in wireless broadband infrastructure.
- **Additional costs of deployment and operations across the Indonesian archipelago**. Deploying mobile broadband infrastructure and services over 1.9 million square kilometres scattered across thousands of islands is geographically challenging. More sites are needed, including towers, fibre and costly submarine cables, meaning Indonesia has higher capital expenditure intensity than Asia's average.[51]

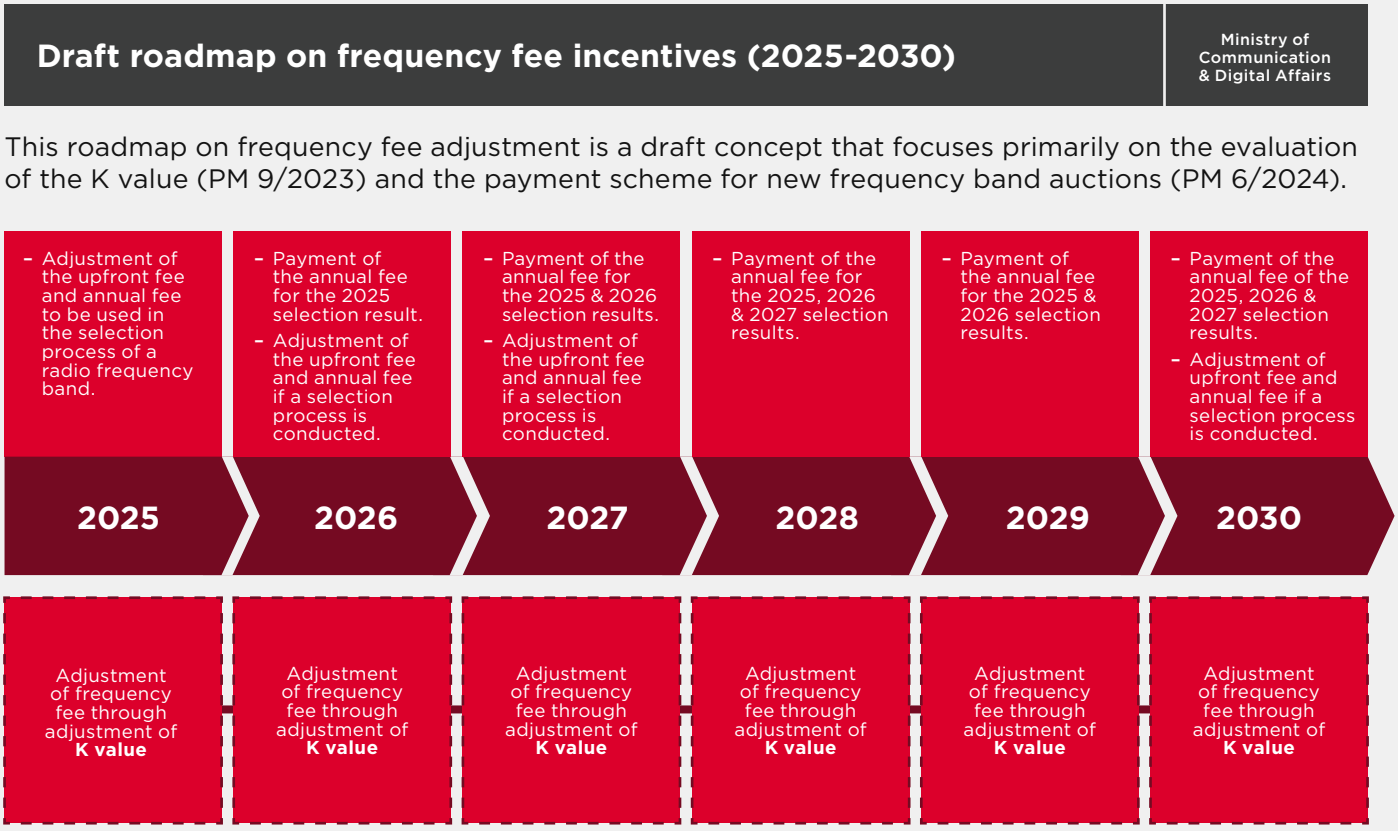
47. GSMA. *Mobile Evolution in 6 GHz: The impact of spectrum assignment options in 6.425–7.125 GHz*, September 2024. Available at https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2024/09/GSMA_Mobile-Evolution-in-6-GHz.pdf
48. Indonesia is planning to strengthen digital infrastructure by expanding coverage through preparations for Non-Terrestrial Network (NTN) under the second strategy of Strengthening Indonesia's Digital Foundation 2025-2029.
49. GSMA. Sustainable spectrum pricing to boost Indonesia's digital economy. October 2023. Available at https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2023/11/GSMA_Sustainable-spectrum-pricing-to-boost-Indonesias-digital-economy.pdf
50. Indonesia's current spectrum cost to revenue ratio for a majority of mobile operators is already above 10%. Based on Coleago study: annualised cost spectrum as a percentage of revenue more than 10 percentage may not be sustainable. Refer to Coleago, *Spectrum pricing, make or break the 5G momentum*, Shanghai, June 2019, page 17
51. To address these higher costs, sharing approaches are supported by Komdigi as part of the regulatory and policy elements of the Penta Helix Model. Source: Dr. Ir. Ismail, M.T, MCI, *Presentation, 5G and Telco Transformation: Indonesia's Path to Ultra-Fast Connectivity*, DTI-CX Conference2024, Jakarta, 31 July 2024, page 8

— **High regulatory costs** hamper the broadband sector from becoming an economic development enabler.[52] The increasing ratio of regulatory costs to revenue has decreased mobile operator funding capability to allocate adequate resources for infrastructure roll-out to boost coverage and quality of services across the Indonesian archipelago.

The government has recognised such issues and the need to provide spectrum fee incentives. A positive development is the 'Strengthening Indonesia's Digital Foundation 2025-2029 Plan', which highlights how price per MHz must be adjusted to maintain a healthy ratio of regulatory costs to gross revenue (approximately 5%). The plan also outlines that, in addition to retaining the spectrum fee-to-revenue ratio at a maximum of 10%, it is recommended that the 5G frequency fee does not exceed 50% of the 4G frequency fee.[53]

The SDPPI is considering a reduction factor in spectrum fees for operators at the upcoming 5G spectrum bands auction if they are given obligations that create additional burdens or costs (such as rollout obligations in non-economic areas), as summarised below.[54]

Figure 9
Draft roadmap on frequency fee incentives (2025-2030)



Source: SDPPI, Penataan Spektrum Frekuensi Radio Dinas Tetap & Bergerak Darat (DTBD) Capaian Tahun 2024 Untuk Dilanjutkan di Periode Tahun 2025-2029, 20 December 2024 page 48. Translation by Retno W. Damajanti

52. When deploying broadband infrastructure, the sector is subjected to permit and right of the way fees, which vary substantially across local government units, thus increasing capital expenditures (CAPEX) of broadband infrastructure deployment and potentially lowering the coverage and the affordability of the mobile services.
53. Refer to Arah Kebijakan dan Strategi Pengembangan Pitalebar Indonesia Periode Tahun 2025-2029, November 2024.
54. SDPPI, Penataan Spektrum Frekuensi Radio Dinas Tetap & Bergerak Darat (DTBD) Capaian Tahun 2024 Untuk Dilanjutkan di Periode Tahun 2025-2029, 20 December 2024 page 48

Recommendations on spectrum pricing

Industry revenue per MHz of spectrum has declined in Indonesia while spectrum fees have increased. Therefore, Indonesia must set modest reserve prices for releasing any new IMT spectrum.

In addition, the formula for calculating annual spectrum fees (BHP IPFR), which has been indexed to inflation and population, should also be reviewed. Adjustments should be made to provide the right long-run incentives and avoid disproportionate cost increases that are not aligned with evolving market conditions.

Spectrum should be licensed as soon as needed. Artificial spectrum scarcity and measures that increase risks for mobile operators should be avoided.

Lastly, incentive policies should be implemented to accelerate infrastructure roll-out and boost coverage and the quality of services in Indonesia. This can be reduced spectrum fees in exchange for operator's investment and network rollout commitments.

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