National Information and Communications Technology Authority

DRAFT Spectrum Outlook & Roadmap 2025 to 2030

Consultation Paper

Papua New Guinea

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Consultation Document on the Spectrum Road Map 2025-2030

This document presents the draft spectrum roadmap 2025-2030 for PNG

Invitations to Comment & Disclaimer

NICTA invites comments on this document, **particularly responses to the consultation questions of Annex I**.

Written representations or enquires may be in sent in writing or via email directed to: sanda@nicta.gov.pg by no later than 5 pm on 04th July 2025.

This public stakeholder consultation is for information purposes only about the NICTA's preliminary views on the subject matter. The consultation is not intended to form any part of the basis of any investment, technical, financial or legal advice.

All views expressed in this consultation paper are subject to updating, modification and amendment at any time as deemed necessary by the NICTA. Whilst NICTA believes that the information in the consultation paper is accurate at the time of publication, it will not accept any responsibility or liability as to, or in relation to, the accuracy or completeness of the information it contains.

Abbreviations

The table below lists the acronyms and abbreviations used in this document.

Acronym	Meaning
AIP	Administrative Incentive Pricing
APEC	Asia Pacific Economic Cooperation
APT	Asia Pacific Telecommunity
DSA	Dynamic Spectrum Access
BWA	Broadband Wireless Access
EHF	Extremely High Frequency
FM	Frequency Modulation
GoPNG	Government of Papua New Guinea
HDS	High Demand Spectrum
HF	High Frequency
ICAO	International Civil Aviation Organization
ICT	Information and Communication Technology
IMT	International Mobile Telecommunication
ISP	Internet Service Provider
ITU RR	International Telecommunications Union Radio Regulation
ITU	International Telecommunication Union
LIC/LMIC	Low Income Country / Low Middle Income Country
LTE	Long Term Evolution
MF	Medium Frequency
MNP	Mobile Network Portability
MNO	Mobile Network Operator
NBP	National Broadband Plan
NICTA	National Information and Communication Technology Authority
NNP	National Numbering Plan
PITA	Pacific Islands Telecommunications Association
PNGDF	Papua New Guinea Defence Force
PNG	Papua New Guinea
PNG NFAT	Papua New Guinea National Frequency Allocation Table
PPDR	Public Protection Disaster Relief
PTA	Point-to-Area
SME	Small and Medium Enterprise
TDD	Time Division Duplexing
UHF	Ultra-High Frequency
UWB	Ultra-wide Band
VHF	Very High Frequency
WRC-19	World Radio Conference 2019
WRC-23	World Radio Conference 2023
1G	First Generation
2G	Second Generation
3G	Third Generation
4G	Fourth Generation
5G	Fifth Generation

1. Executive Summary

The Government of Papua New Guinea envisions connectivity as one of the key national development goals. The "PNG Vision 2050" envisions increased connectivity access from 10% in 2010 to 100% nationwide. In the Long-Term Development Policy 2010 – 2030, the GoPNG emphasize on nationwide coverage and access: 800 mobile subscribers per 1000 people by 2030, 70% of the population to have access to or use the Internet by 2030, and 100% of Papua New Guineans to have access to radio and television by 2030. In order to achieve these development goals, Radio Frequency Spectrum is the key resource enabler that will ensure these policies help people connect with one another and the world. NICTA works to ensure visibility that spectrum resources are available for the various services that offer broadband connectivity to urban and rural Papua New Guineans alike.

Radio frequency spectrum is a scarce resource essential for many vital communication services across many sectors of the economy. As radio spectrum is a limited resource, NICTA manages radio frequency spectrum and ensures spectrum is used in the best interest of all the citizens of Papua New Guinea. With the increasing demand for spectrum due to rapid growth of innovative technologies, it is vital to create a spectrum framework to coordinate spectrum management activities in a structured and transparent manner.

A Spectrum Outlook Plan and a Spectrum Roadmap is needed to provide the roadmap for the efficient use of spectrum that will create new use cases; improve spectrum utilization, creation of new market demand, and to promote efficiency for current and future spectrum allocations. Therefore, *NICTA has taken steps to develop an Spectrum Road Map 2025-2030 to guide the allocation, assignment and efficient management of radio frequency spectrum in PNG.*

Going forward NICTA would like to encourage flexibility in spectrum management and increase access of spectrum for all users by employing technology-and-service-neutral authorizations to let spectrum users choose the best technologies and services to apply in a frequency band. This is becoming common and administrative determination of technologies and services should become the exception and should be clearly justified. The technology-neutral approach will give incentive to network operators to adopt the most spectrally efficient technology.

The **Spectrum Outlook & Roadmap** will provide information to commercial operators, stakeholders and users of NICTA's planned activities to meet expected demand for commercial mobile services, license-exempt applications, satellite services and wireless backhaul services in the next five years. It also outlines NICTAs DRAFT **schedule work plan** for the short, medium and long term to address issues related to spectrum access, reflect current usage and efforts to maximize the use of this limited resource.

Most Low-Income Countries (LIC) and Low-and Middle Income Countries (LMIC) countries like PNG score low in licensing and spectrum management policy and regulatory assessments **due to the lack of a spectrum roadmap** in many of these countries, which partly leads to *not* enough IMT spectrum having been assigned. This is clearly the case in PNG in Q1/Q2 2025, and NICTA is rectifying this position with this Spectrum Outlook & Roadmap.

2. Introduction to PNG's Legal and Policy Frameworks Related to Spectrum Management

2.1 In Papua New Guinea (PNG), the Department responsible for ICT – the Department of Information and Communications Technology[1] (DICT) - is responsible for the administration and implementation of key Government policies, developing goals and policy frameworks for the use of ICT services in Papua New Guinea.

2.2 Telecommunication policy frameworks are important for the orderly development of the radiofrequency spectrum and provide the necessary legal basis, policy direction and tools providing access to radiofrequencies.

2.3 The PNG Government policy objectives, national development goals, Acts and statutory instruments maintained by the DICT are enforced by the National Information & Communications Technology Authority.

2.4 The National Information and Communications Technology Authority (NICTA) is an independent regulatory authority established through the NICTA Act 2009 (Act).

2.5 NICTA is the primary regulator of the ICT industry that is responsible to regulate radio spectrum in Papua New Guinea.

2.6 The NICTA Act 2009 sets out the rights and obligations of radio frequency spectrum users and stipulates the foundational structure of PNGs National Radio Spectrum Management. It also recognizes the international radiocommunications treaties to which PNG is a signatory – namely the International Radio Regulations and the Telecommunications Union (ITU) Convention.

The NICT Act (2009) & the NICTA Radio Spectrum Regulations (2010)

2.7 The NICTA Act 2009 sets out the rights and obligations of radio frequency spectrum users and stipulates the foundational structure of PNGs National Radio Spectrum Management. It also recognizes the international radiocommunications treaties to which PNG is a signatory – namely the International Radio Regulations and the Telecommunications Union (ITU) Convention.

2.8 The NICTA Act 2009 (Act) establishes the spectrum and licensing regimes, compliance and enforcement policy and statutory instruments. The primary objective of the Act is to ensure that the ICT industry contributes to the greatest extent possible the long term economic and social development of Papua New Guinea.

2.9 Therefore, the NICT Act (2009) and the NICTA Radio Spectrum Regulations (2010) are the **key** two Spectrum Laws.

2.9.1 In PNG, the National Information and Communication Technology Act (NICTA) of 2009[2] is the *primary Law* of the sector, while Statutory Instruments ('SIs' or 'Regulations')

[1] https://www.ict.gov.pg/
[2] https://www.nicta.gov.pg/legislative/acts/

are secondary or subordinate to the *primary* legislation.

2.9.2 Section 164(a) of the NICT Act reads: "maximise, by ensuring the efficient allocation and use of the spectrum, the overall public benefit derived from using spectrum".

2.9.3 Section 164(c) reads: "provide a responsive and flexible approach to meeting the needs of users of the spectrum" - this duty to "provide a responsive and flexible approach to meeting the needs of users of the spectrum…".

2.9.4 Section 164(e) reads: "provide an efficient, equitable and transparent system of charging for the use of spectrum, taking account of the value of both commercial and non-commercial use of spectrum" - this duty and factor is more self-evident, and needs less interpretation.

2.9.5 The duties on "ensuring the efficient allocation and use of spectrum…" and that to "provide a responsive and flexible approach to meeting the needs of users of the spectrum…" are both at the core – and form the bases - of this Spectrum Outlook and Roadmap.

2.9.6 The duty to "provide an efficient, equitable and transparent system of charging for the use of spectrum, taking account of the value of both commercial and non-commercial use of spectrum" – is also a key basis to this Spectrum Outlook and Roadmap.

2.9.7 Division 3 [Radio Frequency Planning] Radio Frequency Planning Article 166 Spectrum Plans (1) states: "NICTA shall make or vary rules under Section 218, in the form of a spectrum plan" with a "spectrum plan" detailed in Articles 166(2), 166(3) and 167. Consultation on the Plans have to abide by Article 168. Therefore, NICTA has responsibilities to update, change and make spectrum plans for ALL spectrum bands.

2.9.8 The laws (including on PNG Spectrum) in the 2009 NICT Act come into force via *secondary* Statutory Instruments (SIs). There are two major secondary SIs that NICTA uses daily - *derived* from the NICTA Act (2009)

2.9.8.1 *Statutory Instrument N° 9 (of 2010)* [3] *on National Information and Communication Technology (Operator Licensing) Regulation*: this set of regulations are the key laws that underpin all Licensing of Operators in PNG including *inter alia* types of licenses, Operator Licence fees and more.

2.9.8.2 Statutory Instrument *N° 10* (of 2010) [4] *on National Information and Communication Technology (Radio Spectrum) Regulation* - this set of regulations are the key laws that underpin all Spectrum licensing in PNG including *inter alia* types, duration, renewal, trading, etc. of spectrum licenses, and more.

2.10 The latter Radio Spectrum Regulations govern the daily administration of radio spectrum in PNG. Some relevant provisions of the NICTA Spectrum Regulations include[5] that form part of the bases of this Spectrum Outlook and Roadmap follow.

2.10.1 Section 6(1) (a) and (b) clearly allows NICTA to determine *market-based or administrative cost-based* spectrum fees in the PNG.

[3] https://www.nicta.gov.pg/downloads/download-info/operator-licensing-regulation/
[4] https://www.nicta.gov.pg/downloads/download-info/radio-spectrum-regulation/
[5] https://www.nicta.gov.pg/downloads/download-info/radio-spectrum-regulation/

2.10.2 Section 6(1) states that the fees payable in respect of a spectrum licence can (i.e., a power) be issued "on a market basis" and may be structured to include (i) an annual spectrum fee component to contribute to the maintenance of the spectrum allocated by the spectrum licence; and ii) a price component "set by the relevant allocation process" payable annually or in a lump sum. This provision allows NICTA significant latitude to implement market-based assignments and market-based spectrum fees in the PNG, particularly for high-demand IMT spectrums.

2.10.3 Section 13 (1) of the NICTA Radio Spectrum Regulations stipulates that – for such any *market-based approach* - NICTA shall prepare an Information Package for applicants containing the Marketing Plan and any Conversion Plan.

2.10.4 Section 6(8) states that "the fees payable under this section shall be paid to NICTA by such means, at such times and in such a manner as NICTA may from time to time determine". Therefore, NICTA has much latitude on the means and timing of spectrum payments.

2.10.5 Section 6(2) states that NICTA can recover "standard charges" (or fees) "that would have been recovered by NICTA in respect of a spectrum licence if NICTA had followed its standard allocation process as set out in Subsection (1)(b)".

2.10.6 Schedule 2 of the NICTA Spectrum Regulations – Annual Variable Spectrum Fee for Spectrum and Apparatus Licences uses the formula of Annual variable fee payable = *V x (2600 / F) x B x T X L.* V is the Standard baseline value; F is the Frequency; B is the total Bandwidth in MHz; T is the type of service licenced but specifically looking at opportunity cost; L is for Location. NICTA has a duty to advise the Minister to make adjustments to the value of V, for example.

2.10.7 Section 6(7) states that "in respect of the formula set out in Schedule 2, NICTA shall issue guidelines describing the rationale for, and setting the values of, Type (T) and Location (L) factors".

2.10.8 Indeed, NICTA is currently revisiting and reviewing the Apparatus Fees in Schedule 1 and the entire formula in Schedule 2.

2.11 The government's policy and legislative reforms has continuously impacted NICTA and the ICT industry at large. NICTA, however, remain objective in the way it implements government policy with legislative framework whilst preserving the rights of consumers and industry licensees. There are various policies, Acts and legal regulatory instruments that govern the management of spectrum in Papua New Guinea. NICTA enforces government ICT policies with powers from the NICT ACT 2009.

PNG Government Policies that Influence Spectrum

2.12 The Digital Transformation Policy 2020

2.13 In 2020, the Government of Papua New Guinea (GoPNG) set out an ambitious Digital Transformation Policy[6] – one that promises using digital transformation to change public administration processes, culture, and citizen experiences using information and

[6] https://www.ict.gov.pg/digital-transformation-policy-2020/

communications technology (ICT) advancement as an enabler. "The Department of Information and Communication Technology (DICT), as the lead agency, aims to facilitate this transformation journey starting with transformation of government service delivery on a Whole-of Government basis. The digital transformation process envisions agencies and departments delivering a range of initiatives to improve inter-agency collaboration, that in turn should translate to improvement in public sector service delivery, through the use of innovative and more advanced ICTs"[7].

2.14 In a country like PNG, going online connectivity required in order to be able to realise any such digital transformation *mostly* requires the mobile Internet, and the latter is entirely dependent on PNG's radio spectrum resources.

2.15 Managing PNG's radio spectrum resources efficiently is invaluable to the digital transformation policy. Therefore, this spectrum outlook and roadmap aligns to this key PNG policy.

2.16 In general, the PNG Government through the Ministry of Information & Communication Technology maintains a number of policy document that provides governance and guidance on the importance of connectivity and address telecommunication sector as a key enabler of socio-economic development.

2.17 This policy framework is aligned with national development goals and other policies in the following ways.

2.18 PNG Vision 2050

2.19 Vision 2050 is derived from the National Strategic Plan Framework that was endorsed by the Government and national leaders in September 2008. The concept and strategic direction in the framework were rigorously tested during a three-month comprehensive public consultation program that address the following:

2.19.1 Vision 2050 envision increased communications access from 10% to 100%
2.19.2 Establishment of a communication satellite network for PNG
2.19.3 Establishment of a National Information Database Management System

2.20 PNG Long Term Development Strategy 2010 – 2030

2.21 The Papua New Guinea Development Strategic Plan (DSP) 2010-2030, sets development goals for the nation. The DSP 2010-2030 defined one of its priority goals as: "A modern and affordable information and communications technology that reaches all parts of the country."

2.22 The strategic plan also identified several specific targets for ICT growth:

2.22.1 including 800 mobile subscribers per 1000 people by 2030
2.22.2 70% of the population to have access to or use the internet by 2030 and;
2.22.3 100% of Papua New Guineans to have access to radio and television by 2030

2.23 Additional strategies include:

2.23.1 Maintaining mutual relationships with international ICT organizations ensuring compliance

[7] https://www.ict.gov.pg/digital-transformation-policy-2020/

with international conventions, standards, practices and trends; and

2.23.2 Promoting the development and expansion of a range of government services to rural communities using mobile phone and internet technology.

2.23.3 A modern and affordable information and communications technology system that reaches all parts of the country.

2.24 PNG Alotau Accord III

2.25 The policy allows public private partnership to source private sector capital and technical expertise. The aim of the PPP is to ensure communications services cover the majority of our communities throughout the country and at an affordable cost. Some of its core pillars are:

2.25.1 Recognize ICT as key enabler for development in PNG

2.25.2 Completion of the national fibre-optic cable infrastructure

2.25.3 Delivering e-commerce, e-health, e-agriculture and e-government

2.26 PNG National ICT Policy 2008

2.27 The National ICT policy sets out a strategic framework for meeting the Government's objectives for the ICT sector. Under this policy the Government reaffirms its commitment to the staged introduction of open competition in the telecommunications sector and the transformation of Telikom PNG into a viable and efficient retail competitor in the market.

2.28 NICTA Corporate Plan 2021—2025

2.29 The NICTA Corporate Plan 2021-2025 recognizes the Department of ICT Sector Policy and portfolio direction of digital transformation.

2.30 There are five (5) Strategic Priorities to progress the plans visions "to enable a connected and inclusive PNG".

2.30.1 Strategic Priority 1: Regulatory excellence

2.30.2 Strategic Priority 2: ICT market and industry development

2.30.3 Strategic Priority 3: Universal Broadband Access

2.30.4 Strategic Priority 4: Digital Transformation

2.30.5 Strategic Priority 5: Institutional Capacity

2.31 All these five NICTA Corporate Plan Strategic Priorities are key to this Spectrum Outlook and Roadmap.

APT Policies that Influence PNG Spectrum

2.32 The Asia-Pacific Telecommunity (APT) Spectrum Policy Recommendations

2.33 This Spectrum Outlook and Roadmap 2025-2030 has taken into utmost consideration the

current 'harmonised' or evolving APT Recommendations, Reports & Opinions on spectrum policy positions developed by the APT Wireless Group (AWG)[8].

2.34 For example, the recommendations in this PNG Spectrum Roadmap on WAS/RLANs (including 5925-7125MHz) abide by the most recent September 2024 *APT Report on WAS/RLAN Technology Development and Implementation Aspects*[9]: it covers technology developments and implementation aspects of license-exempt Wireless Access Systems, and Radio Local Area Networks (WAS/RLAN). Similarly, recommendation position in this Roadmap on IMT 600MHz are consistent with the AWG views in the APT Report on PMSE Frequency Usage in the 470-806 MHZ BAND in Asia Pacific Region[10].

[8] Asia-Pacific Telecommunity - https://apt.int/awg-Reports
[9] APT_AWG_REP-144_APT-AWG-REP-144.docx
[10] APT_AWG_REP-138_APT-AWG-REP-138.docx

3. Introduction to the NICTA Spectrum Roadmap

3.1 The NICTA Spectrum Roadmap is a strategic plan that outlines how a regulatory body, like NICTA in PNG, will ***allocate, assign and manage*** the radio frequency spectrum efficiently over a certain period, in this case the 2025-2030 period.

3.2 Globally harmonized radio frequency spectrum bands and arrangements for International Mobile Telecommunications (IMT) can significantly reduce the overall cost of mobile network infrastructure, user devices, and ultimately, subscriber prices.

3.3 Spectrum enables critical applications and activities, including mobile phones, TV broadcasting, maritime communications, remote sensing, Earth exploration, radio sciences, weather forecasting, global positioning systems, space exploration, intelligent transportation systems, and high-altitude platform stations.

3.4 As technologies evolve so does spectrum management. Spectrum management activities in PNG are coordinated in a structured and transparent manner that is inclined towards addressing spectrum related issues.

3.5 In PNG, over 40, 000 radio communication licenses were issued to a number of users for different spectrum needs in the last ten years. As the demand for spectrum increases daily, spectrum users are put on notice to encourage efficient use of spectrum for current and future allocations.

3.6 Like all other nations, Papua New Guinea (PNG) experiences continued growth in demand for more mobile voice and broadband ICT services. As of 2024, these advancements have led to the relative widespread accessibility of telecommunications services to the good majority (>70%) of the PNG population.

3.7 However, to date in late 2024, less than 35 per cent (<35%) of the population own a mobile phone subscription and less than 20 per cent (<20%) of people are connected to the Internet[11], with nearly all these accessing the Internet via mobile phones. The key reason for this lack of participation is that most services remain too expensive and unaffordable for the majority of citizens.

3.8 As of March 2025, NICTA has licensed a total of circa 447.6MHz of IMT spectrum in harmonized bands, see Table 1 (later). **This is well below the baseline of 477 MHz that is widely regarded as the average amount of spectrum licensed in the similar LIC/LMIC African region. Low Income Country Zambia (Southern Africa) has assigned 770MHz as of March 2023 (see Table 5).**

3.9 The deficiency of assigned radio spectrum for IMT brings constraints and challenges in the provision of broadband services. **To address PNG's bandwidth deficiency, the currently assigned bandwidth of circa 447.6MHz of high-demand spectrum will be increased to a minimum of 900MHz over the next five years.**

3.10 So, NICTA has also been engaging in a spectrum policy framework to increase the quantum of assigned spectrums across all key sectors – which includes Market-Based Spectrum Assignments[12] - to have clear visibility on spectrum and users of the spectrum. This exercise is purposely carried out as one of the key objectives of the spectrum framework is to ensure:

3.10.1 there is visibility in the current and future spectrum assignments in the short, medium and long term to 2030;

3.10.2 the spectrum regulatory framework is use to accommodate current and future spectrum demands and needs;

3.10.3 proper consultation is done with commercial stakeholders, government, industry and consumers on the current and future spectrum needs.

3.11 The outcomes of the Spectrum Outlook will give confidence and certainty to stakeholders and industry's alike ensuring NICTA's work plan and priorities are aligned and achievable.

[11] https://idea.usaid.gov/cd/papua%20new%20guinea/information-and-communications-technology-ict

[12] Public Consultation Statement 2600mhz, 3500mhz & Market-based Spectrum Assignment - National Information & Communications Technology Authority (nicta.gov.pg) - https://www.nicta.gov.pg/pcn-0-58/

4. Current Inventory Current Inventory of IMT-related Radio Spectrum in PNG Spectrum Roadmap Benchmarking & Spectrum Policy and Regulatory Review

4.1 Mobile services play a crucial role in providing communication services (voice and data) to consumers but also to many enterprises, especially in the SME sector. Additionally, various econometric analyses have demonstrated that broadband has a positive impact on economic growth in both developing and developed markets.

4.2 NICTA is of the view that mobile telecommunication technologies are a critical component for achieving the goal of "to enable a connected and inclusive PNG" in the NICTA Corporate Plan 2020-2025.

4.3 As noted in the previous section, experiences continued growth in demand for more spectrum as a result of significant growth in traffic.

4.4 The deficiency of assigned Spectrum for IMT brings constraints and challenges in the provision of broadband services. To address PNG's bandwidth deficiency, the currently assigned bandwidth of 447.6MHz (see Table 1) of high-demand spectrum should be increased to a minimum of 900MHz MHz over the next five years.

4.5 So, the rest of this section details and comments on the utilisation of PNG's (i) current mobile spectrum assignments, (ii) current microwave and satellite spectrum assignments and (iii) draws some learnings from other selected benchmark countries.

Operator	700	850	900	1800	2100	Total (MHz)	# of Subscribers	#Subscribers/ MHz	% of PNG Assigned IMT Spectrum
Telikom	30 (2x 15)	22 (2 x 11)	30.8 (2x 15.4)	50 (2x 25)	20 (2 x 10)	152.8	Circa 300,000	1963	34.1%
Digicel PNG	30 (2x 15)		34.8 (2x 17.4)	60 (2x 30)		124.8	Circa 3, 000,000	24038	27.8%
Digitec Vodafone	30 (2x 15)			20 (2 x 10)	60 (2 x 30)	110	Circa 1,200,000	10909	25.5%
KCL				20 (2 x 10)	40 (2 x 20)	60	Miniscule	0	13.4%
Total						**447.6 MHz**			

Table 1 - Spectrum Assignments to PNG Operators as of March 2025

Band	3GPP Band Designation	Transmission Mode	Total Available (MHz)	Licensed for Mobile (MHz)	Licensed for Mobile and FWA (MHz)
700 MHz	28	FDD	90	90	90
800/850 MHz	20	FDD	22	22	22
900 MHz	8	FDD	70	65.6	65.6
1800 MHz	3	FDD	150	150	150
2100 MHz	1	FDD	120	120	120
Total			**452**	**447.6**	**447.6**

Table 2 - Table of Assigned IMT Spectrums in PNG

Mobile Spectrum Assignments and Current Spectrum Utilization

4.6 Current Mobile Spectrum Assignments and Current Spectrum Utilization provide for some interesting conclusions.

4.6.1 The current spectrum assignments to Mobile Network Operators in PNG as of March 2025 are as shown in Table 1 and Table 2.

4.6.2 Table 3 shows the current picture of sub-1GHz IMT "coverage" spectrum assignments in PNG as of March 2025.

Operator	700	800-850	900	Total (MHz)	% of PNG IMT Spectrum
Telikom (Merged Entity)	30 (2x15)	22 (2x11)	30.8 (2x15.4)	82.8	46.6%
PNG Digicel	30 (2x15)		34.8 (2x17.4)	64.8	36.4%
Digitec Vodafone	30 (2x15)			30	16.8%
KCL					
Total				**177.6MHz**	

Table 3 – Sub 1-GHz IMT Spectrum Assignments Source (NICTA) – as of March 2025

Operator	700	850	900	1800	2100	Total	# of Subscribers	#Subscribers/ MHz
Telikom	30 (2x 15)	22 (2 x 11)	30.8 (2x 15.4)	50 (2x 25)	20 (2 x 10)	152.8	Circa 200,000	1309
Digicel PNG	30 (2x 15)		34.8 (2x 17.4)	60 (2x 30)		124.8	Circa 3, 000,000	24038
Digitec Vodafone	30 (2x 15)			20 (2 x 10)	60 (2 x 30)	110	Circa 700,000	6363
KCL				20 (2 x 10)	40 (2 x 20)	60	Miniscule	0
Total						**447.6 MHz**		

Table 4- Table of Assigned IMT Spectrums in PNG as of March 2025 and their Utilization

3GPP Band Designation		Transmission Mode	Total Available (MHz)	Licensed for Mobile (MHz)	Licensed for Mobile and FWA (MHz)
450 MHz	31	FDD	10	10	10
700 MHz	28	FDD	60	60	60
800 MHz	20	FDD	60	60	60
900 MHz	8	FDD	70	70	70
1800 MHz	3	FDD	150	150	150
1900 MHz	33	TDD	20	0	0
2100 MHz	1	FDD	120	120	120
2300 MHz	40	TDD	100	50	100
2600 MHz	41	TDD	190	170	190
3300 MHz	52/78	TDD	100	0	0
3400 MHz	42/78	TDD	200	80	165
Total			**1080**	**770**	**925**

Table 5- Table of Assigned IMT Spectrums in LIC Zambia (Africa) as of March 2024

Commentary on IMT Spectrum Inventory and on Utilization

4.7 Following are some commentaries on PNG's IMT Spectrum Inventory and on Utilization

4.8 Important key analyses can be derived from the preceding tables drawing from a key cardinal principle of spectrum assignments: [absent competition and other national policy considerations], spectrum should migrate to: its highest value use, e.g. the highest value use of 900MHz or 1800MHz is IMT FDD; and to its highest value users, who would make the best use of it for PNG consumers.

4.8.1 PNG fares very poorly with benchmark countries on IMT spectrum assigned

4.8.1.1 As also noted earlier, as of October 2024, NICTA has licensed a total of 447.6 MHz of IMT spectrum in harmonized bands, see Tables 1 and 3.

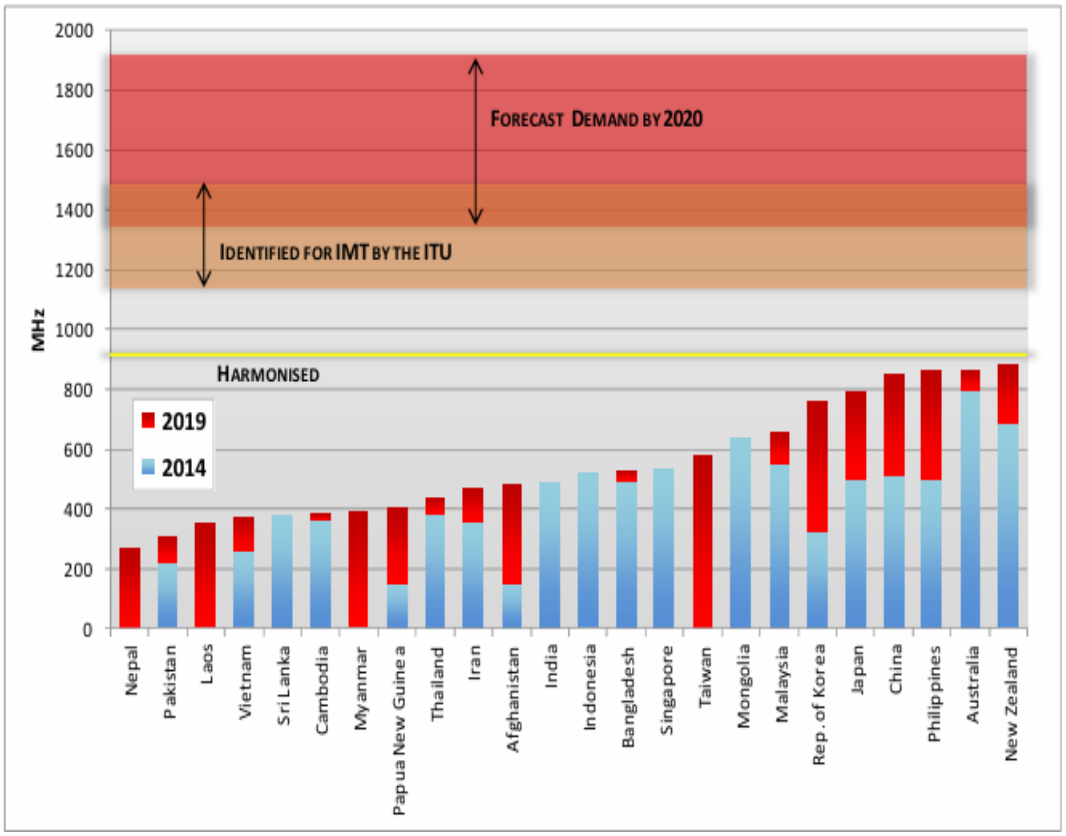

Table 6 – PNG's IMT Spectrum Assugnment compared to Benchmark Countries as of 2019
Source: LS Telecom (2019) [13]

4.8.1.2 This is well below the baseline of 477 MHz that is widely regarded as the average amount of spectrum licensed in the equally less developed African region[14].

4.8.1.3 **As Table 6 shows, PNG also fares well below in its IMT spectrum assigned compared to many APAC countries. Table 5 also shows that PNG has assigned much less IMT spectrum than LIC Zambia (Southern Africa).**

4.8.2 However, Tables 1, 3 and 4 above provide some important derivations that 'break' this cardinal principle of spectrum assignments. i.e., spectrum should migrate to: its highest value use; and to its highest value users, who would make the best use of it for PNG consumers.

4.8.2.1 **Spectrum is generally not in the hands of highest value users: it is clear from the tables that much valuable spectrums – including incredibly valuable sub-1GHz spectrums – are not assigned to the likely highest value users in PNG. This suggests that NICTA should potentially enable, e.g. through revised spectrum pricing, for spectrum to be returned to NICTA in order to be reassigned to higher value MNOs.**

[13] https://www.lstelcom.com/fileadmin/content/lst/marketing/media/2019_Study_LicensingUseofMobileSpectrum.pdf
Roadmaps-for-awarding-5G-spectrum-in-the-APAC-region.pdf
[14] https://www.lstelcom.com/fileadmin/content/lst/marketing/media/2019_Study_LicensingUseofMobileSpectrum.pdf

4.8.2.2 **Subscale Operators hold a significant amount of very valuable sub-1GHz Spectrum in PNG:** for example, as Tables 1 and 3 depict, KCL holds 13.4% of all IMT assigned spectrum but with virtually no subscribers.

4.8.3 Much spectrum is used inefficiently in PNG

4.8.3.1 Table 4 shows this most clearly as it introduces an admittedly crude measure of Number of Subscribers per MHz assigned, i.e. #Subscribers/MHz.

4.8.3.2 Operators like KCL and Telikom hold much spectrums but build no scale networks

4.8.3.3 Table 4 demonstrates amply how spectrum is inefficiently used by many sub-scale players in PNG by looking at the crude measures of #Subscribers/MHz: Telikom and KCL are clearly using spectrum inefficiently.

4.8.3.4 **This presents a key concern as this situation is in contradiction to NICTA's spectrum duties in Section 164(a) of the NICT Act which reads that NICTA should "maximise, by ensuring the efficient allocation and use of the spectrum, the overall public benefit derived from using spectrum".**

4.8.3.5 NICTA therefore proposes to review the assignments in these bands to current licensees.

4.8.4 Asymmetric spectrum holdings amongst the 'Bigger 3' that might impact competition

4.8.4.1 As Table 1 shows, Telikom holds circa 1.5 times the spectrum holdings of Digitec/Vodafone.

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4.8.4.2 **As Table 3 shows, Telikom and Digicel holds more than triple and double the amount of key valuable sub-1GHz spectrum that even Digitec/Vodafone holds.**

4.8.5 The Spectrum Outlook/Roadmap 2025-2030 should acknowledge and work on these challenges of asymmetric spectrum holdings by the Bigger 3 MNOs – if nothing else to ensure it does not get worse during the period of this roadmap, thereby increasing mobile competition concerns even more in PNG.

4.8.6 Division 2 [Objectives] Article 124(1)(a) promote effective competition in markets for ICT services in Papua New Guinea, to be known as the "competition objective". Spectrum is key to competition in Telecoms markets. Assignment of new IMT High Demand Spectrum (HDS) must take into consideration competition issues.

Satellite Spectrum Assignments and Current Spectrum Utilization

4.9 The current satellite apparatus/terminals spectrum assignments in PNG are as shown in Table 7.

4.10 Some commentaries on Satellite Spectrum Assignments and on their Utilizations follow.

4.10.1 NICTA has virtually no satellite assignments in PNG to date.

4.10.2 Rather, there are hundreds - probably close to 1000 (a thousand) cumulatively - satellite Apparatus/Terminals Assignments in PNG as of March 2025.

4.10.3 Most of these would likely be licensed in the future under a Class License approach – and the Apparatus Licence category <u>largely</u> retired and replaced.

4.10.4 With the emergence of LEOs such as OneWeb and Starlink – there is now a dire

need for a Satellite [Spectrum] Licensing Framework for PNG in order to address satellite licensing going forward.

Frequency Band of Operation	4GHz	6GHz	10GHz	14GHz	17GHz	27GHz	71GHz	81GHz
TELIKOM PNG LIMITED								
Ku-BAND			Rx: 10.7 – 12.75 GHz	Tx: 14 – 14.5GHz				
Ka-BAND					Rx: 17.7-21.2 GHz	Tx: 27.5-31.0 GHz		
C-BAND	Rx: 6011.0 – 6017.3GHz	Tx: 3786.0 – 3792.3 GHz						
DIGICEL PNG LIMITED								
Ku TV			Rx: 12500-14000MHz	Tx: 10700-11700MHz				
Ku-BAND			Rx: 12500-14000MHz	Tx: 10700-11700MHz				
Ku BTS			Rx: 12500-14000MHz	Tx: 10700-11700MHz				
C-BAND	Rx: 5625.0 – 6425.0 MHz	Tx: 3400.0 – 4200.0MHz						
C-BAND TV C	Rx: 5625.0 – 6425.0 MHz	Tx: 3400.0 – 4200.0MHz						
VODAFONE PNG LIMITED								
Ka								
Ku								

Table 7 – Satellite Apparatus/Terminals Assignments in PNG as of March 2025
Source (NICTA)

Microwave Fixed Links & MMwave Spectrum Assignments and Current Spectrum Utilization

4.11 Fixed links in the UK now have access to around one quarter of the spectrum between 1 GHz and 10 GHz (in the UK), and there are currently about 2800 licensed fixed links in this spectrum block (see Figure 1).

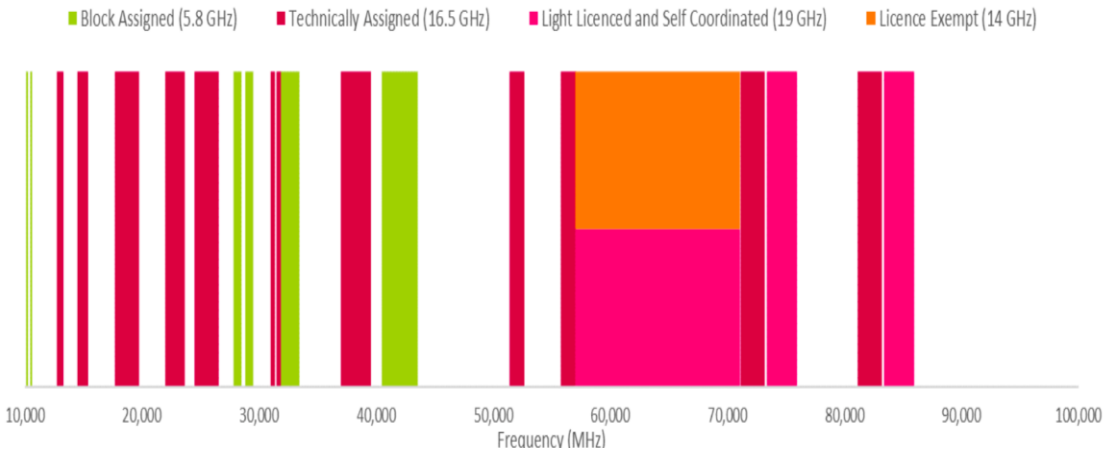

Figure 1 - Authorisation approaches for deploying fixed links in 10-100 GHz range in the UK (Source: Ofcom 2022 Spectrum Roadmap[15])

4.12 The current Microwave Fixed Links spectrum assignments in PNG are as shown in Table 8.

4.13 An overview of **Microwave and MMwave Spectrum Assignments** and their utilization by the three main Mobile Network Operators in **Papua New Guinea—Telikom PNG Limited, Digicel PNG Limited, and Vodafone PNG Limited**—is outlined below.

No.	Band	Assignable Bandwidth (MHz)	Status
	TELIKOM PNG LIMITED		
1	L6	320	Licensed
2	U6	640	Licensed
3	8L	474.4	Licensed
4	11	960	Licensed
5	13	448	Licensed
	DIGICEL PNG LIMITED		
6	5	224	Licensed
7	6L	448	Licensed
8	7L	224	Licensed
9	7	140	Licensed
10	10	60	Licensed

[15] https://www.ofcom.org.uk/siteassets/resources/documents/consultations/category-2-6-weeks/234683-spectrum-roadmap-delivering-ofcoms-spectrum-management-strategy/associated-documents/spectrum-roadmap.pdf?v=327691

11	13	56	Licensed
12	15	672	Licensed
	VODAFONE PNG LIMITED		
13	5	560	Licensed
14	10	280	Licensed
15	11	40	Licensed
16	18	110	Licensed
17	18	1090	Licensed
18	23	448	Licensed

Table 8 – Microwave and MMWave Assignments in PNG as of March 2025
Source (NICTA)

4.14 Some commentaries on Microwave and MMwave Spectrum Assignments and on their Utilizations follow.

4.14.1 There are fixed links assignments in the extended C-Band that would likely all have to be cleared, particularly in the 5925-6425 MHz band – as this band would almost certainly be allocated in PNG for RLANs over the 2025-2030 period, e.g. Telikom and Digicel operating in L6 (lower 6GHz).

4.14.2 Similarly, there are fixed links in 6425-7125 MHz band – as this band would almost certainly be allocated in PNG to IMT over the period of this roadmap, e.g. Digicel operating in L7 (lower 7GHz).

4.14.3 Similarly, some C-Band spectrums such as 3600MHz – 4200MHz are also likely to be allocated to IMT over the period of this spectrum roadmap, 2025-2030. Fixed Links in these bands would be secondary to IMT.

Spectrum Policy & Management Lessons learnt from Spectrum Roadmaps of Selected APAC Benchmark Countries

4.15 During the process of the production of this Spectrum Roadmap 2025-2030, NICTA thought it important to learn lessons from several other Benchmark APAC countries – as well as from ITU recommendations.

4.16 The benchmark countries chosen were/are neighbouring Australia, Pakistan and Sri Lanka.

4.17 Australia

4.17.1 The Australia Roadmap focuses on policies, spectrum changes, licensing adjustments, and technical innovations as part of a five-year outlook (2024–29) and annual work program.

4.17.1.1 *Low-band Spectrum (below 1 GHz)*: This band is used for wide-area coverage in wireless broadband (WBB) networks, with a focus on monitoring the 600 MHz band and managing expiring licenses in the 700 MHz and 850 MHz bands.

4.17.1.2 *Mid-band Spectrum (1-6 GHz)*: Used to balance coverage and capacity, with ongoing management in the 3.4–4.0 GHz range, including recent allocations and auctions for various segments:

3400–4000 MHz in remote areas;

- 3400–3575 MHz, and others to support diverse WBB use cases.

- 3.4–4 GHz Band: This band, significant for WBB and 5G services, has seen spectrum allocations through auctions in Australia, license renewals, and localised services, with a focus on high-priority areas for future WBB expansion
- 3950–4000 MHz – for regional and metropolitan areas)
- 3400–3475 MHz ('urban excise' areas): they plan to consult on technical and licensing arrangements for highly localised WBB services in Q3 2028.

4.17.1.3 *High-band Spectrum (above 6 GHz)*: Includes mmWave bands for high-capacity usage, particularly the 26 GHz and 40 GHz bands for 5G deployment, with attention to global developments and domestic applications in Australia. 40 GHz Band (37-43.5 GHz): Allocated for multiple services, including high-density fixed services and radio astronomy, and was identified for IMT (5G) at WRC-19, with interim licensing for satellite and broadband use. 5030–5091 MHz Band: Designated for Line-of-Sight Remotely Piloted Aircraft Systems (RPAS) and is under international review for permanent arrangements to enable controlled airspace operations.

4.18 Pakistan

4.18.1 The Pakistan Rolling Spectrum Strategy (2020-2023)[16] outlines policies, spectrum allocation plans, licensing strategies, and technical developments to support the nation's telecommunications growth. Pakistan prioritised some of the following.

4.18.1.1 *1427 – 1518 MHz (L-Band):* Identified for future IMT usage to meet long-term demand, pending international equipment availability

4.18.1.2 *1800MHz* – operators in Pakistan requested for further assignments for 5G.

4.18.1.3 *1900 MHz (1950 – 1980 MHz / 2140 – 2170 MHz):* part of the IMT/3G band is being re-farmed to free up spectrum for mobile expansion

4.18.1.4 *2300 MHz - 2400 MHz* identified for IMT (5G); regulator will work with existing users to migrate their systems to alternative bands.

4.18.1.5 *2500 MHz (2500 – 2690 MHz)*: Designated for IMT with potential for 5G trials; currently occupied but targeted for refarming

4.18.1.6 *3000 MHz: 3300 – 3400 MHz* has been identified by ITU for IMT (5G). As such, PTA/FAB will stop assigning frequencies in this band and will work with existing users to migrate their systems to alternative bands.

4.18.1.7 *5470 – 5725 MHz:* Considered for wireless LAN under certain conditions like DFS and TPC if doppler interference can be avoided

4.18.1.8 *57 – 66 GHz* (V-Band): Planned for point-to-point outdoor applications.

4.18.2 The Government of Pakistan (GOP) intends to carry out spectrum auction in 2100 Hz, 1800 MHz and 850 MHz bands by end of Q2, 2025[17].

4.19 Sri Lanka

4.19.1 The Sri Lanka Spectrum Roadmap (2024-2029)[18] provides a comprehensive strategy for managing the nation's spectrum, covering policies, spectrum reallocation, licensing updates, and technical innovations. Sri Lanka prioritised some of the following.

4.19.1.1 *700 MHz:* Currently, unavailable as it is allocated to broadcasting services.

4.19.1.2 *3.5 GHz:* Currently being re-farmed, expected availability for future use.

4.19.1.3 *3.3GHz:* Conducting feasibility for refarming for IMT

[16] https://moitt.gov.pk/SiteImage/Misc/files/PakistanRollingSpectrumStrategyFinal23Nov2020.pdf

[17] https://www.pta.gov.pk/category/spectrum-auction-for-next-generation-mobile-services-in-pakistan-1618073485-2023-06-01

[18] https://www.trc.gov.lk/content/files/spectrum/spectrum%20Division%20FINAL_ROAD_MP_2024.pdf

4.19.1.4 *3.7GHz*: Conducting feasibility for refarming for IMT

4.19.1.5 *5925 – 7125 MHz:* To conduct feasibility study and as per WRC 23 outcome, allow radio LAN (RLAN) to operate in part or the entire band in compliance with WRC23

4.19.1.6 *26/28GHz*: Conducting feasibility for refarming for IMT

4.19.1.7 *Infrastructure and Spectrum Sharing:* The Regulator will facilitate the sharing of infrastructure and spectrum amongst operators.

4.19.1.8 *Unlicensed Band (e.g., 5 GHz) for Mobile Services:* the Regulator RCSL will evaluate the feasibility of allowing unlicensed bands for mobile services on a non-interference and non-protected basis.

4.19.1.9 *E-Band (76 – 84GHz):* Allocation of the band for fixed services, through a light licensing framework.

4.20 The International Telecommunications Union

4.20.1 Having reviewed the benchmarking documentation as well as ITU guidance the following are the key best practice principles on which a spectrum roadmap should be built:

4.20.1.1 State Ownership and Usage: Spectrum should be a national resource under state ownership (ITU). Its use should be aligned with the strategic goals and public interests of the country, ensuring assignment to its highest value use assignment on impartial bases.

4.20.1.2 State Responsibilities: The state has a responsibility to oversee the effective management, allocation, and regulation of spectrum resources. This includes ensuring spectrum is utilized in a way that benefits economic growth, innovation, and societal needs (ITU).

4.20.1.3 Roadmap Timeframe: A spectrum roadmap should have a 5-10 year outlook (ATU). This encourages sufficient forward looking whilst at the same time recognizing the level of uncertainty around technological development and what the optimal use of spectrum might be in the future.

4.20.1.4 Licensing: Roadmaps should underline a policy of encouraging technology and service neutrality wherever possible. However, it is recognised that there may be times when technology plays a role. One such instance might be for example awards of contiguous blocks of spectrum using TDD. Spectrum should be assigned using open, objective, transparent, non-discriminatory, and proportionate criteria and designed to promote competition, although potentially also promote coverage and deployment (Sweden).

4.20.1.5 New Technology Promotion/Innovation: Innovation should be supported in spectrum assignment. That includes examples such as 5G (e.g. NR-U), WAS/RLAN (e.g. Wi-Fi 6E), 6G, etc. - Sandboxes are an option here. Sandboxes involve some form of more limited regulation for experimentation with new services. Sandboxes may involve limiting a service to a smaller geographic area during a trial period. The UK regulator has, for example, stated that it will explore the use of spectrum sandboxes in specific geographic locations and specific bands. The US regulator says that it will explore sandboxes and that they seek to incentivise investment by providing increased spectrum access.

4.20.1.6 Dynamic Spectrum Sharing (DSS) and Management: Experimentation with dynamic spectrum sharing is also encouraged, including the use of AI to enable DSA to be implemented more successfully. In this respect we note that some satellite operators already claim to be using AI for spectrum resource management. According to the Australian regulator. AI dynamic traffic management for satellites, including the reduction of interference, is also already taking place. In this respect, the US regulator says that it will encourage dynamic spectrum sharing and coexistence while mitigating the risks of degrading capabilities to meet mission requirements.

4.20.1.7 Efficiency: Efficient spectrum use should be promoted. This is especially for the case spectrum in short supply. Where there is excess demand, auctions should be one of the options available for finding the optimum use of spectrum. Contiguous larger blocks of spectrum should be assigned where possible in order to enable carrier aggregation and

higher throughput as well as greater efficiency in general. However, efficient usage is clearly not the same as highest value usage. Spectrum can be used efficiently but block higher value use for another service. The highest value use should get priority (Swedish Regulator). Spectrum should otherwise be reallocated and repurposed as appropriate to its most efficient use. We note however that the latter should be consistent with not creating uncertainty for investors.

4.20.1.8 Harmonisation: Regional and global harmonisation should be promoted. This helps to ensure consistency in spectrum use across borders and thereby reducing interference issues. Appropriate representation should therefore be made in, for example for leading up to an including the ITU's WRCs. The Swedish regulator states that only conditions relevant to technically efficient frequency assignment should constitute the requirements for harmonisation. NICTA believes that the arguments for this approach to harmonisation are to: minimise the regulatory burden; encourage innovation; facilitate global compatibility; enable support for diverse applications; enable dynamic spectrum management; and regulatory clarity and predictability.

4.20.1.9 Protection from Interference: It is well recognised that uses of spectrum, particularly those identified as primary or primary users should have protection when using spectrum which they have been assigned. Clearly, priority should be given to preventing spectrum interference considering the economic harm that would be caused by interference. Interference should also be prevented by applying appropriate conditions when spectrum sharing is permitted. Individual assignment of frequencies within a band is required in respect of scarce spectrum being used for purposes for which a high-quality of service is required and where the absence of coordination may lead to interference. Light licensing is used where there is limited risk of interference or quality of service is not essential. However, light licensing should still allow for sufficient intervention where high densities of devices interfere with each other (UK regulator).

4.20.1.10 Transparency and Certainty: the process of spectrum allocation and management should be open to public scrutiny. This is one of the reasons why a roadmap is consulted on and regularly reviewed. NFATs should be published and updated regularly. This is particularly the case after WRCs. Other proposed spectrum changes outside of roadmap reviews should also be consulted on. This will help to create certainty for investors.

4.20.1.11 Stakeholder Engagement: regulators should consult with a wide range of stakeholders with respect to future roadmaps and spectrum changes generally. This will also help to create certainty for investors.

4.20.1.12 Enabling a Diversity of Services: The Swedish regulator holds that it would enable a diversity of radio uses because it is not possible to know in advance which radio uses will be most demanded and neutralised. In order to achieve this, it had four strategies: promoting International harmonisation and standardisation; spectrum planning; rights of use, conditions and assignment methods; and, spectrum sharing and trading. The US regulator holds that it supports policies that allow for the flexible use of spectrum.

4.20.1.13 Spectrum that is Not Scarce: Assignment on a licence exempt or first come first serve basis. The latter applies mainly to licenses for individual radio transmitters (Swedish Regulator).

4.20.1.14 Market and Technical Analysis: Obtaining more real world data is a priority for the UK regulator in order to achieve more efficient use of spectrum and to facilitate spectrum sharing in the future. The US regulator also emphasises evidence based approaches with respect to the identification and reallocation potential spectrum

4.20.1.15 International and Regional Agreements: international agreements on spectrum allocation and coordination via the ITU should be respected.

4.20.2 This NICTA Spectrum Roadmap 2025-2030 tries to abide closely by all these above best practice principles.

5. Overview of the Spectrum Outlook Needs of other Selected Sectors

This section overviews the likely radio spectrum needs of other selected critical users/stakeholders of radio spectrum in PNG, to also take into consideration their needs in this spectrum roadmap 2025-2030.

5.1 Mobile Broadband Services

5.1.1 Future Outlook for Mobile Broadband Services in PNG

5.1.2 Global mobile data traffic experienced significant growth in 2023 and 2024. The growth of mobile broadband has brought a radical change in the way people communicate in terms of voice and data.

5.1.3 The evolution of mobile communication from the first generation (1G) to the fourth generation (4G) is due to the improvement in the wireless technology. With the introduction of 5G systems, a lot of change in the mobile sector is likely to transform the way things are done.

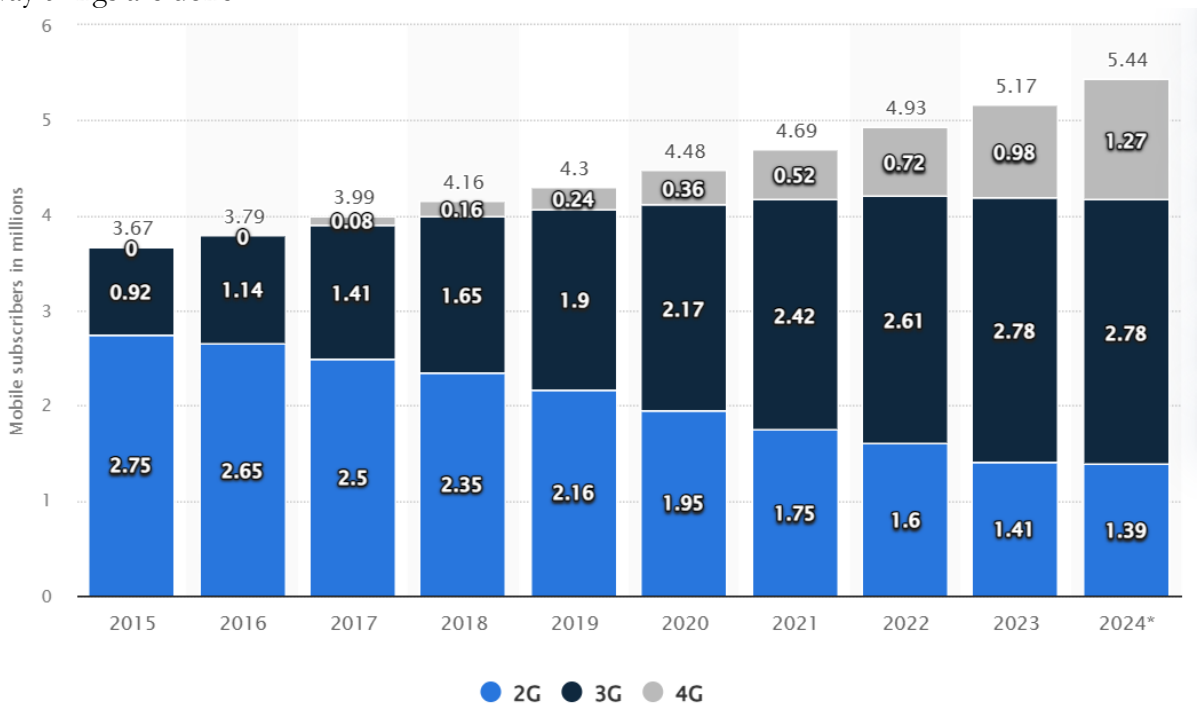

Figure 2 - Number of mobile broadband subscriptions in Papua New Guinea from 2015 to 2024, by mobile network generation
(Source: Statista 2025[19])

5.1.4 Mobile broadbands are used to provide voice and data services. Due to government policy and reform, there has been significant growth in the social and economic growth of the telecommunication industry due to competition creating demands for the market.

5.1.5 According to the Ericsson Mobility Report, mobile data traffic is forecast to grow with a

[19] Papua New Guinea: Mobile data subscriptions by type 2024 | Statista - https://www.statista.com/statistics/1488377/papua-new-guinea-mobile-data-subscriptions-by-type/

Compound Annual Growth Rate (CAGR) of around 20% through 2029[20]. By the end of 2029, total global mobile network data traffic is expected to reach 466 Exabytes (EB) per month[21].

5.1.6 Ericsson also notes that in 2023, 5G accounted for about 25% of mobile data traffic, up from 17% in 2022. Ericsson expects this 5G share of global mobile data traffic to grow to around 75% by 2029[22].

5.1.7 Specifically for PNG, Statista – as depicted in Figure 2 - exponential growth in 3G/4G mobile data services/subscriptions across PNG over the last decade.

5.1.8 Therefore, a key current NICTA focus over the last several years to date has been on spectrum allocation is to facilitate 5G/4G mobile broadband services deployment.

5.1.9 This is typically through awarding available spectrum in existing IMT bands, refarming of 3.5GHz, and allocating mmWave spectrum. Most 5G allocations are in the mid-band and/or mmWave spectrum since most of the sub-1GHz bands are already used for existing 3G or 4G services.

5.1.10 Listed following are some examples of the bands that countries have awarded/re-farmed for 5G: 600MHz, 700MHz (703-738MHz paired with 758-793MHz), 1.5GHz (1427 – 1517MHz); 2.1GHz (1970 – 2170MHz), 2.3GHz (2300 – 2400MHz), 2.6GHz (2500 – 2690MHz), 3.3GHz (3300 – 3400MHz), 3.5GHz (3400 – 3600MHz), 3.7GHz [3600 – 3800MHz], 4.9GHz (4840 – 4920MHz), 26GHz (24.25 – 27GHz) and 28GHz (27.5 – 28.35GHz) shared spectrum.

5.1.11 For context, the largest operator [Reliance Jio] in the most populous Asian country – India – holds the following spectrum holdings: Jio holds 2X20 MHz in six key Indian circles, 40 MHz in the 2300 MHz band, and 100 MHz in the 3300 MHz band across all the 22 circles[23]. Jio also has the right to use 1,000 MHz in the millimeter wave band (26 GHz) in each of the 22 circles, which will be crucial to enable enterprise use cases and provide high-quality streaming services.

5.1.12 **It is clearly the case that the amount of radio spectrum required for mobile broadband services like 4G and 5G in PNG closely correlates to such growth in mobile data traffic** as Ericsson notes has already happened and predicts for the future. This puts pressure on NICTA to ensure that more spectrum is available in PNG for the deployment of 4G/5G services in new spectrum allocations in different bands – the low, mid and mmWave – for different coverage and speed considerations.

5.2 Unlicensed Spectrum Services

5.2.1 **Future Outlook for Unlicensed Spectrum Services in PNG** (that can promote hundreds more mobile broadband WISPs)

5.2.2 More unlicensed radio spectrum would need to be similarly allocated in PNG– certainty and transparency on unlicensed spectrum are equally key like for IMT spectrums.

5.2.3 Allocating more unlicensed spectrum bands, such as the lower 6GHz or 60GHz band present several benefits for PNG.

[20] https://www.ericsson.com/en/press-releases/2023/11/ericsson-mobility-report-resilient-5g-uptake---global-mobile-data-traffic-set-to-triple-in-six-years

[21] *Ibid.*

[22] https://www.ericsson.com/en/reports-and-papers/mobility-report/dataforecasts/mobile-traffic-forecast

[23] India is divided into 22 telecom circles, which are based on state boundaries or a combination of smaller states and union territories. These circles are categorized as either Metro Circles (like Delhi, Mumbai, and Kolkata) or Telecom Circles (covering larger regions like Maharashtra or Uttar Pradesh). Each circle operates as an independent market, and telecom operators must acquire licenses and spectrum rights for each circle to provide services there. This system ensures efficient management of spectrum resources and allows operators to tailor their services to the needs of specific regions.

a. *Wi-Fi Offload for Mobile Network Operators*[24]: the practice of Wi-Fi offloading allows mobile networks operators to offload traffic to Wi-Fi networks when possible, freeing up valuable spectrum for these operators. This would usually improve overall network performance and reduce congestion and improve quality of service.

b. *Improved Connectivity by new entrant mobile broadband players (WISPs)*[25]*:* Unlicensed spectrum allows for easier deployment of Wi-Fi networks, which can help bridge the wide digital divide in PNG by providing internet access in underserved areas by new entrant ISPs. In Brazil, Wireless Internet Service Providers (WISPs) have played a crucial role in providing mobile broadband service. In Brazil,

> "WISPs tend to serve predominantly lower income groups households: according to the CeTIC.br survey, most of WISP customers belong to the C, D, and E strata. In these segments, wireless technology is hardly substituted by other kind of access technology. As a result of the lower income population concentration, WISP Wi-Fi lines are frequently shared among neighbours.[26].

According to this reputable blog[27], the

> "Brazil Internet access industry is quite unique: **Brazil has over 20,000 ISPs** but only 3 have country-wide coverage and 40% of the companies have up to 5 thousand customers. It is a highly competitive and heterogenous marketplace, driven by small and medium regional companies. As of December 2022, **regional ISPs account for over 50% market share in Brazil**."
>
> The role of such WISPs in Brazil in closing the digital divide cannot be overstated. There is much for PNG to learn from Brazil as regards Mobile Broadband Services using unlicensed spectrum.

c. **Cost Efficiency**: As illustrated by the Brazilian example above, using unlicensed spectrum reduces costs for WISPs, as they do need to bid for or pay for IMT spectrum licenses. Some of the bigger ISPs evolve to start bidding for some regional IMT spectrum licenses.

d. **Economic Growth**[28]: Enhanced connectivity – particularly to rural and unconnected areas - obviously drive economic growth by enabling access to digital services, education, and healthcare.

5.2.4 Future Outlook for Unlicensed WAS/RLAN/Wi-Fi Broadband Services in PNG

5.2.5 In most markets, particularly developed ones, Wi-Fi is carrying a significant portion of mobile traffic being offloaded onto unlicensed spectrum. According to a reputable FCC (USA) Commissioner contribution, it is estimated that around 76% of all mobile data traffic was offloaded to Wi-Fi networks by 2022[29]. This trend is expected to continue as the demand for mobile data grows and the need for efficient spectrum usage becomes more

[24] https://www.antlabs.com/blog-articles/why-wifi-offloading-is-even-more-compelling-in-a-5g-driven-world/

[25] Wireless Internet Service Providers (WISPs): https://www.gsma.com/connectivity-for-good/spectrum/gsma_resources/spectrum-pricing-and-licensing-in-africa-driving-mobile-broadband/

[26] https://dynamicspectrumalliance.org/2024/Assessingtheeconomicvalue6GHzBandBrazil2021-2034.pdf

[27] https://wifinowglobal.com/news-and-blog/focus-on-brazil-biggest-challenge-for-isps-is-to-deliver-great-wi-fi-inside-all-rooms-of-the-house-says-abrint/

[28] https://www.kictanet.or.ke/challenges-of-spectrum-access-in-africa/

[29] https://docs.fcc.gov/public/attachments/FCC-20-51A3.pdf

critical.

5.2.6 So, the following unlicensed spectrum work areas are crucial to meet the ongoing and future demand for mobile broadband services in PNG and so are being considered in this roadmap.

(i) *5925-6425MHz [new unlicensed for WAS/RLAN Wi-Fi - Review PNG's position on WAS/RLAN in this band for WRC-27*: It was 20 years at WRC 2023 since the 5GHz/6GHz range spectrum was opened to license-exempt devices at WRC 2003. There has been truly a revolution in Wi-Fi technology over the last two decades, in demand for more spectrum for Wi-Fi/license-exemption, along with numerous use cases. At WRC-23, it was decided that the 5925-6425 MHz band would be allocated for use by ITU Region 1 administrations. This band is reserved for Radio Local Area Networks (R-LAN) and Wi-Fi technologies[30].

(ii) *V-Band - 57-71GHz [new unlicensed band for WAS/RLAN Wi-Gig - Review PNG's position on in this band for WRC-27]:* the 57-64 GHz band is license-exempt by some key administrations like the UK's (Ofcom) for certain types of equipment. Specifically, if a system or station operates at or below 40dBm EIRP (Effective Isotropic Radiated Power), it can be authorized under license exemption regulations. This means that no license is required for such equipment, provided it meets the relevant technical criteria[31].

(iii) *Unlicensed Bands for Short Range Devices (SRD) [NICTA to clearly designate frequency bands for SRDs in PNG]:* NICTA has not – to date – clearly designated frequency bands for SRDs in PNG. NICTA would rectify this in the 2025-2030 period of this roadmap.

5.2.7 In summary, there is much evidence of increased pressure on new spectrum resources from Unlicensed services in PNG.

5.3 Fixed Services

5.3.1 Future Outlook for Fixed Services in PNG

5.3.2 Fixed services operate in various radio spectrum bands from Very High Frequency (VHF) and Ultra-High Frequency (UHF) to Extremely High Frequency (EHF). The VHF and UHF bands are typically used for narrowband applications; for point-to-point links between land mobile base stations or point-to-multipoint.

5.3.3 Various spectrum bands above 6GHz are used for point-to-point links with lower frequency bands supporting longer communications range. Fixed services are being typically deployed by organisations such as government agencies (Defence and public safety agencies), telecommunications operators and broadcasters.

5.3.4 The demand for fixed services is changing. fixed services span:
1. Fixed point-to-point links;
2. Fixed point-to-multi-point links; and
3. Fixed Wireless Access (FWA) services.

[30] https://www.itu.int/en/ITU-R/conferences/wrc/2023/Documents/2023-05-26%20Status%20of%20CEPT%20prepararation%20for%20WRC-23%20%2826%20May%202023%29.pdf
[31] https://www.ofcom.org.uk/spectrum/radio-equipment/spectrum-access-ehf/

5.3.4.1 There are fixed services operating across many spectrum bands including VHF, UHF, C-Band, Ku Band and Extremely High Frequency[32] (EHF) bands (which includes mmWave Ka band frequencies, V-Band, E-Band and more).

5.3.4.2 VHF and UHF **fixed point-to-point** or point-to-multipoint fixed links only support narrowband communications systems because of their lower frequency ranges. However, they could suffice to cater to the needs of government agencies, like defence and public safety agencies. They could also be very useful for narrowband telecoms backbone connections for commercial and industrial operations (e.g., for mining, oil & gas companies in areas where fixed line network is not available).

5.3.4.3 C-Band, Ku Band and higher frequencies fixed point-to-point microwave links are very much in demand in PNG including for corporate data connectivity and backhaul for telecommunications networks – although some of these links are being substituted by fibre in the urban areas. This is because fibre offer much higher capacities and higher reliability. However, fibre is very expensive and may not always be available, as well as it takes longer to deploy. So, the wireless backhauling for 5G and 4G beyond the urban areas will typically require such fixed links using these higher frequencies beyond VHF and UHF frequencies.

5.3.4.4 **Fixed point-to-multipoint** services are offered by companies (e.g., WISP data operators) but – like with Brazilian WISPs mentioned earlier - this is typically through unlicensed 5GHz spectrum which is shared with other systems such as RLAN. [Rural and semi-rural] WISPs in PNG would prefer this approach to the more expensive fibre networks or even using licensed spectrum for backhaul – as they are both faster and more affordable to deploy.

5.3.4.5 **Fixed wireless access (FWA)** services are offered by operators who deliver wireless broadband Internet access, and these FWA services used to (or still) operate mainly in 2.3GHz and 2.6GHz bands. However, as covered in the Mobile Broadband Services (Section 5.1), convergence is ensuring that these bands are being re-purposed too to provide mobile broadband services like 5G and 4G (and in the future 6G).

5.3.5 Future Outlook for Fixed Services in PNG

5.3.5.1 Ericsson forecasts that point-to-point microwave and mmWave links will account for about 60 percent of mobile backhaul over the next five to seven years from 2024[33].

5.3.5.2 So, Mobile Network Operators in PNG are demanding more microwave links for mobile backhaul for 5G small cells deployed for high traffic areas, either as primary backhaul or as secondary backup to fibre.

5.3.5.3 So, the following Fixed Link Services work areas are crucial to meet the ongoing and future demand for mobile broadband services (being considered in this roadmap):

5.3.5.3.1 *5925-6425MHz [new unlicensed for WAS/RLAN Wi-Fi - Review PNG's position on WAS/RLAN in this band*]**:** as covered earlier under Unlicensed Services;

5.3.5.3.2 V-Band (57-71GHz): FWA is optimal for this band as covered in previous section.

[32] Extremely High Frequency (EHF) bands refer to the portion of the electromagnetic spectrum ranging from 30 GHz to 300 GHz

[33] https://www.ericsson.com/en/reports-and-papers/microwave-outlook/articles/backhaul-capacity-evolution

5.3.5.3.3 *E-Band (70/80 GHz):* E-Band could be lightly licensed in PNG.

5.3.6 In summary, there is evidence of increased pressure on new spectrum resources from Fixed services in PNG.

5.4 Broadcasting Services

5.4.1 **Future Outlook for Broadcasting Services in PNG**

5.4.2 Broadcasting stations are used to transmit broadcasting content. There are two types of broadcasting stations: terrestrial and satellite. Most terrestrial stations in PNG until recently have been using analogue technology. However, national broadcaster NBC is currently simulcasting its TV content in both analogue and digital and plans to switch off analogue TV between now and 2030.

5.4.3 *Broadcast AM and FM stations*: The legacy analogue broadcasting stations use MF/HF, VHF or UHF spectrum for transmission. Because of the long-distance propagation characteristics of electromagnetic waves in MF/HF, VHF and UHF bands the spectrum planning has been done at the regional or international level in order to ensure the interference free operation of stations

5.4.3.1 *AM Radio Broadcasting*: AM radio broadcasting is done using the MF band, which has long-range characteristics and hence require international/regional coordination to ensure interference free operation. Since, AM radio has a poor voice quality than FM radio, currently there is not much demand for AM radio and the situation is likely to remain as it in the next 5 years.

5.4.3.2 *FM Radio Broadcasting*: FM radio broadcasting is done using VHF band II. High power transmission in this band also requires international or regional coordination, however this is not required for low power transmissions. In addition to this, there are a couple of frequencies assigned for community radio broadcasting services.

5.4.3.3 *DAB Radio Broadcasting*: DAB radio broadcasting is being considered, and VHF Channel 1 has been

5.4.4 *Terrestrial Broadcasting*:

5.4.4.1 Analogue TV in PNG operates in VHF TV Band III (174 -230 MHz) – see Figure 3
5.4.4.2 Digital TV in PNG operates in both VHF and UHF: VHF TV Band III (174 -230 MHz); UHF Band TV IV (526 - 606 MHz) and Band V (606-694MHz) – see Figures 3 and 4.

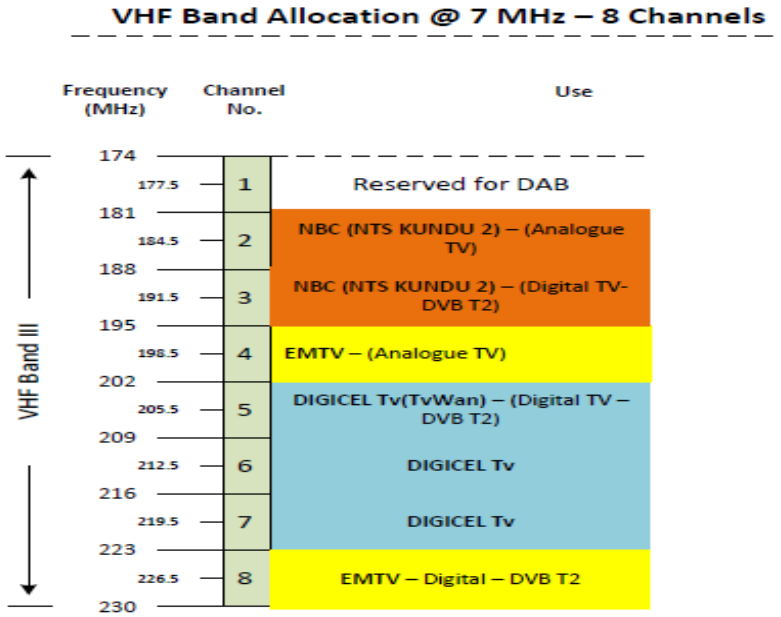

Figure 3 – VHF Band TV Assignments (as of March 2025)
(Source: NICTA)

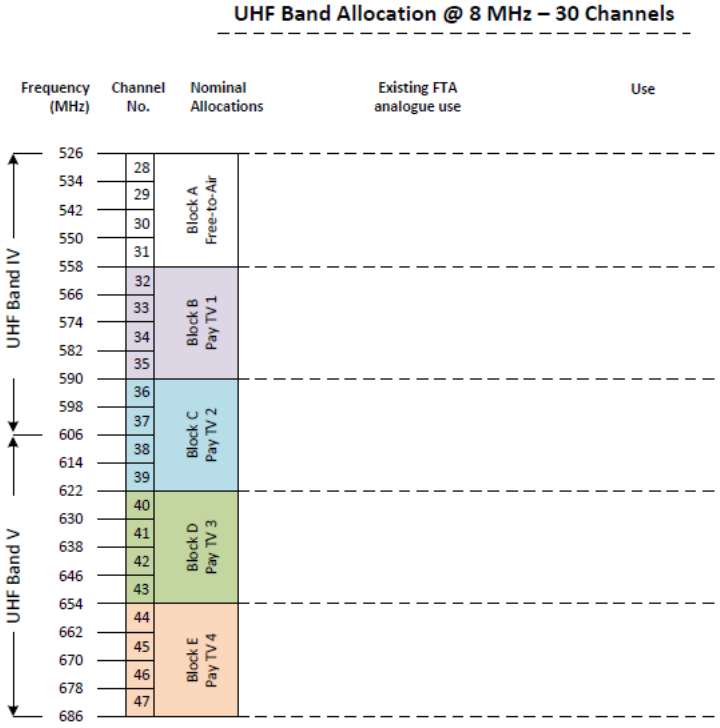

Figure 4 – UHF Band TV Assignments (as of March 2025)
(Source: NICTA)

5.4.4.3 There is a reservation of VHF Band 1 for Digital Audio Broadcasting (DAB). This would be reviewed as this reservation is arguably not the most efficient use of this spectrum band. It is highly unlike that DAB radio would materialise in PNG.

5.4.4.4 Indeed, MW Radio and Short Wave (SW) Radio are more appropriate for the 600+ Islands that make PNG.

5.4.4.5 There are currently 3 TV Broadcasters in PNG: (i) NBCTV, (ii) EMTV and (iii) Digicel TV

5.4.4.6 UHF Band V has some small TV players operating in them including Tolec (in Lae), Raycom (in Madang) and HER (in Alotau).UHF Band V has some small TV players operating in them including Tolec[34] (in Lae), Raycom (in Madang) and HER[35] (in Alotau).

5.4.4.7 This players should/would be migrated to UHF IV, so that UHG Band V should be band-planned for LTE.

5.4.5 In summary and in general, there is <u>little</u> evidence of increased pressure on new spectrum resources from broadcasting services in PNG.

5.5 Satellite and Space Services

5.5.1 Future Outlook for Satellite & Space Services in PNG

5.5.2 There is truly much innovation ongoing in the satellite sector. Satellite remains a vital means of communications particularly in hard-to-reach places in PNG in order to bridge the digital divide. In addition, maritime, weather prediction systems, mining, oil and gas exploration industries rely heavily on satellite communications.

5.5.3 *ESIMs*: satellite earth stations in motion (ESIM) provide connectivity on board aircraft or on ships, operating with GSO space stations in the fixed-satellite service. WRC-23 identified new frequencies for ESIMs to deliver high-speed broadband on vehicles, vessels, aircraft, and trains, crucial for post-disaster communication. There is evidence for increasing demand for ESIMs.

5.5.4 *GMDSS:* Global Maritime Distress and Safety System (GMDSS) – WRC-23 implemented regulatory actions to enhance distress and safety communications at sea, including e-navigation systems. There is evidence for increasing demand for GMDSS.

5.5.5 *Space Weather Observation:* WRC-23 recognized the importance of space weather observation, and introduced a new Resolution and Article in the Radio Regulations to observe phenomena that can interfere with radiocommunication services.

5.5.6 Space Services

5.5.6.1 Space Services typically cover three areas[36]: broadband communications via Non Geostationary Orbital Satellites (NGOS);

5.5.6.2 Earth observation and navigation: to benefit sectors such as agriculture, emergency services, climate monitoring and weather forecasting while <u>simultaneously</u> allowing other services to access spectrum;

5.5.6.3 Understanding and enabling access to space – given the rapidly rising numbers of satellites in orbit and the consequent increasing space debris; addressing space debris is increasingly a challenge as well as and safe access to space[37].

5.5.7 Future Outlook for Satellite & Space Services in PNG

5.5.7.1 *Non Geostationary Orbital Satellites (NGOS)/LEOs for broadband services*: a new breed of

[34] Tolec Electronics

[35] Heavy Equipment Repairs

[36] https://www.ofcom.org.uk/spectrum/space-and-satellites/statement-space-spectrum-strategy/

[37] for example, by considering spectrum access requirements for radars to track objects in space.

innovative satellite services has already emerged, offered by low Earth orbit (LEO) satellite operators such as Starlink, OneWeb and Telesat.

5.5.7.2 These operators have launched or plan to launch a large number of satellites to achieve higher capacity and global coverage.

5.5.7.3 As of September 2024, the Starlink constellation consists of 6,426 satellites in orbit, with 6,371 of them already operational. SpaceX plans to deploy nearly 12,000 satellites in total, with a possible extension to 34,400 satellites in the future[38].

5.5.7.4 The Starlink service is already capable of being made commercially available in PNG. It offers speeds ranging from 50Mbps to 150Mbps and latency from 20ms to 40ms, which is comparable to some high speed fixed and mobile broadband services. However, since August 2024 to date of the publishing of this Spectrum Outlook & Roadmap, the licensing of Starlink in PNG is subject to a judicial review process before the National Court of Justice[39].

5.5.8 In summary and in general, there is evidence of increased pressure on new spectrum resources from satellite and space services in PNG.

5.5.9 There is a clear and obvious need for a Satellite [Spectrum] Licensing Framework that NICTA would have to put in place, due to increasing requests from NGSOs/LEOs, ESIMs, GMDSS, etc.

5.6 Land Mobile & Public Safety Services

5.6.1 Future Outlook for Land Mobile & Public Services in PNG

5.6.2 Land mobile systems are defined as terrestrial Point-to-Area (PTA) systems with fixed base-to-mobile, mobile-to-mobile, transportable base-to-mobile stations. The one-way and two-way paging systems are part of the Land mobile systems.

5.6.3 Services like transportation, government, military, public safety provides two-way radio communication infrastructure and applications to businesses.

5.6.4 **In summary and in general, there is some evidence of increased pressure on new spectrum resources from land mobile and public services in PNG, particularly from Security firms**.

5.6.5 In order to realise efficient use of Land mobile and public services, old radios and assignments relying on 25KHz channels would be priced higher than modern radio equipment based on 12.5Khz and 6.25Khz channels.

5.7 Aeronautical and Maritime Services

5.7.1 Future Outlook for Aeronautical & Maritime Services in PNG

5.7.2 Aeronautical frequency bands are allocated by ITU and support domestic and international communications of Aeronautical services.

5.7.3 International Civil Aviation Organization (ICAO) in cooperation with member states and industry groups to reach consensus on international civil aviation standards and recommended practices. They plan and coordinate the use of radiofrequency assignments.

[38] https://en.wikipedia.org/wiki/Starlink

[39] https://www.nicta.gov.pg/gpn-0-46/

5.7.4 CASA PNG is responsible for;

- Air Traffic services
- Communication and Radio Navigation facilities
- Licensing of pilots and aircraft maintenance engineers and flight checks
- Airworthiness Control
- Relations with ICAO and other international organization

5.7.5 Aeronautical Frequencies are currently prescribed in the Spectrum Rules Annex F – Frequencies related to Aeronautical Mobile are provided based on ITU RR.

5.7.6 **In summary and in general, there is <u>little</u> evidence of increased pressure on new spectrum resources from aeronautical & maritime Services public services in PNG**.

5.8 Modern Spectrum Monitoring & Automated Spectrum Licensing System

5.8.1 **Future Outlook for Spectrum Monitoring in PNG**

5.8.2 The key task of Radio Spectrum Monitoring comprises the eyes and ears of Spectrum Management, and provides independent evidence-based decision making and feedback loop supporting spectrum policy goals

5.8.3 Radio Spectrum Monitoring keeps the radio spectrum clean and fit for purpose, particularly for safety-of-life, business/commercial and domestic stakeholder users of spectrum.

5.8.4 The safeguarding of all spectrum-reliant industries and services together contributes significant economic growth.

5.8.5 Radio Spectrum Monitoring helps eliminate unlicensed and illegal use of Radio Spectrum, thereby protecting the revenue generation of licenced operators.

5.8.6 The task of Radio Spectrum Monitoring Regulatory enhances compliance in order to prevent interference, to ensure quality of service, to ensure fair competition.

5.8.7 Until recently, in late 2024, NICTA did *not* have the radio spectrum monitoring equipment to carry out <u>proactive</u> spectrum monitoring.

5.8.8 **Future Steps in Radio Spectrum Monitoring in PNG**

5.8.9 In December 2024, NICTA signed a major contract for the deployment and provision of a Fixed Mobile and Remote-Controlled Radio Monitoring System (RMS)[40]. This is an important milestone for NICTA and Papua New Guinea.

5.8.10 The RMS will significantly improve spectrum management by monitoring the airways in an *automated and proactive manner*, rather than having to reactively investigate and respond to spectrum interference issues. The RMS will monitor spectrum usage and is capable of monitoring radio frequencies within the range 7 kHz to 54 GHz.

5.8.11 The RMS will act as critical regulatory tool in the management, planning and utilization of PNG's frequency spectrum resources and will contribute to the government digital transformation program.

[40] https://www.facebook.com/story.php/?story_fbid=899399328996813&id=100067802610843&__rdr & https://tvwan.com.pg/news/2474#:~:text=Staff%20Reporter&text=A%20nine%2Dmillion%2Dkina%20contract%20was%20signed%20today%20between%20renowned,for%20Papua%20New%20Guinea%20airwaves.

5.8.12 For this reason, better and more modern radio spectrum monitoring is also key to this NICTA Draft Spectrum Outlook & Roadmap: 2025-2030.

5.8.13 In the duration of this Spectrum Outlook & Roadmap: 2025-2030, Spectrum monitoring will play a crucial role in a Spectrum Roadmap by ensuring efficient and interference-free use of the radio-frequency spectrum. Here are some key aspects of its role:

5.8.13.1 *Proactive Interference Management*: Monitoring will help detect and mitigate interference, ensuring that different services can operate without disrupting each other.

5.8.13.2 *Compliance Enforcement:* this will ensure that licensed users comply with regulations and spectrum usage policies, preventing unauthorized or harmful usage.

5.8.13.3 *Spectrum Efficiency*: By proactively continuously observing spectrum usage, monitoring will help identify underutilized radio frequencies that can be reallocated or shared.

5.8.13.4 *Technology Advancement*: Modern Spectrum Monitoring will enhance the development and deployment of new technologies by providing real-world data on spectrum performance and usage patterns.

5.8.13.5 *Policy Making:* Insights from modern spectrum monitoring will inform policymakers and regulators in making informed decisions about spectrum allocation and management strategies.

5.8.14 In summary, enhanced modern spectrum monitoring is vital for maintaining the balance between growing demand for wireless services and the finite nature of the spectrum resource. It helps ensure that the spectrum is used efficiently and fairly, benefiting all users. This is consistent with NICTA whose statutory duties, amongst others, include spectrum management pursuant to the National ICT Act 2009.

5.8.15 **Automated Spectrum Licensing System in PNG**

5.8.16 NICTA is currently also in the process of automating its spectrum licensing system.

5.8.17 The first key goal of automation is to automate some of the laborious paper-based licensing workflows, to completely make some of them non-paper-bases. Some licence classes like Amateur station and dealers' licenses are good candidates for this. Some of such licences can be issued automatically online.

5.8.18 The second goal is for licensees to be able to use the licensing portal to be able to see the availability of potential licenses, e.g. for fixed links, even before they make an application. This way they apply with more relevant, specific and contextual information, streamlining and making the process more efficient.

5.8.19 NICTA's current licensing system is underutilised by the end-users thus limiting its full potential. To optimise management of spectrum usage effectively and efficiently, the system needs to be administered better for what its designed for. The system allows for web portal integration and other front-end services that reduces user interaction times and promotes a disciplined approach to data management. It has functions such as online license applications and assignments and complaint management, the creation of frequency allocation tables (FAT), spectrum monitoring interface, administration of licensing, billing and tracking payments, supports spectrum auctions and trading, publish ITU notices, manage international and regional coordination, oversee whitespace database, manage cartography including conversion, customisable query editor, data analysis and more. With

its customized features, the system allows for a client interactive function for online customer query, that allows access to live licensing data records and perform data analysis.

5.8.20 NICTA would be exploiting the licensing system to improve the efficiency of the licensing process.

6. Strategic Considerations & Goals for NICTA Spectrum Roadmap 2025-2030

Drawing from the Sections 2, 3, 4 and 5, we derive other several strategic considerations and goals for the NICTA Spectrum Roadmap 2025-2030.

6.1 Miscellaneous Key Spectrum Roadmap Considerations

6.1.1 A spectrum outlook and roadmap help spell out new spectrum allocation, assignment and release plans that would help provide certainty to spectrum stakeholders.

6.1.2 NICTA believes that a Spectrum Outlook & Roadmap: 2025-2030 developed with public consultation will ensure alignment with industry spectrum acquisition plans and priorities for cost-effective network expansion and introduction of new mobile and spectrum-dependent services in PNG.

6.1.3 In developing the IMT Spectrum Roadmap: 2025-2030, the following factors are of utmost consideration too:

6.1.3.1 WRC-23 outcomes and NICTA's and PNG's WRC-27 priorities;

6.1.3.2 Current NICTA Spectrum Regulations and Guidelines, etc;

6.1.3.3 The level of availability of user devices and equipment supporting a candidate band;

6.1.3.4 Industry demand and priorities;

6.1.3.5 The need to prevent harmful interference to other existing wireless services, especially those related to safety-of-life;

6.1.3.6 The need to clear the band by migrating services for which sharing is not feasible without causing or receiving harmful interference;

6.1.3.7 Ensuring that spectrum allocation is prioritized for the highest value uses (and spectrum likely assigned to the highest value users) in order to maximise socio-economic benefits.

6.2 The growth and growth of mobile broadband traffic

6.2.1 Mobile broadband traffic has grown significantly over the last few years in PNG. This is obviously a key consideration for the Spectrum Outlook and Roadmap: 2025-2030.

6.2.2 Global mobile data traffic experienced significant growth in 2023 and 2024. The growth of mobile broadband has brought a radical change in the way people communicate in terms of voice and data.

6.2.3 Mobile services play a crucial role in providing communication services (voice and data) to consumers but also to many enterprises, especially in the SME sector.

6.2.4 Additionally, various econometric analyses have demonstrated that broadband has a positive impact on economic growth in both developing and developed markets. This has been validated by well-known studies including by the ITU (2020)[41] that shows that an

[41] ITU (2020). How broadband, digitisation and ICT Regulation impact the global economy, https://tinyurl.com/27r262k5

additional 10% in mobile broadband penetration yields 2.46% of additional GDP growth in Least Developed Countries like PNG.

6.2.5 As noted in the previous section, experiences continued growth in demand for more spectrum as a result of significant growth in traffic. The deficiency of assigned Spectrum for IMT brings constraints and challenges in the provision of broadband services. To address PNG's bandwidth deficiency, the currently assigned bandwidth of **447.6MHz** (see Table 1) of high-demand spectrum will be increased to a minimum of 900MHz MHz over the next five years.

6.3 Adopting market-based assignment approaches

6.3.1 NICTA has been modernising and adopting best-practice approaches to Licensing Radio Spectrum. NICTA holds the view that this is critical to meeting its core duty spelt out in Section 164(a) of the NICT Act which reads: "maximise, by ensuring the efficient allocation and use of the spectrum, the overall public benefit derived from using spectrum".

6.3.2 NICTA is also of the view that mobile telecommunication technologies are a critical component for achieving the goal of 'broadband for all citizens' in PNG.

6.3.3 The IMT700, IMT800, IMT900, IMT1800, IMT2100, IMT2300, IMT2600 and IMT3500 bands have been identified worldwide for IMT services. These bands complement each other in the sense that they fulfil the requirements for capacity and coverage which make them suitable for rural and urban areas and for bridging the digital divide.

6.3.4 It is the NICTA's position that the licensing of more spectrum (*or making more efficient use of spectrum*) in IMT800, IMT900, IMT1800, IMT 2100, IMT2300, IMT2600 and IMT3500 will contribute a significant bandwidth towards achieving the PNG's connectivity targets.

6.3.5 Indeed, NICTA is in the process of releasing some 2600MHz spectrum to MNOs and ISPs in PNG in 2024 in order for them to deploy [more] 4G and/or Broadband (BWA) Services in PNG from 2025.

6.3.6 This happened because NICTA consulted in 2023 and 2024 and made proposals *to deviate* from its traditional administrative First Come First Serve (FCFS) approach to assigning this spectrum [amongst others] because NICTA designated this band (i.e., 2600MHz) as a High Demand Spectrum (HDS) Band.

6.3.7 NICTA designated certain selected bands as a High Demand Spectrum (HDS) Band[42] that will be subject to market-based assignments (*i.e., market-based spectrum licensing approach*) going forward during the period of this Spectrum Outlook & Roadmap: 2025-2030.

6.3.8 The designation happened after NICTA concluded a consultation[43] that it carried out in 2023 on the assignment of some spectrums in PNG going forward.

6.3.9 So, NICTA has [since] adopted an approach that shifts away from the First Come First Serve (FCFS) to a market-based approach for some spectrums, namely the afore-mentioned HDS spectrums. In the medium to long term, implementation of the approach is expected to significantly reduce risks of inefficient use of HDS spectrums by ensuring they do not go into the wrong hands in the first place. *This is unquestionably the case today in PNG with key HDS spectrum in some "wrong hands".*

6.3.10 This modernising shift to market-based spectrum assignment is consistent with NICTA's core spectrum duty spelt out in Section 164(c) of the NICT Act which reads: "provide a responsive and flexible approach to meeting the needs of users of the spectrum" - this duty to "provide a responsive and flexible approach to meeting the needs of users of the

[42] HDS refers to specific radio frequency spectrum bands that are in high demand by mobile and wireless operators in the market (telecom operators). In 2023, NICTA carried out a consultation on the assignment of some spectrums in PNG going forward. It had adopted an approach that shifts away from the First Come First Serve (FCFS) to a market-based approach. In the medium to long term, implementation of the approach is expected to significantly reduce risks of inefficient use of HDS spectrums by ensuring they do not go into the wrong hands in the first place.

[43] https://www.nicta.gov.pg/pcn-0-58/

spectrum…".

6.3.11 Section 13 (1) of the NICTA Radio Spectrum Regulations[44] stipulates that – for such a market-based approach - NICTA *shall* prepare an Information Package for applicants containing the *Marketing Plan* and any *Conversion Plan*. NICTA is also (as well) required by this section of the Act to include a sample Spectrum Licence in the final Information Package.

6.3.12 So NICTA will be developing and preparing Information Packages containing (*Marketing Plan* and any *Conversion Plans)* for several HDS bands during the period of this Spectrum Outlook & Roadmap: 2025-2030.

6.3.13 NICTA may adopt one of the following market-based assignment processes, i.e. what the assignment process is. e.g. i) a simple Tender, (ii) a modified beauty contest, (iii) a First or Second Price Sealed-Bid Auction or (iv) a Multiple Round Auction (MRA).

6.3.14 NICTA has already informed Stakeholders that the first HDS band to be awarded using the Market-Based Spectrum approach will be the IMT 2600MHz Band.

6.4 Adopting other modern best practice approaches to licensing radio spectrum

6.4.1 NICTA is also considering modernising and adopting other best-practice approaches to Licensing Radio Spectrum including the following over the period of this Spectrum Roadmap: 2025-2030.

6.4.1.1 *Technology Neutrality:* spectrum users would choose the technology of their choices on the spectrum bands assigned. The technology-neutral approach incentivises network operators to adopt the most spectrally efficient technology. PNG is yet to adopt the technology-neutral approach.

6.4.1.2 *Spectrum Sharing & Trading:* emerging technologies are enabling more efficient use of spectrum by limiting the power to avoid interference to primary users; or tapping into spectrum that are unused at a given time and location. Different levels of coordination may be required for the introduction of spectrum sharing. Ultra-Wide Broadband (UWB) and Software-Defined Radio (SDR) are examples of technologies that are capable of utilizing spectrum sharing to promote efficiency.

6.4.1.3 *Light Licensing:* Light licensing is a way to minimize regulatory intervention and it removes the need for the regulator to coordinate frequency assignment. An automated notification and frequency assignment process is set up to allow users to register for a frequency via an online system.

6.4.1.4 *Dynamic Spectrum Access:* Dynamic Spectrum Access enables a radio device to operate in spectrum that is not being used in a particular area, at a particular time. The development of cognitive radios is making this spectrum sharing possible and it can significantly increase efficiency of Table 1spectrum. *TV White Space* is a form of DSA. Spectrum is allocated exclusively to the broadcasting services but they may not be used all the time in all desired locations.

6.4.1.5 Spectrum Pricing: Spectrum Benchmarking, Administrative Incentive Pricing (AIP) & Other Spectrum Prices: Spectrum pricing is another tool that can be used to promote more efficient use of spectrum. NICTA has already commenced some internal Spectrum Pricing benchmarking studies.

6.4.2 NICTA holds the view all these spectrum modernising approaches above are critical to meeting its core duty spelt out in Section 164(a) of the NICT Act which reads: "maximise, by ensuring the efficient allocation and use of the spectrum, the overall public benefit

[44] Radio Spectrum Regulations - National Information & Communications Technology Authority (nicta.gov.pg) - https://www.nicta.gov.pg/licensing/licensing-fees/radio-spectrum-fees/

derived from using spectrum".

6.4.3 Therefore, NICTAs existing Licensing regulating instruments will be reviewed and updated to accommodate new changes and users of spectrum. NICTA's approach to spectrum licensing has included various propositions to encourage wireless coverage to rural and remote regions. An example is the Universal Access Scheme Rural Connectivity program that is creating difference by connecting rural and remote through deployment requirements that go beyond the major urban areas.

6.5 Adopting modern approaches to radio spectrum monitoring

6.5.1 NICTA will also be modernising and adopting best-practice modern approaches to radio spectrum monitoring.

6.5.2 NICTA holds the view that this is also critical to meeting its core duty spelt out in Section 164(a) of the NICT Act which reads: "maximise, by ensuring the efficient allocation and use of the spectrum, the overall public benefit derived from using spectrum".

6.5.3 As Section 5.8 summarised, better and more modern radio spectrum monitoring is also key to this NICTA Draft Spectrum Outlook & Roadmap: 2025-2030.

6.6 Summary

6.6.1 This Spectrum Outlook and Roadmap: 2025-2030 exercise is purposely carried out as one of the key objectives of the spectrum framework is to ensure:

6.6.1.1 there is visibility in the current and future spectrum assignments in the short, medium and long term to 2030;

6.6.1.2 the spectrum regulatory framework is used to accommodate current and future spectrum demands and needs;

6.6.1.3 proper consultation is done with commercial stakeholders, government, industry and consumers on the current and future spectrum needs.

6.6.2 So, NICTA has also been engaging in a spectrum policy framework to increase the quantum of assigned spectrums across all key sectors – which includes Market-Based Spectrum Assignments[45] - to have clear visibility on spectrum and users of the spectrum.

6.6.3 The outcomes of the Spectrum Outlook will give confidence and certainty to stakeholders and industry's alike ensuring NICTA's work plan and priorities are aligned and achievable.

6.6.4 GoPNG's policy objective in the telecommunication sector is to maximize the economic and social benefits that the citizens of Papua New Guinea gain from the use of the radio frequency spectrum, from the urban areas, rural and remotest parts of the country.

[45] Public Consultation Statement 2600mhz, 3500mhz & Market-based Spectrum Assignment - National Information & Communications Technology Authority (nicta.gov.pg) - https://www.nicta.gov.pg/pcn-0-58/

7. Key NICTA 2025-2030 Spectrum Roadmap [Proposed] Action Plans

Drawing from all previous sections, following is NICTA's Spectrum Roadmap 2025-2030 [proposed] Action Plans.

7.1 Proposed Short-Term (2025-2026) Roadmap Actions

7.1.1 The proposed short term actions are as follows

When	Spectrum Work Plan Area	Actions	Status
Short-Term (2025-2026)	**Spectrum Audit**	1. Conduct overall spectrum audit beyond the sectors covered in this Spectrum Roadmap, particularly spectrum being used by Government – e.g. Police, Department of Defence, Fire Services, etc.	Upcoming
	Update PNG Frequency Allocation Table (NFAT) and Radio Frequency (RF) Allocation Chart from WRC-23 outcomes	2. Update PNG Frequency Allocation Table (FAT) in concert with NICTA taking into consideration the consultation responses to this Spectrum Roadmap 2025-2030, consolidating WRC2023 decisions and more 3. To update PNG RF Allocation chart as per changes from WRC-23	Upcoming Upcoming
	NICTA Act 2009	4. Review, Analyse and Propose Update Recommendations on Spectrum Provisions for the NICTA Act 2009, and proceed with proper consultation from all concern stakeholders, government and operators – possibly alongside other propositions to update the 2009 NICT Act.	Ongoing
	Spectrum Resources to enable Fair Competition	5. As Tables 1 and 3 show, one or more players may be at a competitive disadvantage in comparison to others because of them not having sufficient coverage and/or capacity spectrums. NICTA is working to address this concern under Division 2 Article 124(1)(a) of NICTA Act[46]. NICTA will seek to redress these imbalances.	Ongoing

[46] Division 2 [Objectives] Article 124(1)(a) promote effective competition in markets for ICT services in Papua New Guinea, to be known as the "competition objective". Spectrum is key to competition in Telecoms markets. Assignment of new IMT High Demand Spectrum (HDS) must take into consideration competition issues

Short-Term (2025-2026)	**Modernise PNG Spectrum Licencing Regime and Approach**	6. Review and consult on a new Band Plan for UHF Band V (see Figure 3). This band would be allocated for IMT within the 2025-2030 period of this Spectrum Roadmap 7. Review existing Licensing regulating instruments, and update to accommodate new changes and new users of spectrum. a. For example, PNG is yet to adopt the technology-neutral approach – which NICTA will address. b. Review of existing licensing regime to address coverage issues in urban and rural areas in order to propose different licensing approaches especially for spectrum sharing and other purposes c. To propose licensing approaches for emerging 4G/5G applications and services – e.g., spectrum innovation reserves.	Ongoing
Short-Term (2025-2026)	**Assign Low and Mid-Band Spectrums (2600MHz & 800MHz) – and New Band Plan for 600MHz**	8. Carry out and Conclude Consultation and Assignment on first market-based spectrum assignment in PNG [of the 2600MHz spectrum band first, with 800MHz likely to follow][47]. This will realise refarming the 800MHz for higher use and need. 9. New Band Plan for 600MHz (UHF hand V]	Ongoing
	Spectrum Pricing & Fees Review	10. Review and Update Spectrum Pricing in PNG, particularly for HDS Bands. Review and consultation on spectrum fees new fee arrangement, and; 11. Updating the 2010 Spectrum Pricing Formula – in particular, to develop new spectrum pricing and formula for higher bands with the support of APT and ITU. 12. Review, Adopt new Licence categories and Update ALL "Apparatus" Licence fees	Ongoing Ongoing Ongoing
	WRC-27 Preparations	13. Prepare for WRC 2027 (in concert with Department of ICT) 14. Develop national and regional positions to	Upcoming Ongoing

[47] NICTA already announced its intention to do this in 2024. Source: PNG NICTA CEO Keynote Presentation, Digital Transformation Summit 2024, 2nd October 2024, Port Moresby, PNG - https://www.ict.gov.pg/digitaltransformationsummit2024/

		represent PNG interests at WRC-2027. National and Regional engagement at APT and relevant ITU-R study groups and meetings for PNGs position at WRC meetings.	
	Spectrum Clearances & Spectrum Re-Farmings	15. Plan for Spectrum Clearances of [ranked] Bands in this consultation where necessary. 16. Refarm the 450MHz for higher use and need. 17. In order to realise efficient use of Land mobile and public services, old radios and assignments relying on 25KHz channels would be priced higher than modern radio equipment based on 12.5Khz and 6.25KHz channels in UHF Band III. Thiswill help refarm the UHF III Band	Upcoming Upcoming
	Mid Band 5G Spectrum & Updating Band Plans	18. Identify [and potentially clear or refarms] Other Mid Band Spectrums for 4G/5G, e.g. 2300MHz, 3600-3800MHz, 3800-4200MHz, 6GHz (642525-7125MHz), etc. 19. Revise Spectrum Band Plans via Consultations as necessary, e.g. 3600-3800MHz	Upcoming Upcoming
	Spectrum and Licensing Processes Automation (Phase I)	20. NICTA Licensing (LEE) and NICTA IT to work on automating some licensing and spectrum assignment application processes	Upcoming

7.2 Medium-Term (2027-2028) Roadmap Actions

7.2.1 **The proposed medium term actions are as follows**

When	Spectrum Work Plan Area	Actions	Status
	Unlicensed Spectrum Access	1. Consult on providing additional spectrum for licence-exempt use such as Wi-Fi and TV white space devices. Develop a NICTA Unlicensed Framework and Strategy. **Framework is also necessary driven by DataCo ISPs Strategy**	Upcoming

Medium Term (2027-2028)		2. Use above Framework to Allocate/Clearing/Refarming New Wi-Fi bands (e.g. for Wi-Fi 6e), e.g. 6GHz (5925-6425MHz) from *fixed links* and 60GHz (57-66GHz for Wi-Gig). For example, clearing Telikom Lower 6GHz links.	Upcoming
	mmWave 5G Spectrum & Updating mmWave Band Plans	3. Identify [and potentially clear or refarms] mmWave Spectrums for 5G, e.g. 26GHz (24.25 – 27GHz) and 28GHz (27.5 – 28.35GHz), 40GHz, etc. a). A total of 17.25 GHz of spectrum was identified for deployment of 5G at WRC-19 in the frequency bands 24.25–27.5 GHz, 37–43.5 GHz, 45.5–47 GHz, 47.2–48.2 and 66–71 GHz for the deployment of IMT. 4. Revise Spectrum Band Plans via Consultations as necessary for bands such as above	Upcoming Upcoming
	Spectrum Sharing	5. Carry out Study and Consultation on Spectrum Sharing in PNG, e.g. 2G/4G/5G spectrum sharing and TVWS Sharing. Encourage 6. Specifically, NICTA's approach would encourage wireless coverage to rural and remote areas by (i) sharing spectrum and (ii) possibly making spectrum available at a lower spectrum cost.	Upcoming Upcoming
Medium Term (2027-2028)	**Spectrum Leasing & Trading**	7. Carry out Study and Consultation on Spectrum Leasing & Trading in PNG. NICTA sees this as an extension to the the development of the existing 3rd party agreement rules for 'outsourced spectrum'[48].	Upcoming
	Further Assign at least a couple more 4G/5G Mid-Band and at least one High Band mm Wave Spectrum	8. Carry out Consultations to release and assign further mid-band and 5G spectrums, e.g. 600MHz, 2300MHz, 3300MHz, 26GHz, etc.	Upcoming
	Satellite Spectrum Strategy	9. Carry out Study into Satellite Strategy and Policy – and future satellite spectrum licensing in PNG 10. With the emergence of LEOs such as	Upcoming

[48] See Section 5 of Radio Spectrum Regulations: Some operators (Digicel and Telikom) have done deals with their spectrum without these required rules as stipulated by the 2010 NICTA Radio Spectrum Regulations . NICTA needs to regularise such arrangements.

		OneWeb and Starlink – there is now a dire need for a Satellite [Spectrum] Licensing Framework for PNG in order to address satellite licensing going forward.	
	Spectrum and Licensing Processes Automation (Phase II)	11. NICTA Licensing (LEE) and NICTA IT to work on FURTHER automating of some licensing and spectrum assignment application processes	Upcoming

7.3 Long-term (2029-2030) Roadmap Actions

7.3.1 **The proposed medium term actions are as follows**

When	Spectrum Work Plan Area	Actions	Status
Long Term (2029-2030)	**Further Assignments of Mid-band and High-Band mmWave Mobile Spectrums**	1. Carry out Consultations to release and assign further mid-band and 5G spectrums	Upcoming
	Spectrum Regulatory Frameworks	2. Review and Update spectrum regulatory frameworks. 3. Carry out Study into Emerging Opportunities in Spectrum Management and Long Term Spectrum Policy and Regulatory Framework Review for PNG	Upcoming
	Future Spectrum Needs and Outlook	4. Carry out Future PNG Spectrum Needs Beyond the 5-Year Horizon 5. Conduct detailed Spectrum Outlook for post 2030 for PNG	Upcoming Upcoming

Table 9 provides an evolving view of the IMT Spectrum Release Roadmap

No.	Band	3GPP Band Designation & Transmission Mode	Assignable Bandwidth (MHz)	Total (MHz)	Planned Release	Status

1	2600 MHz	Band 41 (TDD)	190	150	Q3/Q4 2025	In preparation
2	800/850 MHz	Band 20 - TDD	22	22	Q2 2026	Pending
3	3300 MHz	Band 52/78 (TDD)	100	100	Q1 2027	Pending
4	3400 MHz	Band 42/78 (TDD)	100	100	Q1 2027	Pending
5	3500 MHz	TDD	100	100	Q1 2027	Pending
6	2300 MHz	Band 40 (TDD)	100	100	Q2 2027	Pending
7	600MHz	Band n71/n105 (FDD)	80	80	Q4 2027	Pending

Table 9- Table of IMT Spectrum Release Roadmap

8. Monitoring and Evaluation

A Spectrum Outlook and Roadmap of this nature needs to be monitored and evaluated.

8.1 Proposed Monitoring and Evaluation (M&E) Framework

8.1.1 **The proposed M&E steps are as follows**

8.1.2 This M&E framework provides a structured approach to assess the efficiency and effectiveness of the spectrum roadmap, and utilization within the PNG telecommunications industry. It ensures that the plan remains on course spectrum is being used optimally, deviations from set targets are identified early, and corrective actions are implemented promptly.

8.1.3 The M&E Framework ensures that ONE key spectrum status reports per annum is prepared and published on NICTA's website, which will provide insights on NICTA's progress in meeting the action plans of the spectrum roadmap, and any corrective actions if there are deviations from the plan.

8.1.4 *Periodic industry feedback on outlook and roadmap update publications on NICTA website***:** NICTA will conduct consultations with industry stakeholders annually to gather insights on current challenges and opportunities in the review period, during each of the two years of the short-term (2025-26), the medium-term (2027-28), and the long term (2029-30).

8.1.5 To keep the M&E framework current, it will be reviewed and adjusted by internal reviews every year to assess progress and make adjustments.

9 References

1. GoPNG Digital Transformation Policy
2. GoPNG Connect & Infrastructure Policy
3. GoPNG Vision 2050 Policy
4. NICTA PNG Licensing Policy
5. NICTA PNG National Frequency Allocation Table
6. NICTA PNG Spectrum Plan
7. https://absatellite.com/facilities/teleports/papua-new-guinea-port-moresby

Annex I – Consultation Questions (Please answer as many as you feel relevant to your organisation)

1. Do you have any comments on Section 5.1 – NICTA's view on the Outlook for Mobile Broadband Services in PNG?
2. As Tables 1 and 3 show, one or more players may be at a competitive disadvantage in comparison to others because of them not having sufficient coverage and/or capacity spectrums. NICTA is working to address this concern under Division 2 Article 124(1)(a) of NICTA Act[49]. Can you comment on how NICTA should/may redress this issue, particularly commenting on 900MHz, 1800MHz and 2100MHz?
3. Do you have any comments on Section 5.2 – NICTA's view on the Outlook for Unlicensed in PNG?
4. Do you have any comments on Section 5.3 – NICTA's view on the Outlook for Fixed Services in PNG?
5. Do you have any comments on Section 5.4 – NICTA's view on the Outlook for Broadcasting Services in PNG?
6. Do you agree that the reservation in VHF Band 1 for Digital Audio Broadcasting (DAB) is arguably **not** the most efficient use of this spectrum band. As it is highly unlike that DAB radio would materialise in PNG (see Figure 3)? Should the reservation be released for other services like Digital TV?
7. Do you have any comments on Section 5.5 – NICTA's view on the Outlook for Satellite and Space Services in PNG?
8. Do you have any comments on Section 5.6 – NICTA's view on the Outlook for Land Mobile and Public Safety Services in PNG?
9. Do you have any comments on Section 5.7 – NICTA's view on the Outlook for Aeronautical and Maritime services in PNG?
10. Do you have any comments on the Action plans for the Short-Term (2025-2026)?
11. Do you have any comments on the Action plans for the Mid-Term (2027-2028)?
12. Do you have any comments on the Action plans for the Long-Term (2029-2030)?
13. How much additional spectrum is required in low, medium and high bands for each, bearing in mind current and future demand?
14. Which unlicensed spectrum bands should be prioritised and assigned in PNG? 6GHz? 60GHz? Any others? Why?
15. Are you aware of any existing spectrum under-utilization (allowing for future likely growth in usage)? If so, in which bands?

[49] Division 2 [Objectives] Article 124(1)(a) promote effective competition in markets for ICT services in Papua New Guinea, to be known as the "competition objective". Spectrum is key to competition in Telecoms markets. Assignment of new IMT High Demand Spectrum (HDS) must take into consideration competition issues

16. Which particular frequency band(s) in the Low Band (sub - 1 GHz), mid-band (1-6 GHz) and high-band spectrum (above 6 GHz) do you believe NICTA should prioritise? Why?
17. Given that NICTA has already designated some bands as High Demand Spectrum (HDS) bands[50] in PNG including IMT700, IMT800, IMT900, IMT1800, IMT2100, IMT2300, IMT2600 and IMT3500 – which other bands do you think should be added to these designations?
18. Can you specify current and likely interference considerations?
19. How can the NICTA best facilitate investment and innovation? In this respect joint research initiatives were a common suggestion from stakeholders – are you able to provide more details about how these would operate?
20. What mechanisms exist or should be developed for spectrum sharing or dynamic spectrum access to optimize usage?
21. How should spectrum leasing or trading be introduced and in respect of which bands?
22. How can NICTA best facilitate collaboration with other stakeholders other than regular stakeholder meetings?
23. How should the value of spectrum bands be assessed for assignment purposes?
24. Stakeholders said that they want efficient spectrum use to be incentivised. Are spectrum pricing approaches, spectrum obligations and [geographical] utilization targets the best way to achieve this?
25. Do you have any further remarks or any questions? Please provide

[50] Public Consultation Statement 2600mhz, 3500mhz & Market-based Spectrum Assignment - National Information & Communications Technology Authority - https://www.nicta.gov.pg/pcn-0-58/