



TELECOMMUNICATION RADIOCOMMUNICATION AND BROADCASTING REGULATOR - PROPOSE SPECTRUM IDENTIFIED FOR IMT 2020 (5G) IN VANUATU

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SPECTRUM IDENTIFICATION FOR IMT-2020 IN VANUATU

Executive Summary

The mobile industry has demonstrated its ability to connect and transform society through its 2G, 3G and 4G networks over the last 30 years, 5G will build on these successes. There has been much discussion around 5G and its impact on data networks. 5G will deliver a platform that enhances existing services and enables new business models. It is expected that 5G will increase mobile connectivity and support new services and a driver to innovations. It will be central to future economic growth, employment, education, transport, retail, health and more. 5G is the next generation of the global broadband multimedia international mobile telecommunication systems, known as IMT 2020 and is the next step in mobile broadband wireless communications. Compared with 4G, 5G Networks will provide an enhanced broadband experience with over 10Gbps speed, data rate and latency of less than 4 milliseconds, and ultra-high-dense connections. With these remarkable features, 5G is anticipated to significantly improve data speed and capacity for conventional mobile and fixed wireless broadband networks, as well as providing opportunities for new emerging markets.

TRBR is mandated by the Telecommunications Radiocommunications and Broadcasting Regulation Act No 30 of 2009 as amended to regulate the telecommunications, radiocommunications and broadcasting market, including management of the radio spectrum in order to promote national, social and economic development. It is TRBR's mandate to develop Radio spectrum plans including frequency band plans in Vanuatu, taking into account global and regional harmonization. All band plans are developed in accordance with recommendations developed by the Radiocommunications sector of the International Telecommunications Union (ITU-R).

In the interest of Vanuatu particularly the Telecommunications sector, TRBR is conducting this general study on the 'Mid' and 'High' frequency bands that were identified in the ITU World Radiocommunication Conferences of 2015 (WRC-15) and 2019 (WRC-19) for deployment of 5G Mobile telecommunication service.

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1. Introduction

ITU-R IMT 2020 is the next step in mobile broadband wireless communications. ITU has specified key characteristics for IMT 2020 which is similar to service requirements and main system characteristics developed by various standardization organizations for 5G. 5G is the new global wireless standard after 1G, 2G, 3G, and 4G. 5G is the next generation of mobile communication technology. The potential use cases for 5G systems can be grouped into:

- enhanced mobile broadband
- support more massive machine connectivity type communications (the internet of things), and
- ultra-high reliability and low latency communications.

5G is the fifth-generation wireless technology for digital cellular networks. Compared with 4G, 5G will deliver over 10 Gbps data rate, millisecond-level latency, and ultra-high-dense connections. With these remarkable features, 5G is set to welcome a world filled with unlimited possibilities and an exciting new era that promises the connectivity of everything. This document outlines the potential frequency bands identified for 5G use in Vanuatu.

2. Definitions

Any word, phrase or expression in this document shall, unless the context requires otherwise or it is expressly defined herein, have the same meaning as in the Act.

3GPP: 3rd Generation Partnership Project, is an important organization in the standardization process.

eMBB: Enhanced Mobile Broadband.

FDD: Frequency Division Duplex.

High-Frequency Bands (mmWave): Frequency ranges 24.25 GHz – 27.5 GHz, 37 GHz – 43.5 GHz and 66 GHz – 71 GHz.

IMT: International Mobile Telecommunications.

IMT 2020: International Mobile Telecommunications 2020.

ITU: International Telecommunications Union.

Mid-Frequency Bands: Frequency bands between 2600 MHz (2500 MHz – 2690 MHz) and 3500 MHz (3400 MHz – 3600 MHz).

MNO: Mobile Network Operator.

mMTC: Massive Machine Type Communications.

mmWave: Millimeter wave spectrum is the band of spectrum between 30 GHz and 300 GHz.

NICTA: National Information and Communications Technology Authority.

TDD: Time Division Duplex.

TRBR: Telecommunications, Radiocommunications and Broadcasting Regulator of Vanuatu

UHF: Ultra High Frequency

uRLLC: Ultra-Reliable Low Latency Communications.

VR: Virtual Reality

WRC - 19: World Radio Conference 2019.

WRC: World Radio Conference

3. Requirements for IMT-2020 (5G)

5G is defined in a set of standardized specifications that are agreed on by the international bodies most notably the 3GPP and the ITU. The ITU has defined criteria for IMT-2020 – commonly regarded as 5G and selected a set of compatible technologies which will support the following use cases:

- **Enhanced mobile broadband:** Including peak download speeds of at least 20 Gbps and a reliable 100 Mbps user experience data rate in dense urban areas.
- **Ultra-High reliability and low latency communications:** Including 1ms latency and very high availability, reliability and security to support services such as VR, Augmented reality and connected vehicles.
- **Massive machine connectivity type communications:** Including the ability to support at least one million IoT connections per square KM with long battery life and extensive wide-area coverage.

In order to meet the three ITU-R usage scenarios, significant amount of spectrum is required. 5G needs spectrum across low, mid and high spectrum ranges to deliver widespread coverage and support all use cases.

- Low-Bands (sub-1 GHz) support widespread coverage across urban, suburban and rural areas and help support Internet of Things (IoT) services.
- Mid-Frequency bands typically offer a good mixture of coverage and capacity benefits. In the long term more spectrum is needed to maintain 5G quality of service and growing demand in bands between 3 and 24 GHz.
- High-Frequency bands (mm Wave) are needed to meet ultra-high broadband speeds envisioned for 5G. Currently 26 GHz, 28 GHz and 40 GHz have most international support and momentum.

At least 80-100 MHz of contiguous spectrum per MNO at mid-frequency bands is needed for the first wave of 5G deployments.

4. IMT-2020 (5G) Band Harmonization

Spectrum harmonization continues to be important for the mobile industry in the 5G era. Globally harmonized spectrum enables economies of scale and facilitates cross-border coordination and roaming for end users: a critical factor for initial deployment of 5G. Vanuatu will adopt 3GPP specifications for initial 5G bands and associated band combinations for 5G deployment.

5. Possible Frequency Band for 5G in Vanuatu

So, in consistent with ITU WRC-19 Global IMT Band identification, bands identified for IMT 2020 (5G) in Vanuatu are in the Mid-Frequency band and High-Frequency band. it is important that any bands used for 5G are also used by many other countries to increase equipment availability, and ease of global roaming.

Mid-Frequency Bands

- 2 600 MHz (2 500 – 2 690 MHz) *
- 3.5 GHz (3 400 – 3 600 MHz)*

- i. 2.6 GHz band (2 500 – 2 690 MHz)
 - This band is identified for both 4G and 5G deployment according to ITU recommendation, ITU-R M.1036.
 - The band is suitable to cater for current 4G spectrum needs in Vanuatu.
 - TRBR propose 2.6 GHz band plan is based on this immediate need.

Organization	Frequency Arrangement Number/3GPP Band Number	Paired arrangements			Un-paired Arrangements (TDD) (MHz)	Duplex Mode
		Mobile Mode station transmitter (MHz)	Base station transmitter (MHz)	Duplex separation (MHz)		
ITU (M.1036)/3GPP	C1 /n7	2 500 -2 570	2 620 -2 690	120	2 570 -2 620	FDD & TDD

Figure 1: Proposed Channeling arrangements.



Figure 2: 120 MHz Duplex separation.

**Decision 01 of 2016 outlines the initial band plan for the 2.6 GHz spectrum.*

ii. 3.5 GHz Band (3 400 – 3 600 MHz)

- This band is currently allocated for both Fixed and Mobile Service.
- The band is critical for satellite service in the Downlink direction of extended C-Band.

5G is also the first major rollout of Time Division Duplex (TDD) cellular networks in most countries. All 5G bands above 3 GHz – including the vital 3.5 GHz range and mm Wave bands – will adopt TDD

Frequency Band	3GPP Band Number	Frequency Range	Duplex Mode
FR 1 (sub-6 GHz)	n78	3.4 -3.6 GHz	TDD

Figure 3: ITU recommended range in the 3.5 range.

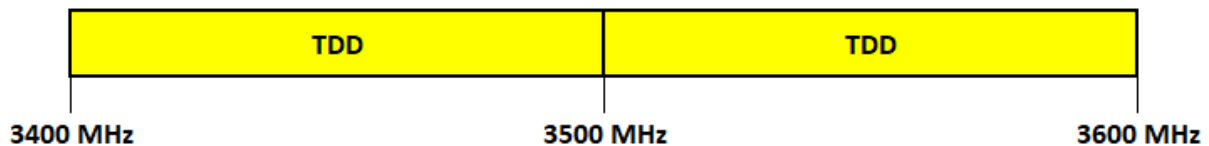


Figure 4: Proposed Channeling arrangements for Vanuatu.

Note: Channels may be reduced to 80MHz if sharing with C-Band downlink is not possible.

**Decision 01 of 2016 outlines the initial band plan for the 3.5 GHz spectrum.*

High-Frequency Bands (mmWave)

- 26 GHz (24.25 – 27.5 GHz)
- 40 GHz (37 – 43.5 GHz)
- 66 – 71 GHz

a. 26 GHz (24.25 – 27.5 GHz)

- This band is identified for IMT globally as per WRC-19 decision.
- The administration of Vanuatu has also identified this band to be used for IMT in consistent with WRC-19 final acts. However, this band is also allocated for Fixed, Radionavigation, Fixed-Satellite, Inter Satellite, Earth Exploration-Satellite and Space Research on a primary basis. Also portion of this band is allocated to ISM applications.
- The assignment of these 5G spectrum in Vanuatu must take into consideration existing services operating in this band.

Frequency Band	3GPP Band Number	Frequency Range	Frequency Identified for 5G in Vanuatu	Duplex Mode
FR 2 (above-6 GHz)	n258	24.25-27.5 GHz	25.25-27.5 GHz	TDD

Figure 5: ITU Recommended range.



Figure 6: Proposed Channeling arrangements.

b. 40 GHz (37 – 43.5 GHz)

- This band is identified for IMT globally as per WRC-19 decision.
- The administration of Vanuatu has also identified this band to be used for IMT in consistent with WRC-19 final acts. However, this band is also allocated for Fixed, Fixed-Satellite, Mobile-Satellite, Space Research, Earth Exploration-Satellite, Land-Mobile, Broadcasting, Broadcasting-Satellite and Land-Mobile on a primary basis.
- The assignment of these 5G spectrum in Vanuatu must take into consideration existing services operating in this band.
- Portions of this band may be used to address 5G capacity issues in the future.
- Studies and development are in progress on how to utilize this band as per ITU IMT 2020 framework.
- The TRBR will closely follow research and development progress and identify portions of this band for IMT 2020 (5G). Identification of 5G spectrum in this band will be aligned to APT regional recommendations.

Frequency Band	3GPP Band Number	Frequency Range	Duplex Mode	Comments
FR 2 (above-6 GHz)	n259/n260	37-43.5 GHz	TDD	Future 5G use

Figure 7: Proposed Channeling arrangements for Vanuatu.

c. 66 – 71 GHz

- This band is identified for IMT globally as per WRC-19 decision.
- No 3GPP standard has been developed at this stage for this band.
- The administration of Vanuatu has also identified this band to be used for IMT in consistent with WRC-19 final acts. However, this band is also allocated for Inter-Satellite, Mobile-Satellite, Radionavigation and Radionavigation-Satellite on a primary basis.
- The assignment of these 5G spectrum in Vanuatu must take into consideration existing services operating in this band.
- The TRBR will closely follow research and development progress and identify portions of this band for IMT 2020 (5G). Identification of 5G spectrum in this band will be aligned to APT regional recommendations.

Frequency Band	3GPP Band Number	Frequency Range	Duplex Mode	Duplex Mode
FR 2 (above-6 GHz)	N/A	66-71 GHz	TDD	3GPP standard yet to be developed

Figure 8: Proposed Channeling arrangements for Vanuatu.

The respective tables above show frequency bands identified for 5G usage in Vanuatu. Respective band plans will be developed prior to assignments to MNOs.

6. Spectrum Assignment.

TRBR will allocate this spectrum according to the provisions of the Telecommunications and Radiocommunications Regulation Act No 30 of 2009 as amended, and in particular the Radio Apparatus Licence and Spectrum Licence (Fees) Regulation, Order No 153 of 2012 (The Regulation).

The Regulation states that in relation to a spectrum licence, the “Regulator is to charge the assignment of a spectrum using the administrative incentive pricing or spectrum auctions whichever is appropriate under the circumstance.”

Administrative incentive pricing (AIP) and spectrum auctions are market-based methods of allocating and pricing spectrum. TRBR believes that market-based methods should be used wherever there may be more demand for a particular spectrum band than the available supply.

While TRBR is open to considering either method to allocate this spectrum, in this case our preference is to use incentive pricing (AIP). Due to the small market of Vanuatu, AIP would be the choice of assignments but where the demand is high, TRBR may consider auctioning.

The IMT 2020 (5G) spectrum identified in this paper is categorize as high value band, therefore attract spectrum license fees as per the Regulation. The recommended spectrum fee schedule shall be set as follow:

Table 1: Propose Spectrum Fees for 5G bands in Vanuatu.

Band	Annual Fee (Vatu per MHz)
Mid Frequency Band	
2 600 MHz (2 500 – 2 690 MHz)	90,000 VT
3.5 GHz (3 400 – 3 600 MHz)	90,000 VT
High-Frequency Bands (mmWave)	
26 GHz (24.25 – 27.5 GHz)	120,000 VT
40 GHz (37 – 43.5 GHz)	120,000 VT
66 – 71 GHz	120,000 VT

Frequency identified in the Mid frequency band have been identified as wireless broadband spectrum and are specified as high value band in the Decision 01 of 2016 “*Radio Spectrum Fees for the Republic of Vanuatu*”. Although the fees for the Mid frequency bands specified in Table 1 are set in the Decision 01 of 2016, but if these frequency bands are to be used specifically for 5G, then the fees shall be set as specified in Table 1.

TRBR also believes that MNOs who are more active in rolling out quality network will be the preferred choice for allocating frequencies for important rollout but advice against frequency hoarding which is considered anti-competitive.

Vanuatu remains one of the biggest challenges for connecting Rural communities. Although, most of the rural areas in Vanuatu are covered by 2G or 3G mobile service with 4G in major towns. Most of the Low-Band spectrum has been fully assigned to 2G, 3G or 4G, hence the Mid-Band and the High-Band are the only suitable bands for 5G trials and initial deployment at this stage. TRBR foresee to see 5G trials and initial deployment in the Mid-Band and eventually moving into High-Bands to address capacity issues, TRBR understands that making spectrum available in a timely manner is key to enabling progress in technology development and enabling economy growth. Licensing consideration will be a factor to consider when dealing with mmWave, collaboration is required to ensure a suitable licencing regime is agreed to by all parties to ensure growth and development of 5G with little or no interference issues. TRBR will also consider setting spectrum allocation limits per MNO to ensure fairness and will work to develop band plans for identified 5G bands and welcomes views and opinions from all interested stakeholders.

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